ALABAMA DEPARTMENT OF TRANSPORTATION

STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION

2002 EDITION

FOREWARD

This book has been prepared to provide a compilation of Standard Specifications for insertion by reference into Alabama Department of Transportation construction contracts.

U.S. Customary and Metric (SI) units of measurement are shown in this 2002 edition. Metric units of measurement are shown by the corresponding U.S. Customary units and are enclosed in braces { }. The units of measurement, either U.S. Customary or Metric, that are applicable to a construction project shall be those that are shown on the plans or in other contract documents.

The requirements given in these Specifications may be revised or amended by Supplemental Specifications and Special Provisions that are applicable to a specific contract.

Copies of this Standard Specifications book may be purchased from:

Proposals Engineer
Alabama Department of Transportation
1409 Coliseum Boulevard
Montgomery, Alabama 36130-3050

Book Number _____

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DIVISION 100
GENERAL PROVISIONS

SECTION 101
DEFINITION OF TERMS

101.01 Definitions.

Wherever the following terms or abbreviations (or pronouns in place of them) are used in these Specifications or in other contract documents, the intent and meaning shall be interpreted as follows:

(a) ABBREVIATIONS.

AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ADEM	Alabama Department of Environmental Management
AGC	The Associated General Contractors of America, Inc.
AIA	American Institute of Architects
ALDOT	Alabama Department of Transportation
ANSI	American National Standards Institute
ARA	American Railway Association
ARBA	The American Road Builder's Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
FHWA	Federal Highway Administration
FSS	Federal Specifications and Standards, General Services Administration
IMSA	International Municipal Signal Association, Inc.
ITE	Institute of Transportation Engineers
LVD	Laboratory Vibrated Density
MUTCD	Manual on Uniform Traffic Control Devices for Streets and Highways
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
SAE	Society of Automotive Engineers
UL	Underwriters' Laboratories, Inc.

(b) TERMS.

Acceptance Plan. A prescribed method of sampling, measuring and testing together with criteria for the acceptability of a lot of material or construction.

Additive. A substance or agent added in small amounts to a basic ingredient of a mixture prior to mixing.

Advertisement For Bids or Notice to Contractors. A public announcement inviting bids for work to be performed or materials to be furnished, as required by law.

Article. An immediate subheading of a section of these Specifications consisting of Subarticles, Items, Subitems and/or paragraphs which set forth details and requirements essential or necessary to form

the Specifications. Specifications are divided into Divisions, Divisions into Sections, Sections into Articles, Articles into Subarticles, Items, Subitems and paragraphs.

Award. The acceptance by the Director of the proposal of the lowest responsible bidder, as required by law.

Backfill. Material used to replace or the act of replacing material removed during construction; also may denote material placed or the act of placing material adjacent to structures.

Back Slope. The sloping surface of a cut, of which the downward inclination is toward the roadbed.

Base. The layer or layers of specified materials of designed thickness placed on a subbase or a subgrade to support a pavement or surface.

Bidder. An individual, firm, partnership, corporation or any acceptable combination thereof submitting a bid for the advertised work.

Binder Layer. The lower layer of the surface, consisting of a plant mix of graded aggregate and bituminous material.

Bituminous Concrete. A designed combination of dense graded mineral aggregate filler and bituminous cement mixed in a central plant, laid and compacted while hot.

Borrow. Suitable material from sources outside the roadway prism, used primarily for embankments.

Bridge. A structure, including supports, erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet {6.1 m} between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.

Bridge Length. The length of a bridge structure is the over-all length measured along the line of survey stationing back to back of backwalls of abutments, if present; otherwise, end to end of the bridge floor; but in no case less than the total clear opening of the structure.

Bridge Roadway Width. The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or guard timber risers.

Bypass. An arterial highway that permits traffic to avoid part or all of an urban area.

Calendar Day. Every day shown on the calendar, beginning and ending at midnight, Sundays and holidays included.

Construction Change and/or Work Order Request. A written document between the Department and the FHWA covering proposed project changes.

Construction Joint. A joint made necessary by a prolonged interruption in the placing of concrete.

Contract. The written agreement between the State of Alabama and the Contractor setting forth the obligations of the parties hereunder for the performance of the prescribed work.

The Contract includes the proposal, contract forms and contract bonds, specifications, supplemental specifications, special provisions, general and detailed plans, and notice to proceed, also any change orders and supplemental agreements that are required to complete the construction of the work in an acceptable manner, including authorized extensions thereof, and such other documents as by law or references are made a part thereof, all of which constitute one instrument.

Contract Bid Price. The sum total of the products of the approximate quantities of the items of the work listed in the proposal and the respective unit prices bid in the proposal.

Contract Bonds. The approved bonds furnished and executed by the Contractor and his surety to guarantee completion of the contract in accordance with its terms.

Contract Item. (Pay Item). A specifically described unit of work for which a price is provided in the contract. Each pay item is numbered and is paid for under the terms of the specification section of the same number.

Contract Payment Bond. The bond furnished by the Contractor and his surety to guarantee payment of the debts covered by the bond.

Contract Performance Bond. The bond furnished by the Contractor and his surety to guarantee performance of the work in accordance with the contract.

Contract Period or Contract Time. The number of work days or calendar days allowed for completion of the contract, including authorized time extensions.

In a case where a calendar date of completion is shown in the proposal, in lieu of the number of working or calendar days, such work contemplated shall be completed by that date.

Contract Sum or Contract Amount. The total contract bid price, revised to include changes caused by overruns and underruns in contract items, plus the sum of all approved supplemental agreements and force account orders.

Contraction Joint. A joint at the ends of a rigid slab to control the location of transverse cracking.

Contractor. The individual, partnership, firm, corporation, or any acceptable combination thereof contracting with the State for performance of prescribed work.

Controlling Item(s). The current controlling item(s) or operation(s) includes any feature of the work considered at the time by the Engineer as essential to the orderly completion of the work and which, if delayed, will delay the time of completion of the contract.

County. The county or counties of Alabama in which work herein specified is to be performed.

Culvert. Any structure not classified as a bridge which provides an opening under the roadway.

Dense Graded Aggregate. A well-graded aggregate so proportioned as to contain a relatively small percentage of voids.

Department. Alabama Department of Transportation, as constituted under the laws of Alabama for administration of highway work.

Detour. A route provided for traffic to use in lieu of a regular route.

Director. The chief executive officer of the Alabama Department of Transportation as created by law, also referred to herein as Transportation Director.

Divided Highway. A highway with separated roadways for travel in opposite directions.

Division. Subdivision of the Alabama Department of Transportation for supervision of construction and maintenance operations. There are nine construction divisions within the State.

Division Engineer. The Engineer in charge of a designated division of the State.

Dowel. A load transfer element usually consisting of a plain round steel bar.

Drainage Plane. A plane for internal drainage of the roadbed, usually formed by a layer of water-permeable material.

Easement. A right to use or control the property of another for designated purposes.

Embankment. A structure of soil, soil-aggregate or broken rock between the embankment foundation and the subgrade.

Embankment Foundation. The material below the original ground surface the physical characteristics of which affect the support of the embankment.

Employee. Any person working on the project to which these specifications apply, and who is under the direction or control of, or receives compensation from, the Contractor or Subcontractor.

Engineer. The Chief Engineer of the Department, acting directly or through his duly authorized assistants or representatives, who is responsible for engineering supervision of the construction.

Equipment. All machinery and equipment, together with the necessary supplies for operation and upkeep, maintenance, and protection, and also tools and apparatus necessary for the proper construction and acceptable completion of the work.

Existing. The physical status as of the date of the invitation for bids of any structure, base, surface, subgrade, road, bridge, detour, or other unit affected by a particular project or designated highway.

Expansion Joint. A joint located to provide for expansion of a rigid slab, without damage to itself, adjacent slabs, or structures.

Extra Work. An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract within its intended scope.

Extra Work Order. A change order concerning the performance of work or furnishing of materials involving extra work. Such extra work may be performed at agreed prices or on a force account basis as provided elsewhere in these specifications.

Faulting. Differential vertical displacement of rigid slabs at a joint or crack.

Flagman. An individual with a flag, lantern, or other approved signaling device, whose duty is to signal vehicular traffic to: (1) come to a stop, (2) alter its speed and/or course, or (3) receive other instructions with reference to highway routes and their condition.

Flexible Pavement. A pavement structure which maintains intimate contact with and distributes loads to the subgrade and depends upon aggregate interlock, particle friction, and cohesion for stability.

Force Account Work. Work paid for by reimbursing for the actual costs for labor, materials, and equipment usage incurred in the performance of the work, as directed, including a percentage for overhead and profit, where appropriate.

Frontage Road. A local street or road auxiliary to and located generally on the side of an arterial highway, for service to abutting property and adjacent areas and for control of access to the highway.

Front Slope. The sloping surface of an embankment or roadway side ditch of which the downward inclination is away from the roadbed.

Grade Separation. A structure, with its approaches, which provides for highway traffic to pass without interruption over or under a railway, street, or another highway.

Highway, Street or Road. A general term denoting a public way for purpose of vehicular travel, including the entire area within the right of way.

Holiday. See "Legal Holiday".

In Place. A term to denote that the unit price covers compensation for the item complete in place including all costs incident to procurement, handling, hauling, and processing the item (including water) as required. The item will be measured and paid for in the manner provided in applicable sections of these specifications.

Inspector. The Engineer's authorized representative assigned to make detailed inspection of contract performance.

Interchange. A system of interconnecting roadways, in conjunction with one or more grade separations, providing for the movement of traffic between two or more roadways on different levels.

Intersection. The general area where two or more highways join or cross, within which are included the roadway and roadside facilities for traffic movements in that area.

Joint. A designed vertical plane of separation or weakness.

Laboratory. The testing laboratory of the Department or any other testing laboratory which may be designated by the Engineer.

Legal Holiday. Holidays which will be allowed in computing Contractor's time charges on a working day basis will be limited to the following days: Sundays, New Year's Day, Robert E. Lee's/ Martin Luther King's Birthday (the third Monday in January), George Washington's/ Thomas Jefferson's Birthday (the third Monday in February), Mardi Gras Day (Mobile and Baldwin Counties only), Confederate Memorial Day, National Memorial Day, Jefferson Davis' Birthday, Independence Day, Labor Day, Columbus Day/ Fraternal Day (the second Monday in October), Veterans' Day, Thanksgiving Day, and Christmas Day. All dates for legal holidays will be as prescribed by Alabama Act 250 of 1991. Dates for combined holidays are shown herein.

Leveling Course. The layer of material placed on an existing surface to eliminate irregularities prior to placing an overlaying course.

Load Transfer Device. A mechanical means designed to carry loads across a joint.

Local Road or Street. A street or road primarily for access to residence, business, or other abutting property.

Longitudinal Joint. A joint normally placed between traffic lanes to control longitudinal cracking.

Lot. A uniquely defined quantity of material from a single source, or homogeneous segment of construction, on which decision is made for acceptance.

Major Highway. An arterial highway with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.

Major Item. Any item having an original contract value in excess of 10 percent of the total contract bid price.

Major Street. An arterial highway with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.

Materials. Any substances specified for use in the construction of the project and its appurtenances.

Material Vendor. A corporation, firm or individual who sells or rents supplies, equipment, or materials to a Contractor or Subcontractor or whose materials are prepared away from the construction premises and are delivered in final form to the construction site; such delivery being merely incidental to the sale. Material vendor must be a separate legal entity with independent investment in facilities and equipment and an independent business organization and operation, exercising a prerequisite degree of independent initiative, judgment, and foresight. A corporation, firm or individual which establishes a temporary plant or facility of any kind on or near a project for the purpose of furnishing material for that project only will not be considered a "material vendor" but will be considered a "Subcontractor" as defined in these specifications.

Median. That portion of a divided highway separating the traveled ways for traffic in opposite directions.

Median Lane. A speed-change lane within the median to accommodate left-turning vehicles.

Navigable Stream. A stream classed by the U.S. Coast Guard and/or the U.S. Army Corps of Engineers as navigable.

Notice to Contractors. See "Advertisement for Bids."

Notice to Proceed (Work Order). Written notice to the Contractor informing him of approval of his contract and notifying him to proceed with the contract work, including, when applicable, the date of beginning of contract time.

Original Ground. The ground surface just prior to the initiation of the proposed work.

Parking Lane. An auxiliary lane primarily for the parking of vehicles.

Pavement Structure. The combination of subbase, base, and surface placed on a subgrade to support the traffic load and distribute it to the roadbed.

Pay Item. See "Contract Item".

Plans. The contract drawings, which show the location, character, dimensions, and details of the prescribed work, including layouts, profiles, cross sections, and other details or reproductions thereof.

Prime Coat. An application of a low viscosity liquid bituminous material to coat and bind mineral particles preparatory to placing a base or surface course.

Profile Grade. The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the contract.

Project. The specified section of the highway together with all appurtenances and construction to be performed thereon under the contract.

Project Number. A number assigned for convenience to identify the work covered in a project.

Proposal. The offer of a bidder, on the prescribed form, to perform the stated construction work at the prices quoted.

Proposal Form. The prescribed form on which the offer of a bidder is to be submitted.

Proposal Guaranty. The cashier's check or bid bond furnished with a bid to assure that the bidder will enter into the contract if his offer is accepted.

Questionnaire. The specified forms on which the Contractor shall furnish required information as to his ability to perform and finance the work.

Ramp. A connecting roadway between two intersecting highways, generally at a highway separation, or a sloping driveway giving access to a highway.

Random Sample. A small part of a lot which is used to represent the whole, so chosen that each portion of the lot has an equal probability of being selected.

Record Plans. Reproductions of plans issued to bidders as noted in Article 105.02.

Recovery Time. Recovery time is defined as the time required, after the controlling item or items of work have been substantially damaged as a result of conditions and causes beyond the control of the Contractor and not due to his negligence or fault, to restore the work to the condition existing prior to such damage so that normal operations can be resumed on the contract pay items. Recovery time shall be the number of days required by the Contractor, working with normal forces, to restore the work as described above.

Reinforcement. Steel embedded in a rigid pavement slab and in concrete structures to resist tensile stresses and detrimental opening of cracks.

Repetition, Avoidance of. See Article 101.01(c).

Reprocessing. The renewal of an existing surface by scarifying, remixing with or without additional material, and relaying.

Resurfacing. The placing of one or more new courses on an existing surface.

Retainage. The Department will not withhold retainage. Retainage is the money belonging to the Contractor which was held by the Department conditioned on final completion and acceptance of all work in connection with a project or projects by the Contractor.

Right of Way. A general term denoting land, property or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

Rigid Pavement. A pavement structure which distributes loads to the subgrade having as one course a Portland cement concrete slab of relatively high bending resistance.

Rigid Slab. A section of Portland cement concrete pavement bounded by joints and edges, designed for continuity of tensile stress.

Road. A general term denoting a public way for purposes of vehicular travel including the entire area within the right of way.

Roadbed. The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulder. The top surface of the roadbed is the subgrade.

Roadbed Material. The material below the subgrade in cuts and embankments, and in embankment foundations extending to such depth as affects the support of the pavement structure.

Roadside. A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

Roadside Improvement or Development. Those items necessary to the complete highway which provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

Roadway. The portion of the highway within the limits of construction. A highway may have more than one roadway.

Seal Coat. A thin treatment consisting of bituminous material, usually with cover aggregate, applied to a surface course. The term includes, but is not limited to, sand-seal, chip-seal, slurry seal, contrast seal and fog seal.

Shop Drawings. Fabrication plans for any part of the work including, but not limited to, precast concrete items, structural steel items, or other metal items, and connections thereof, which the Contractor is required to submit to the Engineer.

Sidewalk. That portion of the roadway primarily constructed for the use of pedestrians.

Skew Angle - Skew. The complement of the acute angle between two centerlines which cross; for a structure centerline, skew right means the right side of the structure is ahead; skew left means the left side of the structure is ahead.

Soil Survey. The exploration of the site of the proposed improvements by borings and tests or other methods and the preparations of soil profiles showing the significant layers, bedrock, water table, and other features.

Special Provisions. Additions and revisions to the Standard and Supplemental Specifications applicable to an individual project. Special Provisions shall prevail over Standard Specifications, Supplemental Specifications, and plans.

Specifications. The compilation of provisions and requirements of prescribed work.

Specified Completion Date. The date on which the contract work is specified to be completed.

Speed Change Lane. An auxiliary lane, including tapered areas, primarily for the acceleration or deceleration of vehicles entering or leaving the through traffic lanes.

Stabilization. Modification of soils or aggregates by incorporating materials that will increase load bearing capacity, firmness, and resistance to weathering or displacement.

Standard Drawings. Drawings approved for repetitive use, showing details to be used where appropriate.

Standard Specifications. A book of specifications approved for general application and repetitive use.

State. The State of Alabama, the party of the first part to the contract, acting by and through the Transportation Director.

Station. One hundred feet {one hundred meters} measured horizontally.

Street. A general term denoting a public way for purposes of vehicular travel, including the entire area within the right of way applicable to travel ways in urban areas.

Structures. Bridges, culverts, basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains and other features which may be encountered in the work and not otherwise classed herein.

Subbase. A layer or layers of specified or selected material or designed thickness placed on a subgrade to support a base or rigid pavement.

Subcontractor. An individual, partnership, firm, corporation or any acceptable combination thereof who has or have, with the written approval of the Department, contracted with the Contractor to execute and perform in his stead any part of the contract, as permitted by Article 108.01 of these Specifications. Material vendors as defined herein are not Subcontractors.

Subgrade. The top surface of the roadbed, upon which the pavement structure and shoulders are constructed.

Subgrade Treatment. Modification of roadbed material by stabilization.

Substructure. All of that part of the structure below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames; including backwalls, wingwalls, and wing protection railings.

Superintendent. The Contractor's authorized representative in responsible charge of the work.

Superstructure. All that part of a structure above, and including, the bearings of simple and continuous spans, skewbacks of arches and top of footings of rigid frames; excluding backwalls, wingwalls, and wing protection railings.

Supplemental Agreement. A written agreement with the Contractor covering changes in the plans, specifications, or quantities or any combination thereof, within the scope of the contract and establishing the basis of payment and time adjustments for the work affected by the changes.

Supplemental Specification. Approved additions and revisions to the Standard Specifications.

Surety. The corporation, partnership or individual other than the Contractor executing a bond furnished by the Contractor, licensed under the laws of Alabama.

Surface. One or more layers of a material designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion and the disintegrating effects of climate. The top layer is generally called the wearing layer and the lower layer the binder layer.

Surface Treatment. One or more applications of bituminous material and cover aggregate or thin plant mix on an old pavement or any element of a new pavement structure.

Tack Coat. An application of bituminous material to an existing surface to provide bond with a superimposed course.

Temporary Structure. Any structure required to maintain traffic during construction of the work, which will be dismantled if required when the work is completed.

Through Highway. Every highway or portion thereof on which vehicular traffic is given preferential right of way, and at the entrances to which vehicular traffic from intersecting highways is required by

law to yield right of way to vehicles on such through highway in obedience to either a stop sign or a yield sign, when such signs are erected.

Through Street. Every street or portion thereof on which vehicular traffic is given preferential right of way, and at the entrances to which vehicular traffic from intersecting streets is required by law to yield right of way to vehicles on such through highway in obedience to either a stop sign or a yield sign, when such signs are erected.

Tie Bar. A deformed steel bar or connector imbedded in the concrete across a joint to prevent separation of abutting slabs.

Traffic Lane. The portion of a traveled way for movement of a single line of vehicles.

Transportation Director. See "Director".

Traveled Way. The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

Typical Section. That cross section established by the plans which represents in general the lines to which the Contractor shall work in the execution of his contract.

Work (The Work). Work shall mean the furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to the successful completion of the project and the carrying out of all duties and obligations imposed by the contract.

Working Day. Any Calendar Day, exclusive of Saturdays and Legal Holidays (as defined herein), on which the Contractor could proceed with construction operations for a period of six hours or more with the normal working forces engaged in performing work on the controlling item or items of work, which normally would be in progress at that time, will be classified as a working day. Saturdays and Legal Holidays on which the Contractor elects to work for a period of four hours or more will be classified as a working day.

Working Drawings. Erection plans, falsework plans, framework plans, cofferdam plans, or any other supplementary plans or similar data which the Contractor is required to submit to the Engineer.

(c) GENERAL TERMS.

1. "NO DIRECT PAYMENT", "WITHOUT EXTRA COMPENSATION" AND "SUBSIDIARY OBLIGATION".

Compensation shall be included in other items of work (other pay items) for work where it is shown that "no direct payment" will be made for the work, or that the work shall be done "without extra compensation", or the work shall be a "subsidiary obligation" of other items of work.

2. AVOIDANCE OF REPETITION.

Wherever the terms "contemplated", or "required", "directed", "authorized", "considered necessary", "permitted", "approved". "suitable", "unacceptable", "designated", or terms of like import are used in these Specifications, they shall be construed to mean "to" or "by the Engineer" or "Director", unless the contract or context clearly indicates otherwise.

SECTION 102
PROPOSAL REQUIREMENTS AND CONDITIONS

102.01 Notice to Contractors (Advertisement).

(a) GENERAL.

Bids will be invited in a "Notice to Contractors" advertisement, advertised as required by State laws. The advertisement will contain the date, time, and place of opening bids; a description of the work; contract time; a stipulation as to the character and the amount of the proposal guaranty; and instructions to the bidders as to access to plans and specifications.

(b) QUANTITIES.

The quantities shown on the "Notice to Contractors" and mailed to prospective bidders are to be considered as approximate only and may be amended in the proposal to include additional quantities or additional items, or to decrease quantities or to exclude items of work before bids are to be received. This information sheet is to advise prospective bidders informally as to the type of work and approximate quantities involved.

102.02 Qualification of Bidders.

(a) PREQUALIFICATION.

Proposal forms will be issued only to prospective bidders who have qualified with the Department and have a valid certification of qualification under the terms of existing State laws. All applicants for qualification shall file with the Department a complete confidential statement, equipment questionnaire, and experience questionnaire under oath, on forms that will be furnished by the Department on request. To insure sufficient time for consideration, the applicant must have these forms properly filled out and submitted to the Department at least 14 days prior to the date of opening bids on which the applicant desires to submit proposals. Forms received at a later date will be considered whenever practicable. If the applicant is a corporation organized in a State other than Alabama, it shall furnish a certificate from the Secretary of State showing that it is Qualified to transact business in Alabama. A corporation from another State can be issued a certificate valid for bidding only on projects involving Federal participation, without the certificate from the Secretary of State.

Prospective bidders will not be prequalified who have a corporate officer or principal owner, as listed in the certification of incorporation, who is a corporate officer or owner of another firm which is presently disqualified by the Department.

(b) DISQUALIFICATION.

The Department reserves the right to disqualify or refuse to issue a proposal to a prospective bidder for the following reasons:

1. Lack of competency and adequate machinery, plant and other equipment as revealed by the financial Statement and experience questionnaires required.
2. Uncompleted work which, in the judgement of the Department, might hinder or prevent the prompt completion of additional work if awarded.
3. Failure to pay or satisfactorily settle all bills due for labor and material on former contracts in force at the time of issuance of proposals.
4. Failure to comply with any pre-qualification regulations of the Department.
5. Default, as defined in Article 108.12, under a previous contract, or unsatisfactory work of any nature on previous work.
6. Actions in bidding or subcontracting which have the effect of limiting competition and violating the competitive bid process, or if any partner, association member, corporate official or individual owner, respectively, of any firm submitting a bid has been convicted or entered a guilty plea in any legal jurisdiction of the United States or any of the various States, of Federal or State crimes that involve the restraint of trade or limiting competition in any manner, or has been debarred by the Federal Highway Administration.
7. Any firm or individual officer or owner of a firm that has been disqualified by the Federal Highway Administration will result in disqualification of the firm for the same period covered by the Federal Highway Administration disqualification.
8. Upon issuance to the contractor of two warning letters for DBE violations during any successive 24 month period. DBE violations apply on a company-wide basis and not for a particular project.

Disqualification will be for an indefinite period, but may be reviewed each six months, if requested in writing by the disqualified firm.

Disqualification applies to bidding as a prime contractor or doing any subcontract work for a prime contractor.

(c) REQUALIFICATION.

If a prospective bidder is disqualified from bidding under any of the provisions of this Article, it will be required of the prospective bidder to again prequalify under the provisions of Subarticle 102.02(a) above.

When requalified, the qualification will be issued subject to continued examination and evaluation of the Contractor's performance. The Contractor will be in probationary status for a period of one year following his requalification with the Department. If, during the period of probation, the Contractor is disqualified under any of the provisions of these Specifications, the Department may suspend the Contractor's right to requalify for a maximum period of two years.

102.03 Contents of Proposal Form.

(a) GENERAL.

The Department will furnish bidders a blank proposal form showing the location and description of the work contemplated, the approximate estimate of the various quantities of the pay items of the work to be performed and materials to be furnished, and the amount of the proposal guaranty. The proposal form also will contain "Supplemental Specifications" (if any), "Special Provisions" (if any), and any requirements that vary from, or are not included in, the approved Alabama Department of Transportation Standard Specifications. All papers bound with or attached to the proposal form are a necessary part thereof and must not be detached or altered.

The plans, specifications, and other documents designated in the proposal form will be considered a part of the proposal whether attached or not. The prospective bidder will be required to pay the Department the sum, determined by State law, for each copy of the proposal form and each set of plans.

(b) CORRECTIONS.

Corrections and minor changes in the proposal form or plans may be put into effect by telegram, certified letter, express type mail, or other electronic media from the Office Engineer Bureau, notifying all prospective bidders to whom proposal forms have been previously issued.

102.04 Interpretation of Quantities in Bid Schedule.

The quantities appearing in the bid schedule are approximate only and are prepared for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted, or materials furnished, in accordance with the contract. The scheduled quantities or work to be done and materials to be furnished may each be increased, decreased, or omitted as provided herein.

102.05 Examination of Plans, Specifications, Special Provisions, and Site of Work.

Before submitting a proposal, bidders shall examine carefully the site of the proposed work, the general and local conditions, the proposal form, standard specifications, supplemental specifications, special provisions, and the bid bond form, and it is mutually agreed that the submission of a proposal shall be prima facie evidence that the bidder has made such examination and has judged for and satisfied himself as to the conditions to be encountered in performing the work, and to the requirements of plans, standard specifications, supplemental specifications, special provisions, contract, and bonds. No adjustments or compensation will be allowed for losses caused by failure to comply with this requirement.

Boring logs and other records of subsurface investigations are available for inspection by bidders. It is understood that such information was obtained and is intended for State design and estimating purposes only. It is made available to bidders that they may have access to identical subsurface information available to the State, and is not intended as a substitute for personal investigation, interpretations and judgement of the bidders.

Bidders are advised that the State disclaims responsibility for any opinions, conclusions, interpretations, or deductions that may be expressed or implied in any of the information presented or made available to bidders; it being expressly understood that the making of deductions, interpretations, and conclusions from all of the accessible factual information is the bidder's sole responsibility.

102.06 Preparation of Proposal.

(a) PROPOSAL FORM.

The bidder's proposal must be submitted on the complete original proposal form including the bid diskette and the bid item sheets generated by the bid diskette furnished him by the Department. Proposal forms are numbered serially and are not transferable. Unless otherwise provided in the proposal, joint venturers may submit a proposal for a joint venture of qualified bidders on a proposal

form issued to one of them, provided each venturer has taken out a proposal and provided the proposal is signed by each co-venturer.

(b) DETAILS.

All bids shall be submitted using the ALDOT diskette bid system. Bids submitted using any other form, format, or means shall be rejected. On "lump sum" items an entry shall be shown in the amount bid column. If a bidder wishes to bid an item "free", then he shall enter 0 (zero) in the dollar column and 00 (double zero) in the cents column in both the unit price column and amount bid column.

Where alternate designs are provided by the plans and proposal, the bidder shall enter prices only on the items for the design alternate that will be most economical for him to construct, and other bid items that will be common for all alternates.

If any item on the proposal form permits a choice between alternate specified types of materials, the bidder shall indicate by a check mark the type of material he proposes to use. If more than one type or none is checked, the Department will make the selection.

Any interlineation, erasure, or other alteration of a figure shall be initialed by the signer of the proposal. The Department will check the extension of each item given in the proposal and correct all errors and discrepancies. In case of a discrepancy between a unit bid price and the extension amount, the unit price shall govern. The sum of the extension amounts will be the contract bid price.

(c) SIGNING.

The bidder's proposal must be signed with ink by the individual, by one or more members of the partnership, by one or more members or officers of each firm representing a joint venture, or by one or more officers of a corporation, or by an agent of the Contractor legally qualified and acceptable to the State. If the proposal is made by an individual, his name and business address must be shown; by a partnership, the name and business address of each partnership member must be shown; as a joint venture, the name and business address of each member or officer of the firms represented by the joint venture must be shown; by a corporation, the name of the corporation and the business address of its corporate officials must be shown.

The proposal bid bond, if bid bond is tendered, shall be properly signed by the bidder and the surety.

(d) COLLUSION.

Bidders will be required to execute a collusion affidavit conforming to the requirements of the laws and regulations cited in Article 107.05. Failure to execute an affidavit when such is a part of the proposal shall be cause for rejection of the bid. If there is any reason for believing that collusion exists among the bidders, any or all proposals may be rejected, and those participating in such collusion may be barred from submitting bids on the same or other work with the Department until they have been reinstated as a qualified bidder.

Only the affidavit form provided in the proposal will be acceptable.

(e) COMPUTER DISKETTE BIDDING.

When ordering bid proposal forms, the Contractor will receive computer diskettes for preparing the bid. Two diskettes will be required to prepare each bid. One diskette is the Master Program Diskette, which contains all program modules necessary for executing options used in the main menu which drives the system. This diskette also contains user instructions and can be reused for each letting. The other diskette, purchased each letting, is the Proposal Data Diskette and contains information pertinent to an individual project. This diskette is purchased for the applicable project each letting. The program shall be used to prepare the bid and print official bid item sheets for submittal. The program will operate on IBM personal computers or IBM compatible computers with a minimum 512K Random Access Memory using PC-DOS or MS-DOS operating systems, version 2.0 or higher.

The only entries permitted into the computer program by the bidder will be the unit or lump sum prices for items that must be bid. The program will perform all extensions of the unit or lump sum prices, calculate the total bid, and print a complete set of bid item sheets including the total bid price.

Bid item sheets generated from the computer program shall be printed on 8.5 X 11 inch {216 mm x 279 mm} paper using 10 characters per 1 inch {25.4 mm} type in accordance with instructions furnished on the diskette.

This set of bid item sheets, generated from the program provided by the Department, along with a complete proposal package, will constitute the official bid. The computer generated bid item

sheets shall be signed and dated in the title block provided. The computer generated bid item sheets and proposal shall be signed by the same individual and delivered to the Department in accordance with Article 102.10, Delivery of Proposals.

Only computer generated bid item sheets printed from the computer program diskettes, furnished by the Department, will be accepted for the official bid. Failure to use and submit diskette generated bid item sheets shall result in the bid being rejected. Care shall be taken to make sure that each computer generated bid item sheet and signature sheet has the same proposal control number located in the upper right corner of each page. Failure to do so will be cause for rejection under Subarticle 102.07(a).

All provisions of Subarticles (a) through (d) of this Article will apply to the preparation of bids that are submitted on computer program generated bid item sheets. Any necessary changes to entries on the computer program generated bid item sheets shall be made in accordance with Subarticle (b) of this Article.

The individual proposal data diskette furnished by the Department shall be returned with the proposal. Failure to do so will cause the bid to be rejected.

In case of a discrepancy between the unit or lump sum prices submitted on the program printed bid item sheets and those contained on the proposal data diskette returned to the Department, the unit or lump sum prices submitted on the program printed bid item sheets shall prevail in all cases.

The Department will not be responsible for loss or damage to a bid diskette after it has been mailed or delivered to the bidder. If loss or damage occurs, the bidder may order another bid diskette.

The Department is not responsible for delay in completion of, or failure to timely submit, a bid due to an alleged bid diskette failure.

102.07 Irregular Proposals.

(a) GENERAL.

Proposals will be considered irregular and may be rejected if they contain any omissions, alteration of form, additions not called for, incomplete bids (includes failure to enter a unit bid price on a bid item or, in the case of an alternate, the alternate being bid by the Contractor), interlineations, erasures or alterations not initialed by the person signing the proposal, inconsistent proposal control numbers on each computer bid item sheet and signature sheet, or other irregularities of any kind. Proposals may be rejected at any time prior to the execution of the contract by the Director.

Any bidder using the same or different names for submitting more than one proposal upon any project will be disqualified from further consideration on that project. Evidence that any bidder is interested, as a principal, in more than one proposal for work contemplated (for example bidding in a partnership, as a joint partnership or association, and as a partnership, association, or individuals) will cause the rejection of any such proposal. A bidder, however, may submit a proposal as principal and as a Subcontractor to some other principal, or may submit a proposal as a Subcontractor to as many other principals as he desires, and by so doing will not be liable to disqualification in the intent of these Specifications.

(b) UNBALANCED BIDDING.

In order that no party of the contract will be financially hurt over changes in the estimated quantities, a proposal may be rejected if any of the unit prices are obviously unbalanced. The Department will decide whether any unit prices are unbalanced either excessively above or below a reasonable cost analysis value determined by the Engineer, particularly if these unbalanced amounts are substantial and contrary to the interest of the Department.

102.08 Combination Bids.

(a) GENERAL.

Combination bids which combine two or more individual projects may be submitted by stating in writing on each project proposal to be considered in the combination, one of the following:

1. That he is bidding on "All or None" of the work for designated proposals. The Department will evaluate all bids on these proposals and make awards based on the bids most advantageous to the State.

2. The reduction he will make in the unit price of one or more of the items in any or all of the proposals if awarded the combination; however, the bidder will not be permitted to make a

reduction in any unit price that may be fixed by the Department in the proposal. The Department will select from the proposals submitted the individual or combination bids most advantageous to the State.

3. That he is bidding on a number of projects but desires to be awarded work not to exceed a specified total amount or a specified number of contracts. The Department will select from his proposal those which are most advantageous to the Department within its specified amount or total number of contracts.

Combination bids which state that a lump sum shall be deducted from the final estimate, or that a reduction in prices shall be made on a percentage basis, or that states that award of a job is contingent upon being awarded another job, will not be accepted and the bids with which such a letter is submitted will be considered irregular and rejected.

(b) COUNTY FINANCED PROJECTS.

No combination bids will be accepted on any project or projects wholly or partially financed by a county unless all of the projects bid in combination are county financed projects located in the same county. Any such combination bid shall be in accordance with the provisions of Subarticle (a) above.

102.09 Proposal Guaranty.

No proposal will be considered unless accompanied by a cashier's check drawn on an Alabama bank or a bid bond of the prescribed form made payable to the Alabama Department of Transportation in the amount indicated in the Notice to Contractors. The cashier's check shall have the name of the company submitting the bid and the project number on the check.

102.10 Delivery of Proposals.

Each proposal for each contract shall be placed, together with the proposal guaranty, in a sealed envelope on the outside of which is written in large letters "Proposals for Highway Work" and so marked as to indicate the project number, the county or counties in which the work is located and the name of the bidder. Proposals will be received by the Proposal Engineer or his representative at the Alabama Department of Transportation Building in Montgomery, Alabama, unless otherwise provided, until the hour and date set in the notice to Contractors for the opening thereof. No proposal will be considered which has not been received prior to the hour and date set for the opening of bids. Proposals received after that time will be returned.

102.11 Withdrawal or Revision of Proposals.

A bidder may withdraw or revise a proposal after it has been deposited with the Department provided the request for such is received by the Department in writing or by telegram before the time set for opening proposals. No proposal can be withdrawn, modified, or corrected after the hour set for opening such proposals.

102.12 Public Opening of Proposals.

Proposals will be publicly opened and bid totals read aloud at the place, time, and date indicated on the "Notice to Contractors" advertisement. Bidders or their authorized agents are invited to be present.

102.13 Blank.

102.14 Familiarity with Laws and Ordinances.

(a) GENERAL.

Bidders shall familiarize themselves with and shall comply with all Federal and State laws and local laws, ordinances, and regulations which may directly or indirectly affect the work or its prosecution, persons engaged in or employed on the work, and the equipment and tools used in the work. No adjustments or compensation will be allowed for losses caused by failure to comply with this requirement.

1. CONTRACTOR'S LICENSING FOR 100% STATE FUNDED PROJECTS.

Prior to the opening of bids, all bidders on 100% state funded projects shall submit a copy of their license issued by the State Licensing Board for General Contractors. Bidders shall place a copy of the license into the proposal of all bids that they submit for these projects.

2. CONTRACTOR'S LICENSING FOR PROJECTS FUNDED WITH FEDERAL MONIES.

Prior to being awarded a contract, bidders on projects that are partially or wholly funded with federal monies shall submit a copy of their license issued by the State Licensing Board for

General Contractors. Bidders may satisfy this requirement by placing a copy of the license into the proposal of each submitted bid.

3. BIDDER'S RESPONSIBILITY.

It is the bidder's responsibility to provide proof of being licensed by the State Licensing Board for General Contractors. Failure to do so may result in the rejection of a bid.

4. CODES.

Attention is directed to Titles 23 and 39, Code of Alabama, 1975, also Title 23, U.S. Code, and amendments thereto to the date of the contract.

(b) LABOR RATES.

Attention is called to the fact that the wage rates listed in the proposal are minimum required rates. Bidders therefore should investigate and determine the prevailing local wage rates which for certain classes may be higher than the listed minimum rates. Under no condition shall the Contractor pay less than the listed minimum rate but it may be necessary in some cases to pay more in order to secure the labor.

The bidders should investigate and the Contractor shall abide by any orders issued by the Wage Adjustment Board or any other Federal agency having jurisdiction over wage rates.

102.15 Material Guarantee.

The successful bidder may be required to furnish a complete statement of the origin, composition, and manufacture of any or all materials to be used in the construction of the work together with samples, which samples may be subjected to the tests provided for in these specifications to determine their quality and fitness for the work.

SECTION 103
AWARD AND EXECUTION OF CONTRACT

103.01 Consideration of Proposals.

After the proposals are opened and read, they will be compared on the basis of the summation of the products of the approximate quantities shown in the bid schedule multiplied by the unit bid prices. The results of such comparisons will be available to the public. In the event of a discrepancy between unit bid prices and extensions, the unit bid price shall govern.

The right is reserved to reject any or all proposals, to waive technicalities or to advertise for new proposals, if, in the judgment of the awarding authority, the best interest of the Department will be promoted thereby.

A proposal will not be considered unless signed by the bidder or his authorized agent and accompanied by cashier's check or properly signed bid bond as required by law.

103.02 Award of Contract.

(a) GENERAL.

The award of the contracts, if to be awarded, will be made within 30 calendar days after opening of proposals to the lowest responsible and responsive bidder whose proposals comply with the requirements of Section 102 and the invitation to bid (Notice to Contractors). Should no award be made within the 30 days, all proposals will be rejected unless the successful bidder agrees in writing to a stipulated extension in the time limit for award. The successful bidder will be notified by telegram, confirmed facsimile, or letter mailed to the address shown on his proposal that his bid has been accepted and that he has been awarded the contract.

After the opening of bids on work involving Federal funds, the award of the contract to the low bidder will be contingent upon said low bidder obtaining a license from the State Licensing Board for General Contractors in accordance with the existing State laws.

(b) BIDDER LOW ON MORE THAN ONE CONTRACT.

Should any responsible bidder be low on more contracts or work than he is qualified to handle under his certificate of qualification issued by the Department, the State reserves the right to select from his submitted proposals those for award to him which are most advantageous to the State. His other submitted proposals will not be considered in making the awards.

103.03 Cancellation of Award.

The Director reserves the right to cancel the award of any contract at any time before the execution of the said contract by all parties, without any liability against the State. He may reject the bid of the lowest bidder if any of the conditions for disqualifying as noted in Article 102.02 are found to exist at any time prior to the execution of the contract by all parties, and may, at his discretion, award to the second lowest bidder, when it is determined to be in the best interest of the State.

103.04 Return of Proposal Guaranties.

All proposal guaranties, except those of the 3 lowest bona fide bidders, will be returned without undue delay after proposals have been checked, tabulated, and the relation to the proposals established. The proposal guaranty of the 3 lowest bona fide bidders will be returned as soon as the contract bonds and the contract of the successful bidder have been properly executed and approved. When the award is deferred for a period of time longer than 15 days after the opening of the proposals, all proposal guaranties except that of the successful bidder will be returned. Should no award be made, all guaranties will be returned. Should the successful bidder agree in writing to a stipulated extension in the time limit for award, the Director may, at his discretion, permit the successful bidder to substitute a satisfactory bidder's bond if a cashier's check was submitted with his proposal as a proposal guarantee. The Director reserves the right to return all proposal guaranties by registered mail and his responsibility shall end upon the mailing thereof.

103.05 Requirements of Contract Bonds.

(a) PERFORMANCE BOND.

The bidder to whom the award is made shall, within 15 days after the prescribed forms have been presented to him for signature (i.e. after date of award), furnish and file with the Transportation Director an acceptable surety bond on the form included in the proposal in an amount equal to 100 percent of the contract bid price of the contract as awarded. Said bond shall be furnished by a surety company qualified and authorized to make such bonds in the State of Alabama, and countersigned by an authorized agent resident in the State who is qualified to execute such instruments. The bond shall have attached thereto power of attorney of the signing official unless such power of attorney is already on file in the office of the Department. In case of default on the part of the Contractor, all expense incident to ascertaining and collecting losses suffered by the State under the bond, including engineering, direct administration, and legal services, shall be charged against the contract bond for performance of the work.

(b) LABOR, MATERIALS, SERVICES, INSURANCE, FEED STUFFS, OR SUPPLIES BOND.

In addition thereto, the bidder to whom the award is made shall, within the same 15 days, execute and file with the Director an acceptable surety bond payable to the State in an amount not less than 100 percent of the contract bid price, with the obligation that the Contractor shall promptly make payment to all persons furnishing him or them with labor, materials, feed stuffs, services, insurance, bond, or supplies for or in the prosecution of the work, and for the payment of reasonable attorneys fees, incurred by successful claimants or plaintiffs in suits on said bond.

(c) CONTINUOUS BOND COVERAGE.

Surety bonds shall continue to be acceptable to the Director throughout the life of the contract. In event the surety executing the bonds, although acceptable to the Director at the time of execution of the contract, subsequently becomes insolvent, bankrupt, unreliable, or otherwise unsatisfactory due to any cause which becomes apparent after the Director's initial acceptance of the bonds, then the Director will require that the Contractor replace the bonds with like bonds drawn on a surety company which is acceptable to the Director. In such event, all costs of the premium for the new bonds will be borne by the Contractor.

103.06 Execution of Contract.

The contract shall be executed by the bidder to whom award is made, on the form included in the proposal, and returned to the Director with satisfactory contract bonds within 15 days after the prescribed forms have been presented to him for signature (i.e. after date of award). Should extenuating circumstances prevail, the Director may grant an extension in time not exceeding five days for the return of the contract and bonds as provided herein and in Article 103.05.

103.07 Approval of Contract.

A period of 20 days will be allowed for execution of the contract by the Director and approval of same by the Governor, after its presentation by the successful bidder, unless the successful bidder agrees in writing to a longer period. No contract is binding upon the State until it has been executed by the Director and approved by the Governor of the State. The date of the final execution of the contract shall be the date on which it is signed by the Governor.

103.08 Failure to Execute Contract.

Should the successful bidder or bidders to whom the contract is awarded fail to execute a contract and furnish acceptable contract security as provided by Articles 103.05, 103.06 and 103.07, the Director shall retain from the proposal guaranty if it be a cashier's check or recover from the principal or the sureties if the guaranty be a bid bond, the difference between the amount of the contract as awarded and the amount of the proposal of the next lowest responsible bidder but not to exceed the total amount of the proposal guaranty shall be so retained or recovered as liquidated damages for such default. Any sums so retained or recovered shall be the property of the State. In the event of the death of the successful bidder between the date of the opening of the bids and the 15 days following the date of award of the contract as allowed in Articles 103.05 and 103.06 for furnishing contract security and executing contract, the Director will return the proposal guaranty intact to the estate of the deceased successful bidder.

When the successful bidder or bidders fail to execute a contract, and the contract is awarded to the next lowest bidder, the original low bidder will be prohibited from doing any work on the contract, either as a subcontractor or in any other capacity. The original low bidder will also be prohibited from bidding on the project if it is readvertised for letting. These restrictions shall apply to any other name under which the same person, individual, partnership, company, firm, corporation, association, cooperative, or other legal entity may be operating in which the principal owners are involved.

Failure by the Department to return to the successful bidder his approved contract and to issue a work order as required by law shall be just cause, unless both parties agree in writing to a stipulated extension in time for issuance of a work order, for the successful bidder to withdraw his bid, contract, and bonds, without forfeiture of cashier's check or bid bond.

SECTION 104
SCOPE OF WORK

104.01 Intent of Contract.

The intent of the contract is to provide for the construction and completion of the work described. The Contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the work in accordance with the plans, specifications, and terms of the contract.

When Item 680-A, Engineering Controls, is included on the plans and in the proposal, the Contractor shall also furnish all engineering controls (see Section 680).

Special provisions covering any special conditions, materials, or construction not covered on the plans or in these specifications will be included in the bidders' proposals or in supplemental agreements.

104.02 Alterations of Plans or Character of Work.

(a) GENERAL.

The Engineer reserves the right to make, in writing, at any time during the work, such changes in quantities and such alterations in the work as necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the contract nor release the surety, and the contractor agrees to perform the work as altered.

If the alterations or changes in quantities significantly change the character of the work under the contract, whether such alterations or changes are in themselves significant changes to the character of the work or by affecting other work cause such other work to become significantly different in character, an adjustment, excluding anticipated profit, will be made to the contract. If the cost of the work does not change, then the adjustment will be zero. The basis for the adjustment shall be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an

adjustment will be made either for or against the contractor in such amount as the Engineer may determine to be fair and equitable.

If the alterations or changes in quantities do not significantly change the character of the work to be performed under the contract, the altered work will be paid for as provided elsewhere in the contract.

The term "significant change" shall be construed to apply only to the following circumstances:

(1) When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction or

(2) When a major item of work, as defined elsewhere in the contract, is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed. Changes in quantities for the items of Unclassified Excavation, Muck Excavation, Borrow Excavation, Pipe Underdrain, extra Concrete and Steel Reinforcement (for structure foundations), Piling, Bituminous Plant Mix leveling and widening material, and Bituminous Material used in plant mix bases and pavements shall be excluded in determining increases and decreases under the provisions of this paragraph, since it is understood that these items cannot be accurately determined before the work is done.

No claims shall be made by the Contractor for any anticipated profits because of any such alteration, or by reason of any variation between the approximate quantities and the quantities of work as done.

No allowance will be made on an item for which a fixed price is set in the proposal.

Payment for work occasioned by changes or alterations will be made in accordance with the provisions set forth under Article 109.05. If the altered or added work is of sufficient magnitude as to require additional time in which to complete the project, such time adjustment may be made in accordance with the provisions of Article 108.09.

Under no circumstances shall alterations of plans or of the nature of the work involve work beyond the termini of the proposed construction except as may be necessary to satisfactorily complete the project.

(b) CHANGED OR DIFFERING SITE CONDITIONS.

During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

Upon written notification, the Engineer will investigate the conditions, and if he determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the contract, an adjustment, excluding anticipated profits, will be made and the contract modified in writing accordingly. The Engineer will notify the Contractor of his determination whether or not an adjustment of the contract is warranted.

No contract adjustment which results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.

The Contractor shall carry on the work promptly and diligently pending a decision.

Any adjustment in compensation because of such change or changes will be made in accordance with the provisions of Article 109.05. Any adjustment in contract time because of such change or changes will be made in accordance with the provisions of Article 108.09.

(c) CLAIMS.

If the Contractor does not agree with the Department's decision concerning his request for extra compensation, he may file a claim following the procedures outlined in Section 110, Claims.

104.03 Extra Work.

(a) GENERAL.

The Contractor, when so directed in writing, shall perform extra work for which there is no quantity or unit price in the contract and is deemed necessary or desirable in order to complete fully the work as contemplated. Such work shall be performed in accordance with the Specifications and as directed and will be paid for as provided under Subarticle 104.03(b).

(b) SUPPLEMENTAL AGREEMENT OR FORCE ACCOUNT ORDER REQUIRED.

Before any such extra work is started, a supplemental agreement shall be executed, describing the kind, location, and estimated quantities of the extra work to be done and specifying the unit prices or lump sum agreed upon, or a written order shall be issued for the work, stating that compensation will be on a force account basis. However, in an emergency, the Engineer may direct the immediate start of the extra work by letter containing this information. Such letter shall be superseded later by a supplemental agreement or force account order. If satisfactory unit prices or lump sum cannot be agreed upon, the Director may require that the extra work be performed on a force account basis as outlined in Subarticle 109.04(b) or he may direct that one or more of the items of the proposed extra work be omitted from consideration and performed by other agents.

104.04 Sequence of Construction for Handling Traffic Through The Work and Construction and Maintenance of Detours.

(a) GENERAL.

No highway or section of highway or bridge shall be closed to traffic and no construction operations that will for any reason render the roadway generally unsuitable for use of the traveling public shall be started until adequate provisions have been made to detour or by-pass the traffic in safety and comfort. Special reference is made to Article 107.07, "Public Convenience and Safety" and such is approved in writing by the Engineer.

The Contractor's attention is directed to the possible existence of pipe lines or other public utilities which may be buried within the limits of the work or adjacent thereto and which may or may not be shown on the plans. He shall be responsible for and shall take all necessary precautions to protect and preserve any and all such existing drains, sewers, pipes, conduits, and other underground structures or parts thereof which may be affected by his operations on the work, and which, in the opinion of the Engineer, may be properly continued in use without any changes. He shall assume full responsibility for reimbursing the owners for any damage or injury to properties or interference with their service which may result from any of his operations or negligence during the period the contract is in force. Also, he shall be responsible for any damage to utilities above ground, regardless of their location, where such damage results from any of his operations or his negligence. Attention is directed to Subarticle 107.12(b).

The Contractor shall repair, replace, relocate, extend, reconstruct or make any other change in any subsurface sewer or drain encountered in the prosecution of the work and unless otherwise provided in the contract, the cost of replacing or restoring or connecting any such sewer or drain substantially to its original location, when incidental to the construction shall be included in the contract unit prices for various pay items.

Where mail delivery service is to be maintained during construction, mailboxes within the limits of operations shall be removed by the Contractor before work is begun and set temporarily where they will be accessible both to the mail carrier and the patron. As soon as the state of the work permits and the Engineer directs, all mailboxes shall be reset by the Contractor in permanent locations in compliance with U.S. Postal Service Regulations. Mailboxes or supports that have been damaged by the Contractor shall be replaced at his expense. The cost of removing and/or temporarily resetting mailboxes shall be included in the prices bid for the various pay items of work and no direct payment will be made for this work. Unless Item 209-A, Mailbox Reset, is included on the plans or in the proposal, no direct payment will be made for permanently resetting mailboxes.

When the Contractor performs any operations after daylight hours, he shall provide and maintain, at his expense, sufficient artificial lighting to permit proper construction and inspection.

(b) SIGNS AND WARNING LIGHTS.

All signs, barricades, etc. used along the project shall be in accordance with the provisions of Part VI of the MUTCD, the plan details and the following: Posts shall be appropriately sized for the sign of either timber (treated or painted) of not less than 4 inch by 4 inch {100 mm x 100 mm} (Nom.) cross section or metal (min. 2 lbs. {1 kg} "U" channel or equivalent) so spaced to rigidly support the sign.

All signs, barricades, drums or other devices intended for use in controlling traffic shall be in accordance with the requirements of Part VI of the MUTCD and the detailed plans, with reflectorization as noted therein. Reflectorization shall be accomplished using materials meeting the requirements of Article 880.02.

All barricades, drums, signs and other devices shall be kept clean, legible, and in their proper position at all times. Damaged, defaced or dirty barricades, drums, signs and other devices shall be

repaired or replaced immediately. The Engineer will insure compliance by periodic inspections and require replacements or repair as deemed necessary.

In addition to the requirements of Article 107.10 where particular hazardous conditions exist or traffic volumes warrant, or where there is serious interference from extraneous light sources and a reflectorized sign is not likely to be effective, the Engineer may require any or all signs and barricades to be illuminated.

Illumination of signs, barricades, etc. shall be accomplished by the use of 100 watt or greater, incandescent or equivalent fluorescent electric light bulbs, shielded to protect the driver from glare and so located that the sign shape and message is clearly visible to the driver. Street or highway lighting by itself is not regarded as meeting illumination requirements.

(c) SEQUENCE OF CONSTRUCTION.

Unless otherwise provided by plan details or special provisions included in the contract, the sequence of construction for the project shall be the Contractor's provided the following requirements are met to the satisfaction of the Engineer.

1. Provides for the orderly construction of the project within the time limit provided by the Contract.
2. Provides for the preparation of any bridge sites as a first order of work.
3. Provides for handling of traffic through the work in accordance with the details noted in Subarticle (d) of this Article.
4. Provides for the working out of minor drainage problems and details of temporary or permanent access as they are encountered.
5. Provides for the continuous prosecution of all paving work through the final wearing layer once planing (milling) operations, surface treatment operations, or paving operations have begun.

(d) HANDLING OF TRAFFIC.

Unless otherwise provided, the Contractor shall keep the road open to all traffic while performing the required improvements. The Contractor shall keep the portion of the project being used by public traffic, whether it be through or local traffic, in such condition that traffic will be adequately accommodated. He shall provide and maintain in a safe condition temporary approaches or crossings and intersections with trails, roads, streets, businesses, parking lots, residences, garages, and farms. Where so provided on the plans or approved by the Engineer, the Contractor may bypass traffic over an approved detour route.

The Contractor shall furnish, erect, and maintain barricades, warning signs, delineators, flagmen, and pilot cars in accordance with Part VI of the MUTCD. The maintaining of traffic may restrict the movement of some units of construction equipment and make necessary the use of flagmen for directing the traffic and protecting the work. Flagmen shall wear either an approved uniform or vest of Fluorescent Orange color and an orange hardhat and be equipped with a STOP/SLOW paddle.

Construction adjacent to existing pavement will require the use of portable barricades, drums, signs, vertical sign panels, delineators, or other approved traffic control devices. Posts used for traffic control device supports shall be appropriately sized for the intended purpose and uniform in shape and color throughout the project.

The above traffic control devices shall be supplemented as necessary with warning lights of the kind and type indicated by plan details, the proposal, or as directed by the Engineer. In addition, when deemed necessary by the Engineer, special warning lights shall be used on equipment working adjacent to traffic lanes to warn traffic. These special warning lights shall be either all purpose, 360°-2 sealed beams, revolving types of at least 8 inches {200 mm} in height, or electronic strobe beacons. These lights shall be amber or orange colored and mounted so as to be readily seen by traffic at a safe distance.

104.05 Blank.

104.06 Final Cleaning Up.

Upon completion and before work will be finally accepted and final payment made, the Contractor shall perform the following work: (1) He shall clear and remove from the right of way and adjacent areas not owned by him, all falsework, equipment, surplus and discarded materials, temporary structures, rubbish, debris, and all other objectionable litter, and dispose of them in a satisfactory manner. (2) He shall not remove barricades, warning and direction signs, until directed by the Engineer. (3) He shall remove from the site of other operations such as pits, quarries, stream channels, structures sites, and storage yards, all weeds, portions of trees, discarded materials, machinery,

temporary structures, and equipment and dispose of them in a satisfactory manner. Depositing such material on abutting property or adjacent to the right of way with or without the consent of the property owner, will not be accepted as satisfactory disposal. However, he may be allowed temporarily to store equipment, surplus material, usable forms, etc., in a neat manner on a well-kept site near the right of way. (4) He shall restore in an acceptable manner all property, public and private, damaged incident to the prosecution of the work, and shall leave the right of way and sites of structures in a neat and presentable condition satisfactory to the Engineer.

104.07 Maintenance of Roads and Detours.

(a) GENERAL.

The Contractor shall maintain at his expense, except as explicitly outlined in this Article, all detours and haul roads, and all roads, streets, bridges, and intersections within the project limits. This includes, but is not limited to, haul roads and detours constructed by the Contractor for his convenience. It also includes damage to the road, street, or structure caused by the Contractor's equipment.

The Contractor shall regulate his loads as required by Article 105.12 and he and his surety shall be responsible for any specific damage that may result to the road, street, or structures from failure to observe regulations governing traffic thereon, or for negligence on his part.

The Contractor shall perform required repairs without delay; otherwise, the State or County will perform the repairs and the cost thereof will be deducted from amounts due on the contract. The Contractor and his surety shall indemnify and hold harmless the State, the Director, and the Engineer for damages arising from the use of roads and streets in the performance of the contract.

(b) DETOURS.

Detours designed by the Engineer and constructed in an acceptable manner shall be maintained by the Contractor with payment made under the appropriate Pay Items or as Extra Work unless the State elects to perform the maintenance instead. Roads designated as detours by the plans or the Engineer shall be maintained as outlined in this paragraph.

(c) HAUL ROADS.

Unless the plans designate otherwise, the Contractor may use any State road as a haul road with the maintenance performed as specified in Subarticle 104.07(b) above as long as his loads are regulated as specified in Subarticle 104.07(a) above.

Should the Contractor wish to use a county road or city street as a haul road, he shall meet with the local governing body, review the condition of the facility, and reach an agreement as to the maintenance thereof. No payment will be made for such maintenance or restoration thereof.

(d) ROADS AND BRIDGES.

Existing roads and bridges which have not been constructed or overlaid by the Contractor shall be maintained by the State unless the Contractor is directed to make repairs with payment to be made as specified in Subarticle 104.07(b).

104.08 Value Engineering.

(a) PURPOSE AND SCOPE.

Value Engineering (VE) applies to cost reduction proposals that are initiated, developed, and submitted in writing by the Contractor to the Department for modifying the plans, the specifications, or other contract requirements. This applies only to a proposed change which is identified as a Value Engineering proposal at the time it is submitted to the Department.

VE proposals are those which would require a change in the contract and would result in a net savings over the contract cost without impairing essential functions and characteristics of the project, including but not limited to, service life, reliability, economy of operation, ease of maintenance, desired aesthetics, and safety.

The intent of this provision is for the Department to share with the Contractor any cost savings generated on a project as a result of a proposal or proposals offered by the Contractor and approved by the Department. The purpose is to encourage the use of the Contractor's ingenuity and experience in arriving at alternate, lower cost construction methods than those reflected in the contract documents by the sharing of savings resulting therefrom. VE proposals based solely on deleted pay items will not be considered.

Nothing herein shall be construed as requiring the Department to consider or approve a VE proposal submitted hereunder; however, if a VE proposal is approved by the Department, the net savings resulting from the proposal will be shared by the Department and Contractor on a 50-50 basis.

(b) SUBMITTAL OF PROPOSAL.

As a minimum, the following materials and information shall be submitted with each VE proposal, plus any additional information requested by the Department:

1. A Statement that the proposal is being submitted as a Value Engineering proposal.

2. A description of the difference between the existing contract requirements and the proposed change, and the comparative advantages and disadvantages of each, including considerations such as service life, economy of operations, ease of maintenance, desired appearance, and safety.

3. A complete detailed cost analysis indicating the final estimate costs and quantities to be replaced by the proposal, the new costs and quantities generated by the proposal, and the cost effects of the proposed changes on operational, maintenance, and other considerations.

4. Plans, specifications, and recommendations as to how the VE proposed changes are to be accomplished.

5. A statement of the deadline for issuing a change order adopting the proposed change to obtain the maximum cost reduction during the remainder of the contract, noting any effect on the contract completion time or delivery schedule.

6. A description of any previous use or testing of the proposal on another Department project, or elsewhere, and the conditions and results therewith. If the proposal was previously submitted on another Department project, indicate the date, project number, and the action taken by the Department.

7. VE proposals may be submitted only by the prime Contractor. Subcontractors may not submit a proposal except through the prime Contractor.

8. Six complete copies of all submittal data included in a VE proposal shall be submitted to the Department's Project Engineer. All copies of the proposal will be forwarded through the Division Office to the State Construction Engineer for further handling.

(c) CONDITIONS FOR CONSIDERATION OF PROPOSAL.

1. The Contractor is cautioned not to base any bid prices on the anticipated approval of a VE proposal and to recognize that a proposal may be considered but not approved. In the event of rejection of the proposal, the Contractor shall complete the contract in accordance with the plans and specifications at the contract prices bid.

2. The Department will not be liable to the Contractor for failure to accept or act upon any VE proposal submitted nor for any delays to the work attributable to any such proposal.

3. The Contractor shall absorb all costs incurred in preparing a VE proposal for submission to the Department. The Department will bear the cost of reviewing and administering the VE proposal.

4. Until a proposal is approved by supplemental agreement, the Contractor shall remain obligated to the terms and conditions of the existing contract.

5. All VE proposals, whether approved or not approved by the Department for use on a referenced project, become the property of the Department, and shall contain no restrictions imposed by the Contractor on their use or disclosure. The Department shall have the right to use, duplicate, and disclose in whole or in part any data necessary for the utilization of the proposal. The Department retains the right to utilize any accepted proposal or part thereof on any other or subsequent projects without any obligation to the Contractor. This provision is not intended to deny rights provided by law with respect to patented materials or processes.

6. The proposal shall not be experimental in nature but shall have been proven to the Department's satisfaction under similar or acceptable conditions on another project or location.

7. Proposed changes in the basic design of a bridge or pavement type, or which require different right-of-way limits, will not normally be considered as an acceptable VE proposal. Items of work which are specifically excluded from Value Engineering by the plans will not be considered as a VE proposal.

8. If a supplemental agreement has not been executed by the date upon which the Contractor's proposal specifies that a decision should be made, or such other date as the Contractor may subsequently have specified in writing, such proposal shall be deemed rejected.

9. If additional information is needed to evaluate proposals, such information shall be provided in a timely manner. Failure to do so will result in rejection of the proposal.

10. If a VE proposal is accepted in whole or in part, such acceptance will be by a contract supplemental agreement. The supplemental agreement will incorporate the necessary changes in the plans and specifications to permit the proposal, or any part of it accepted, to be put into effect. If there is to be an extension or reduction in contract time, the supplemental agreement will so note. If the approval of the Department is conditional, the supplemental agreement will specify the conditions.

11. The Department will be the sole judge as to whether a proposal qualifies for consideration and evaluation. It may reject any proposal that requires excessive time or costs for review, evaluation, and/or investigations, or which is not consistent with the Department's design policies and basic design criteria for the project.

(d) VALUE ENGINEERING PAYMENT.

If a VE proposal is approved by the Department, the changes and payment therefore will be authorized by a supplemental agreement. Reimbursement to the Contractor will be made as follows:

1. The changes shown on the VE proposal will be incorporated into the contract through changes in the quantities of unit bid items, newly agreed price items or by force account, as appropriate, in accordance with the specifications.

2. The cost of the revised work will be paid for directly as determined from the above mentioned changes. In addition to such payment, the Department will pay to the Contractor, by a separate Lump Sum Item, an amount equal to one-half of the savings as reflected by the difference between the cost of the original contract work and the cost of the work performed under the approved VE proposal. Payments will be made on monthly estimates based on the estimated savings generated by the approved VE proposal. The amount to be paid on these estimates will be a percentage of the total estimated savings in proportion to the amount of the VE proposal work performed during that month. Upon completion of all work included in the VE proposal, the final total savings will be determined by comparing the cost of the work based on the original contract quantities and the cost of the actual VE work performed. The final payment for work performed under the VE proposal will make any necessary corrections in previous payments to reflect a total payment of 50% of the generated savings to the Contractor.

3. The Contractor's costs for development, design, and implementation of the VE proposal are not eligible for reimbursement.

4. The Contractor may submit VE proposals for an approved subcontractor but, if the proposal is approved, the reimbursement will be made by the Department to the Contractor.

5. Payment will be made under item number:
   104-A Value Engineering Proposal No. _____ - per lump sum

SECTION 105
CONTROL OF WORK

105.01 Authority of the Engineer.

The Engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the Contractor.

The Engineer shall have the authority to withhold further payment or to suspend the work wholly or in part due to failure of the Contractor to correct conditions unsafe for the workmen or the general public; failure to carry out provisions of the contract; failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions unsuitable for prosecution of the work; or for any other condition or reason deemed to be in the public interest.

105.02 Plans, Shop and Working Drawings.

(a) GENERAL.

Construction plans will show details of all structures, lines, grades, typical cross-sections of the roadway, location and design of all structures, a summary of the items appearing on the proposal supplemented by such details as necessary to give a comprehensive idea of the completed construction.

Only general features will be shown for structures. Structures plans shall be supplemented by such shop and work drawings as noted in Subarticles (c) and (d) as may be required to adequately control the work and shall be furnished by the Contractor.

The Contractor shall keep one set of construction plans and details available on the work at all times.

The Contractor will be furnished a set of record plans that are reproductions of the approved plans issued to bidders for use in submitting proposals. Each sheet of these plans except cross section sheets will be stamped "Record Plans", and will be signed and dated by a representative of the Department.

All drawings, equipment and material lists requiring approval shall be submitted to the State Construction Engineer through the Project Engineer, except as follows: Shop drawings for bridge structures shall be submitted directly to the State Bridge Engineer for approval; working drawings for bridge structures shall be submitted directly to the State Construction Engineer for distribution. All plans and drawings shall be in the same units of measurement shown on the Contract Plans.

(b) ROADWAY PLANS

Roadway plans will show title sheet, alignment, profile, typical cross section of improvement, and other information pertinent to the project. Highway lighting and signal plans, while classified as roadway plans, require submission of material and equipment listings as well as support pole data. Such submission requirements are noted in the sections covering this type work.

(c) STRUCTURE AND BRIDGE PLANS.

1. GENERAL.

Structure or bridge plans will, in general, show in detail all dimensions of the work contemplated. When the structure plans do not show all dimensions in detail, they will show general features and such details as are necessary to give a comprehensive idea of the structure.

2. SHOP DRAWINGS.

a. The plans furnished the Contractor by the Department are not intended for use as shop fabrication drawings.

b. The Contractor shall carefully verify and shall become responsible for the correctness of all other than the principal controlling dimensions shown on the plans and shall immediately advise the Engineer of any errors or discrepancies he may discover therein.

c. As soon as possible after the execution of the contract, the Contractor shall prepare complete, accurate shop drawings on Standard Plan Sheets (22 inches {559 mm} x 36 inches {914 mm}) as required for the fabrication of any part of the work. This shall include precast concrete items, structural steel, all other metal work and the masonry connections thereof. The signature of the preparer shall be shown on all drawings.

d. Any details not sufficiently shown on the plans will be furnished by the Engineer upon request by the Contractor.

e. Three legible prints of the completed and checked shop drawings shall be submitted to the Engineer who will return one set to the Contractor marked approved or marked with corrections to be made.

f. Six copies of the prints as approved, revised or corrected, shall be promptly resubmitted for distribution. All drawings shall be clear and complete and shall be checked before final approval will be granted. The Engineer may require additional copies if railroads are involved or he determines that additional copies are needed.

(d) WORKING DRAWINGS FOR STRUCTURES.

Working drawings shall consist of such detailed plans as may reasonably be required for the successful prosecution of the work and which are not included in the plans furnished by the Department. These working drawings shall include, where applicable, sheeting and shoring plans, cofferdam plans, steel erection plans (all continuous spans), falsework plans, and other details determined to be necessary by the Engineer. Refer to Sections 501, 503 and 508 for design requirements.

A minimum of six prints of all required working drawings and calculations, along with a letter of transmittal, shall be submitted by the Contractor to the State Construction Engineer for distribution. Such drawings shall be submitted well in advance of the time of need for performing the work involved. Prior to submittal, all details shall be checked, stamped approved, and signed by a Licensed Professional Engineer licensed in the State of Alabama and not employed by the Alabama Department

of Transportation. Details shall be approved for conformance with plan and specification details, structural adequacy, and safety.

Working drawings for work on or over railroad right-of-way must have the approval of the railroad company involved before any work can be performed thereon. Therefore, the Contractor shall submit to the State Construction Engineer appropriate drawings in accordance with the provisions noted above plus four extra sets of prints for each railroad company involved for obtaining said approval. Extra time should be allowed by the Contractor to cover the processing of the drawings through the railroad companies.

No work shall be performed on the project, regarding work items requiring working drawings, until after the drawings have been submitted to the State Construction Engineer and distribution has been made to the Division, District and Project Engineers.

(e) ENGINEER'S APPROVAL OF CONTRACTOR'S SHOP DRAWINGS.

1. The approval of shop drawings by the Engineer will cover only the features of the design and in no case shall this approval be considered to cover error or omissions in shop details or a check of any dimensions. The Contractor shall be responsible for the accuracy of the shop drawings, the fabrication of materials and the fit of all connections; and he shall bear the cost of all extra work in erection caused by errors in shop drawings or in fabrication, inaccurate workmanship, misfits of connections, or for any changes in fabrication necessary.

2. No work shall be done on the material before the shop drawings have been approved. Any material that the Contractor orders prior to the approval shall be at the Contractor's risk.

3. After a shop drawing has been approved, no changes shall be made unless directed in writing.

4. 10 calendar days will be allowed for each examination of each set of drawings submitted for approval containing five sheets or less and two days for each sheet of each set of drawings containing more than five sheets.

5. If shop drawings are detained for a longer period than above stated, and the delay is not the fault of the Contractor, such detention will be considered along with any application of the Contractor for an extension of the date of completion of the contract.

6. The Contractor shall furnish the Department without charge one set of satisfactory reproducibles (Mylar or equal) of the approved corrected shop drawings. The reproducibles shall be delivered to the Engineer at the completion of the work. If the structure is to be maintained by a railroad, one extra set of reproducibles shall be furnished for each railroad involved.

(f) COMPENSATION FOR WORKING DRAWINGS AND SHOP DRAWINGS.

Compensation for preparing and furnishing all shop and working drawings, as required above, shall be included in the contract unit prices for the various pay items of work.

105.03 Conformity with Plans and Specifications.

All work performed and all materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions and material requirements, including tolerances shown on the plans or indicated in the Specifications.

In the event the Engineer finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and Specifications but that reasonably acceptable work has been produced, he shall then make a determination if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as he deems necessary to conform to his determination based on engineering judgement.

Where definite tolerances are specified in the contract, such tolerances shall fix the limits of reasonably close conformity. Where tolerances are not specified in the contract, the Engineer will determine the limits of reasonably close conformity in each individual case and his decision shall be final and conclusive and mutually accepted by all parties.

In the event the Engineer finds the materials furnished, work performed, or the finished product are not within reasonably close conformity with the plans and Specifications, the work shall be removed and replaced or otherwise satisfactorily corrected by and at the expense of the Contractor.

105.04 Coordination of Plans, Specifications, and Special Provisions.

(a) GENERAL.

These specifications, the supplemental specifications, the plans, special provisions and all supplementary documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complimentary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions, unless obviously incorrect, shall govern over scaled dimensions. Supplemental Specifications shall govern over the Standard Specifications. Plans shall govern over Standard Specifications and Supplemental Specifications. Special Provisions shall govern over Standard Specifications, Supplemental Specifications, and Plans.

(b) ERRORS.

The Contractor shall not take advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

105.05 Cooperation with Utilities and Non-Highway Public Facilities.

It will be the State's duty to notify in writing all utility owners or other parties affected, of the date they may begin adjustments of their facilities. The State will endeavor to have all necessary adjustments of public or private utilities, or other appurtenances within or adjacent to construction limits, made as soon as practicable. The owners or operators of private or public utilities shall have access to the work for the installation, adjustment, or repair of main line and service facilities. All frames of openings for valves, manholes, catch basins, or other fixtures encountered in areas to be covered by a pavement, shall be adjusted to the proper elevation before the pavement is placed. The Contractor shall coordinate his activities with those of utility owners while utility adjustments are being made. Copies of utility agreements will be made available for the Contractor's inspection at the Alabama Department of Transportation Division offices. The Contractor shall investigate conditions of existing utilities prior to submitting his bid for the purpose of coordinating the work to the greatest extent possible.

The Contractor's attention is directed to any utilities that may be involved on this project and are designated in the Plan Assembly. In any event, it shall be the Contractor's responsibility to determine the exact location of all existing utilities, whether shown on the Plans or not. The relocation and/or adjustments of said utilities have been authorized and utility facilities have been cleared or adjusted; however, should additional points of conflict occur, they will, of necessity, be performed during the construction operation. Cooperation between the Contractor and the Utility Companies shall be expected in accordance with this Article.

Any existing underground utilities, whether indicated on the plans or not, that have been abandoned by the Utility Companies within the limits of construction that require removing shall be removed by the Contractor. Any material removed in this manner shall become the property of the Contractor. Disposal of said material shall be at his discretion outside of the right-of-way limits. Cost of such work shall be paid for under applicable contract items of work or as Extra Work as outlined in Article 104.03.

105.06 Cooperation by the Contractor.

(a) GENERAL.

The Contractor will be supplied with a minimum of two sets of approved plans and contract assemblies (except Standard Specifications) including Special Provisions. The Contractor shall purchase any required Standard Specifications from the Department.

One set of approved plans and one copy of the contract assembly, including the Standard Specifications shall be kept available on the work at all times.

The Contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Engineer, his inspectors, and other Contractors in every way possible.

(b) CONTRACTOR'S SUPERINTENDENCE AND SUPERVISION.

The Contractor shall have on the work at all times, as his agent, a competent superintendent capable of reading and thoroughly understanding the plans and specifications and thoroughly experienced in the type of work being performed, who shall receive instructions from the Engineer or his authorized representatives. The Superintendent shall have full authority to execute orders or

directions of the Engineer without delay and to promptly supply such materials, equipment, tools, labor and incidentals as may be required. Joint venture Contractors shall have one such superintendent for all ventures. Such superintendents shall be furnished irrespective of the amount of work sublet and shall have full authority over all subcontract work.

105.07 Cooperation Between Contractors.

(a) GENERAL.

The Department reserves the right at any time to contract for and perform other or additional work on or near the work covered by the contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Department from any and all damages or claims that may arise because of inconvenience, delays, or loss experienced by him because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. He shall join his work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

The Engineer is empowered to regulate and coordinate the stages or progress of construction, or items of work of the respective Contractors to affect necessary cooperation and satisfactory performance and completion. The Engineer's decision shall be binding in any dispute involving the work arising between Contractors.

(b) RIGHT OF WAY FOR STRUCTURE CONTRACTOR.

Except as provided in Subarticle (a) above, the structure Contractor shall have available for his operations and storage the right of way between abutments and for a distance of up to 150 feet {45 m} (unless otherwise shown on the plans) back of the face of each abutment of each proposed structure along the main road, depending upon site conditions.

In the case of an underpass structure, the structure Contractor will have the use of the right of way for a distance of up to 150 feet {45 m} (unless otherwise shown on the plans) on each side of the centerline of the structure, depending upon site conditions. He shall provide a minimum 12 foot {3.7 m} vertical and 14 foot {4.2 m} horizontal clearance through the falsework of such structure, for movement of construction equipment. He shall keep open and not interfere with roadways or detours for public travel. He shall have right of access to each structure along the roadbed location or other portion of the right of way and shall not be barred from such access by operations of other Contractors. He shall not by his operations bar passage of other Contractors between sections of their work beyond each end of a structure.

105.08 Construction Stakes, Lines, and Grades.

(a) FOR PROJECTS CONTAINING ITEM 680-A, ENGINEERING CONTROLS, THE FOLLOWING SHALL APPLY:

The furnishing of construction stakes, lines, and grades shall be as outlined in Section 680.

(b) FOR PROJECTS NOT CONTAINING ITEM 680-A, ENGINEERING CONTROLS, THE FOLLOWING SHALL APPLY:

1. DETERMINATION OF LINES AND GRADES.

The Engineer will set construction stakes for the Contractor establishing all the lines, grades, and measurements necessary for the proper prosecution of the work. The location, alignment. and elevation of all parts of the work will be established by the Engineer, but the Contractor shall assume full responsibility for construction to the alignment, elevations, and dimensions as indicated by the stakes and/or plans. These stakes and marks shall constitute the field control by and in accordance with which the Contractor shall govern and execute the work. For all work, the Engineer will furnish the Contractor all lines, elevations, and bench marks needed to lay out the work correctly. No work shall be done without lines and grades having been given by the Engineer.

For control of elevations of base and pavement layers, the Contractor will be furnished one set of control elevation stakes. These stakes will be set on grade at intervals of not more than

50 feet {20 meters} along and near each side of each roadbed, and at other points as needed for accurate grade control. It shall be the Contractor's responsibility to obtain from this one set of control stakes the proper elevations for each layer of subbase, base, and pavement.

2. CONTRACTOR'S RESPONSIBILITY FOR STAKES.

The Contractor shall be responsible for the preservation of all stakes and marks. If in the opinion of the Engineer, any of the construction survey stakes or marks have been carelessly destroyed or disturbed by the Contractor, the cost to the State of replacing them will be charged against him, and will be deducted from the payment for the work.

3. FURNISHING STAKES, TEMPLATES, ETC.

The Contractor shall furnish free of charge, all stakes, templates, and other materials necessary for marking and maintaining points and lines given, and shall furnish the Engineer such incidental labor as he may require in establishing points and lines necessary to the prosecution of the work to satisfactory completion.

105.09 Inspectors, Assistants, and Representatives.

(a) GENERAL.

The Engineer may appoint such inspectors, assistants, or representatives as he deems necessary, and they shall be granted full access to the work and to the mills and factories in which material is being prepared for use under the contract. In County Aid work, the Engineer may appoint the County Engineer as his representative on the work.

(b) DUTIES OF THE INSPECTOR.

Inspectors will be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector will not be authorized to alter or waive the provisions of the contract. The inspector will not be authorized to issue instructions contrary to the plans and specifications, or to act as foreman for the Contractor; however, he shall have the authority to reject work or materials until any questions at issue can be referred to and decided by the Engineer.

105.10 Inspection of Work.

All materials and each part or detail of the work shall be subject to inspection by the Engineer. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

If the Engineer requests it, the Contractor, at any time before acceptance of work, shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and replacing of the covering or making good of the parts removed will be paid for as extra work; but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good the parts removed, will be at the Contractor's expense.

Any work done or materials used without supervision or inspection by an authorized Department representative may be ordered removed and replaced at the Contractor's expense unless the Department representative failed to inspect after having been given reasonable notice in writing that the work was to be performed.

When any unit of government, political subdivision, utility company, or railroad corporation is to pay a portion of the cost of the work covered by this contract, its respective representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit of government, political subdivision, utility company, or railroad corporation a party to this contract, and shall in no way interfere with the rights of all parties.

105.11 Removal of Unacceptable and Unauthorized Work.

All work which does not conform to the requirements of the contract will be considered as unacceptable work.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or due to any other cause, shall be removed immediately and replaced in an acceptable manner.

Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans, or any extra work done without authority will be considered as unauthorized and will not be paid

for under the provisions of the contract. Work so done may be ordered removed or replaced at the Contractor's expense unless specifically waived by the Director.

Upon failure on the part of the Contractor to comply forthwith with any order of the Engineer made under the provisions of this Article, the Engineer will have authority to cause unacceptable work to be remedied or removed and replaced and unauthorized work to be removed and to deduct the costs from any monies due or to become due the Contractor. Continued failure on the part of the Contractor to comply shall be considered sufficient cause for the Director to declare the contract in default and to proceed to have the work completed in accordance with Article 108.12.

105.12 Load Restrictions.

The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads beyond the limits of the project. In the hauling of materials on city streets or county roads, it shall be the responsibility of the Contractor to regulate his loads so that damage does not occur, regardless of the legal or posted load limit. Maintenance of public roads shall be as outlined in Article 104.07. A special permit will not relieve the Contractor of liability for damage which may result from the moving of material or equipment.

Within the project limits, loads shall be so regulated that damage will not occur to base or pavement layers and structures, but in no case shall loads exceed the legal load limit unless permitted in writing by the Engineer under special conditions. No loads will be permitted on base, pavement or structures before the expiration of any required curing period. The Contractor shall be responsible for all damage by his hauling and other construction equipment within the project limits.

Gross weight {mass} tickets for loads delivered to the project will be verified by the Engineer that all loads incorporated in the project are within the legal load limit. Required information for verification will be secured at the time of delivery; however, verification of weights {masses} may be made at any time during the course of the project. Loads over the legal load limit and which have been incorporated in the project by the Contractor will not be paid for as outlined in the last paragraph of this Article.

On loads of materials not accompanied by a gross weight {mass} ticket, the Contractor shall furnish, upon request of the Engineer, the tare weight {mass} of any truck delivering such materials to the project. These truck tare weights {masses}, along with appropriate volumes and conversion factors, will be used by the Engineer in determining approximate quantities of materials which may be hauled to the project and still remain within the legal load limit. At such times as the Engineer feels that the legal load limit is being exceeded, he will order the Contractor to verify the weight {mass} of designated loads at an approved truck scale. Loads over the legal load limit which are incorporated into the project by the Contractor will not be paid for as outlined in the last paragraph in this Article.

No payment will be made for any materials placed in the project for which the delivered gross weight {mass} exceeds the legal load limit. No payment will include the total amount of the delivered load at the full contract unit price for the item of work under which the material is used.

105.13 Maintenance of the Work.

(a) GENERAL.

The Contractor shall maintain the work during construction until the entire project is completed and accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end that the roadway or structures are kept in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

The Contractor's attention is directed to Article 104.07 for maintenance of roads and detours, and compensation thereof.

(b) COMPENSATION.

All cost of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various pay items and the Contractor will not be paid an additional amount for such work.

105.14 Failure to Maintain Work.

If the Contractor, at any time, fails to comply with the provisions of Article 105.13, the Engineer will immediately notify the Contractor of such non-compliance. If the Contractor fails to remedy

unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may immediately proceed to maintain the project, and the entire cost of this maintenance will be deducted from monies due or to become due the Contractor on his contract.

105.15 Acceptance.

(a) CONSTRUCTION ACCEPTANCE INSPECTION.

Whenever the Engineer considers the work provided for and contemplated by the contract is nearing completion, or within five days after being notified by the Contractor that the work is completed, the Engineer will inspect all the work in the contract. If the Engineer finds that the work has not been satisfactorily completed at the time of such inspection, he will advise the Contractor in writing as to the work to be done or the particular defects to be remedied to place the work in condition satisfactory for final construction inspection.

(b) PARTIAL ACCEPTANCE.

If so provided by the proposal, units such as structures, sections of road or pavement may be accepted and the Contractor relieved of maintenance of that unit until final acceptance of the project. When such designated units are considered substantially complete, the Contractor may request an inspection as noted in Subarticle (a) above. If the Engineer finds that the unit has been satisfactorily completed in compliance with the contract requirements the unit will be accepted and the Contractor notified in writing as noted in Item 105.15(c)2 below. Such partial acceptance shall in no way void or alter any terms of the contract.

(c) FINAL ACCEPTANCE.

1. GENERAL.

Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection.

If during the course of the heretofore mentioned inspections the Engineer determines that all work has been satisfactorily completed save that of a substantial stand of grass on all or part of the work, he may recommend acceptance if the Contractor provides a bond covering all erosion control and related items. The face amount of the bond shall equal replacement costs of the erosion control items as determined by the Engineer. The time period to be covered by the bond will be sufficient to insure obtaining a satisfactory stand of growth, however, it shall not exceed 12 months. It shall be understood by all that such a bond is to insure replacement of the erosion control items should it become necessary and will in no way relieve the Contractor from the responsibility of damages caused by the lack of erosion control growth.

2. ACCEPTANCE FOR MAINTENANCE.

Upon satisfactory completion of the work as noted in Item 105.15(c)1 above, the Central Office will advise the Contractor in writing that the work has been accepted and the Department will assume the maintenance thereof subject to the "record check" of materials and workmanship.

On certain Federal-aid projects, a statement of materials and labor used on the project (Form FHWA-47) shall be submitted by the Contractor prior to final acceptance.

3. WRITTEN NOTICE OF FINAL ACCEPTANCE.

After completion of all requirements noted in this Article, the Engineer will give the Contractor written notice that the work has been accepted, and will specify the date of acceptance.

4. CONTRACTOR'S ADVERTISEMENT OF COMPLETION.

The Contractor, immediately after receiving notice of acceptance for maintenance or notice of final acceptance, shall give notice of said completion by an advertisement for a period of four successive weeks in some newspaper of general circulation published within the county in which the project is located. If the project is located in more than one county, an advertisement shall be given in a newspaper of general circulation published within each county in which the project is located. Proof of publication of said notice shall be made by the Contractor to the Director, by affidavit of the publisher, and a printed copy of the published notice. If a newspaper is not published in a county where work is done, the notice may be given by posting at the Court House for 30 days and proof of same shall be made by the Probate Judge or Sheriff and the Contractor.

105.16 Claims for Adjustments and Disputes.

Claims shall be handled as provided in Section 110, Claims.

105.17 Blank.

SECTION 106
CONTROL OF MATERIALS

106.01 Source of Supply and Quality Requirements.

(a) GENERAL.

Attention is directed to Section 800, Materials, which includes additional Specifications for materials.

The materials furnished for use in the work shall be new unused materials, unless otherwise specified, meeting all quality requirements of the contract. In order to expedite the inspection and testing of materials, the Contractor shall notify the Engineer of his proposed sources of materials prior to delivery. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce uniform and satisfactory products, or, if the product from any source proves unacceptable at any time, the Contractor shall furnish acceptable materials from other approved sources. The Engineer shall have the right to reject the entire output of any source from which he finds it is impracticable to secure a continuous flow of uniformly satisfactory materials.

1. Federal Participating Projects.

a. Steel and Iron Products.

All steel and iron materials, all manufacturing processes for these materials, and the action of applying a coating to these materials (i.e., epoxy coating, galvanizing, painting, or any other coating that protects or enhances the value of the coated material) which are permanently incorporated into the completed project shall be produced in the United States, its territories or possessions, except that minor items of foreign steel may be used if their cost is less than one tenth of one percent of the total contract cost or $2,500, whichever is greater.

b. Convict Produced Materials.

Materials produced after July 1, 1991, by convict labor are prohibited from being incorporated in the work unless such materials have been:

- Produced by convicts who are on parole, supervised release, or probation from a prison or

- Produced in a qualified prison facility and the cumulative annual production amount of such materials for use in Federal-aid highway construction does not exceed the amount of such materials produced in such facility for use in Federal-aid highway construction during the 12-month period ending July 1, 1987. "Qualified prison facility" means any prison facility in which convicts, during the 12-month period ending July 1, 1987, produced materials for use in Federal-aid highway construction projects.

2. Non-Federal Participating Projects.

On projects financed entirely by the State of Alabama or any political subdivision thereof, the Alabama Legislature has passed Acts that require the exclusive use of American materials, products, and supplies as follows:

a. Steel Products.

Act No. 83-196, as approved by the Alabama Legislature of 1983, shall be applicable and is quoted in part as follows:

"Section 1. Any contractor for a state, county or municipal construction project, financed entirely by the State of Alabama or any political subdivision thereof, within this State is hereby required to use steel produced within the United States when specifications in the construction contract require the use of steel. If, in the opinion of the Transportation Director, the procurement of the above mentioned domestic steel products becomes impractical as a result of a national emergency, national strike, or other cause, the Transportation Director may waive the above restriction for highway related projects."

"Section 2. The construction contract with any contractor who violates the domestic steel requirements of Section 1 of this Act shall be automatically revoked and such contractor shall not be entitled to any set-off or recoupment for labor or materials used up to the time of such revocation."

b. Non-Steel Materials, Supplies and Products.

Section 1 of Act No. 876, as approved by the Alabama Legislature of 1961, shall be applicable and is quoted as follows:

"Section 1. The awarding authority contracting for the construction, repair or maintenance of any public building, bridge, road or other like project of public works to be financed entirely by the State of Alabama, or any political subdivision thereof, shall stipulate or cause to be stipulated in the contract a provision whereby the person, firm, or corporation undertaking the project agrees to use in the execution thereof materials, supplies and products manufactured, mined, processed or otherwise produced in the United States or its territories, if the same are available at reasonable prices. Such contracts shall also contain a stipulation for payment of liquidated damages in an amount not less than $500 nor more than 20 percent of the gross amount of the contract in the event the contractor breaches his agreement to use domestic products."

The term reasonable prices shall mean that domestic prices shall not exceed foreign prices for the same grade of material by more than 6 percent. Prior to the use of any foreign material the Contractor will be required to submit support documentation to the Engineer for review showing that the price of the foreign material is reasonable (as defined in this paragraph). Unless waived by the Director, a minimum of three quotes from three different suppliers of the American (U.S.) material must be submitted to the Engineer for each material request. Such documentation may be submitted at any time during the life of the contract; however, prior approval for use of the foreign material must be obtained in writing from the Engineer. The use of foreign material under this provision, if approved, will not require price reductions on the bid prices of the affected pay items.

(b) GENERAL CONDITIONS GOVERNING USE OF LOCAL MATERIAL SOURCES AND WASTE AREAS AND ALL STAGING AREAS OUTSIDE OF THE DEPARTMENT OWNED RIGHT-OF-WAY.

The operations of any material pit or waste area shall be so conducted that it will blend into the surrounding landscape. Pit sites and waste areas shall be dressed to obliterate any unsightly appearance and treated in such a manner that erosion will not occur and result in the pollution of the watershed area. In general, sources will not be permitted at locations where resulting scars are visible from any highway. However, when approved, adequate space for conservation of existing natural screenings or to permit the installation of screen planting between the road surface and the disturbed area shall be provided.

The Contractor shall be responsible for obtaining stormwater permits on all material pits, waste areas, haul roads and other off-site areas selected by the Contractor to construct the project. The work within the project right of way and within construction easements will be covered by a Department obtained stormwater permit for the project.

The Contractor shall accept full responsibility for the quality of the materials used. He shall make all necessary arrangements with the owners of the materials; pay the purchase price or royalty directly to the owners and bear all the expense of procuring and delivering the materials complete in place, including cost of ingress and egress, and including the cost of opening, developing, and operating such sources.

If the Contractor submits a written request to the Department asking that the Department run samples or analyses on the materials, the Department may, at its option, run such samples or analyses, but a charge will be made for the tests and the cost deducted from the next monthly estimate due the Contractor.

Where access to a material source or waste area requires removal of fencing, the removal and replacement of fence, together with the protection of any livestock affected, shall be the responsibility of the Contractor without direct compensation.

Use of existing public roads for hauling materials to be used in the work shall be governed by Article 104.07.

All material pits (base, borrow, etc.), all waste areas, and all staging areas off the Department owned right-of-way shall have a historical and archaeological clearance from the Alabama State Historical Preservation Officer. The clearance shall be obtained from the following address:

Alabama Historical Commission Office
725 Monroe Street
Montgomery, AL 36130

In addition to the above, the Contractor shall provide the Department, by copy, a report from a professional biologist stating that no wetlands will be impacted by the proposed material source, waste area and/or staging area outside the Department owned right-of-way.

The Contractor shall also provide the Department, by copy, a letter from the U.S. Fish and Wildlife Service in Daphne, Alabama, stating that no endangered or threatened species or any proposed species protected under the Endangered Species Act will be impacted by the proposed material source, waste area and/or staging area outside the Department owned right-of-way. The address for the Fish and Wildlife Service is as follows:

U.S. Fish and Wildlife Service
P.O. Box 1190
Daphne, AL 36526

The letters from the Alabama State Historical Preservation Officer, professional biologist, and U.S. Fish and Wildlife Service along with the stormwater permit, shall be provided to the Engineer prior to any Contractor initiated disturbance (other than routine surveys) of the material source, waste area, haul road, and/or staging area outside the Department owned right-of-way.

(c) BLANK.

(d) BLANK.

(e) BLANK.

(f) USE OF MATERIALS WITH SPECIAL ACCEPTANCE REQUIREMENTS.

The Alabama Department of Transportation maintains several lists of materials, sources, and devices, which have undergone some form of preliminary evaluation. These lists are established both as reference for Contractors and as methods to eliminate some of the lengthy time delays required in evaluating certain products. Each list is unique in requirements and job control acceptance. Users of these lists should read all requirements carefully before using products on them. When materials or products shown on these lists are used, they shall be selected from the most current applicable list at the time of installation. These lists are published in the Department's manual "MATERIAL, SOURCES, AND DEVICES WITH SPECIAL ACCEPTANCE REQUIREMENTS", which is available for purchase from the Department.

The lists are not a blanket approval and do not relieve the Contractor of the responsibility of furnishing quality materials. The Project Engineer will inspect the material, and if doubt exists, job control samples will be taken. If these job control samples indicate failing test results, one of the following actions will be taken depending on the detrimental effects to the project:

1. Previously installed materials may be ordered replaced with passing materials at no cost to the Department.
2. Previously installed materials, which are of a temporary nature, may be left in place with the Contractor maintaining the failing materials for the duration of their use at his expense.
3. Previously installed materials may remain in place with an agreed price reduction.

After failing job control results are received, no further installation of the failing material will be allowed and a determination will be made by the Department as to the removal of the product from the list.

The lists are established and maintained by the individual sections within the Department of Transportation who are primarily concerned with the products. Lists are divided into five general categories of similar requirements. They are:

1. Qualified Sources of Materials
2. Approved Materials
3. Qualified Materials
4. Approved Traffic Control Devices and Materials
5. Qualified Traffic Control Devices and Materials

The Alabama Department of Transportation Product Evaluation Board has final authority for addition or removal of products from these lists. The Bureau of Materials and Tests duplicates and disseminates these lists.

General information concerning materials, sources, and devices with special acceptance requirements is contained in ALDOT-355. Information concerning items on these lists or how to get an item onto one of these lists may be obtained by contacting:

Alabama Department of Transportation
Bureau of Research and Development
1409 Coliseum Boulevard
Montgomery, AL 36130-3050
(334) 206-2240

106.02 Samples, Tests, Cited Specifications.

(a) GENERAL.

All material used in the work shall be inspected, tested and approved by the Engineer, Inspection and testing shall be in accordance with the current Departmental Testing Manual. Any work in which untested materials are used without approval or written permission of the Engineer shall be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be paid for and, if directed by the Engineer, shall be removed at the Contractor's expense. The Engineer may permit use prior to sampling and testing of certain materials accompanied by a signed materials guaranty on the form furnished by the Department guaranteeing the material conforms to Departmental Specifications. Such material may be tested at any time and, if found unsatisfactory, shall be removed and replaced with satisfactory material at no additional cost to the Department. The Engineer reserves the right to refuse permission for use of materials on the guaranty basis at any time.

The Contractor shall furnish the Department, free of charge, ample quantities of such samples as are necessary or required by the Engineer to test adequately any and all materials. Any damage caused by in-place testing when such is specified shall be repaired by the Contractor without additional compensation. Samples will be taken by or under the supervision of a representative of the Engineer. Required or designated tests will be made by and at the expense of the State unless otherwise noted on the plans or in the specifications, in accordance with the most recent standard, interim, or tentative standard methods of ALDOT, AASHTO, ASTM or F.S.S. in force and on file with the Department at the date of advertisement for bids, indicated date of adoption notwithstanding, except where standard or special drawings are included in the plans. Then the AASHTO, ASTM, or F.S.S. in effect on the date of the latest revision to the drawing shall govern.

(b) PLANT INSPECTION.

The Engineer may undertake the inspection of materials at the source. Manufacturing plants may be inspected periodically for compliance with specified manufacturing methods and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This may be the basis for acceptance of manufactured lots as to quality.

In the event plant inspection is undertaken, the following conditions shall be met:

1. The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted for materials.
2. The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of materials being furnished.
3. If required by the Engineer, the Contractor shall arrange for an approved building for the use of the Inspector; such building to be located conveniently near the plant, independent of any building used by the material producer, and conforming to requirements of Article 106.03.
4. Adequate safety measures are to be provided and maintained. It is understood that the Department reserves the right to retest all materials prior to incorporation into the work which have been tested and accepted at the source of supply, after the same have been delivered, and to reject all materials which, when retested, do not meet the requirements of these specifications or those established for the specific project.

(c) SUPPLY OF TESTED MATERIALS.

The Contractor shall regulate his supply so that at all times there will be a sufficient quantity of tested and accepted materials on hand to prevent any delay to the work.

106.03 Field Laboratories.

(a) GENERAL.

The laboratories furnished for use shall be roofed, insulated and weather tight with suitable operational air-conditioning and heating facilities for year-round use. Each unit shall be wired for electrical service and in addition the following minimum requirements are applicable to the particular type of laboratory required.

Compensation for the field laboratories shall be in accordance with Section 601.

(b) BASE, SOIL AND STRUCTURE LABORATORIES.

This type laboratory shall contain not less than 200 square feet {18.5 square meters} of floor space (minimum width 8 feet {2.4 m}) with a 7 foot {2.1 m} (minimum) ceiling height and shall contain suitable work benches and drawers. The laboratory shall be portable and shall be independent of other buildings or office space used by the Contractor. It shall have not less than two windows and one outside door, both of which shall be screened and of adequate size to facilitate ventilation of the unit. Location of the laboratory shall be as directed by the Engineer. In addition each unit shall be provided with the following equipment:

1. Double sink with running water (minimum 100 gallon {375 liter} supply).
2. Lights, when requested by the Engineer.
3. Three laboratory burners (one combined unit or separate) (gas type shall have minimum capacity to supply the burners five working days).
4. Laboratories for use at rock crushing operations shall also include an approved mechanical shaking machine for screening samples and shall have power for operating the machine.

Cabinets and shelving shall be provided as appropriate.

(c) CONCRETE PLANT LABORATORIES.

Concrete plant laboratories shall contain not less than 200 square feet {18.5 square meters} of floor space. These laboratories shall have a minimum width of not less than 10 feet {3 m} with a 7 foot {2.1 m} (minimum) ceiling height and shall contain suitable work benches and drawers. A waiver of the 10 foot {3 m} width requirement may be granted for mobile, trailer type laboratories after an inspection of the lab's suitability has been made and approved. The laboratory may be a portable, a permanent, or a partitioned portion of a permanent structure provided it meets the requirements of these specifications. The unit shall be independent of plant storage, office space, etc., and shall have one private entrance door that can be secured. The laboratory shall be located as directed by the Engineer with window space suitable to the Engineer for periodic observation of plant operations. All outside windows and doors shall be screened. In addition each shall be provided with the following equipment:

1. Single sink with running water (minimum 100 gallon {375 liter} supply).
2. One laboratory burner or oven.
3. Lights.
4. Shelves and cabinets shall be provided as appropriate.

(d) ASPHALT PLANT LABORATORIES.

Asphalt plant laboratories shall contain not less than 450 square feet {41.8 square meters} of floor space and shall be of sufficient size to allow the required independent laboratory equipment to be used simultaneously by the contractor and the state. These laboratories shall have a minimum width of not less than 10 feet {3 m} with a 7 foot {2.1 m} (minimum) ceiling height and shall contain suitable work benches and drawers. A waiver of the 10 foot {3 m} width requirement may be granted for mobile, trailer type laboratories after an inspection of the lab's suitability has been made and approved. The laboratory may be a portable, a permanent, or a partitioned portion of a permanent structure provided it meets the requirements of these specifications. The unit shall be independent of plant storage, office space, etc., and shall have at least one private entrance door that can be secured. The laboratory shall be located as directed by the Engineer with window space suitable to the Engineer for periodic observation of plant operations. In addition each shall be provided with the following equipment:

1. Single sink with running water (minimum 100 gallon {375 liter} supply).
2. One laboratory burner or oven.
3. Lights.
4. Shelves and cabinets shall be provided as appropriate.
5. All asphalt plant laboratories shall be equipped with an exhaust fan, sufficiently sized and located to effectively clear the laboratory of smoke and fumes in a reasonable, in the judgment of the Engineer, amount of time. All asphalt laboratories shall also be equipped with all applicable equipment listed in ALDOT-349.

106.04 Contractor's Statement of Material Sources.

Before work on any contract is started, the Contractor may be required to furnish a complete statement of the origin, composition and manufacture of any or all materials proposed to be used in

the construction of the work, together with samples which may be subjected to the tests provided in the contract to determine their quality and fitness for the work.

106.05 Handling and Storage of Materials.

(a) HANDLING MATERIALS.

All materials shall be handled in such a manner as to preserve their quality and fitness for the work. Aggregates shall be transported from the storage site to the work in tight vehicles so constructed as to prevent loss or segregation of materials after loading and measuring in order that there may be no inconsistencies in the quantities of materials, intended for incorporation in the work, as loaded and the quantities as actually received at the place of operations.

(b) STORAGE OF MATERIALS.

Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the right of way may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space required therefor must be provided by the Contractor at his expense. Private property shall not be used for storage purposes without written permission of the owner or lessee, and if requested by the Engineer copies of such written permission shall be furnished him. All storage sites shall be restored to their original condition by the Contractor at his expense. This shall not apply to the stripping and storing of topsoil, or to other materials salvaged from the work.

106.06 Unacceptable Materials.

All materials not conforming to the requirements of the Specifications shall be considered as unacceptable and all such materials will be rejected and shall be removed immediately from the site of the work unless otherwise instructed by the Engineer. No rejected material, the defects of which have been corrected, shall be used until approval has been given.

In case of failure by the Contractor to comply promptly with any order by the Engineer to remove rejected materials, the Engineer shall have authority to have such rejected materials removed by other means and to deduct the expense of such removal from any monies due or to become due the Contractor.

106.07 Department Furnished Material.

The Contractor shall furnish all materials required to complete the work, except those specified to be furnished by the Department.

Material furnished by the Department will be delivered or made available to the Contractor at the points specified in the special provisions.

The cost of handling and placing all materials after they are delivered to the Contractor shall be considered as included in the contract price for the item in connection with which they are used.

The Contractor will be held responsible for all material delivered to him, and deductions will be made from any monies due him to make good any shortages and deficiencies, from any cause whatsoever, and for any damage which may occur after such delivery, and for any demurrage charges.

106.08 Rights In and Use of Materials Found on the Right of Way.

The Contractor, upon his written request and written approval of the Engineer, may use on the project, sand, gravel, rock, or other materials determined suitable by the Engineer as may be found in the limits of the regular excavation. The Engineer will make a study of the Contractor's request and shall submit to the Contractor a written statement of the guidelines under which the request is approved. This statement shall include a detailed analysis of the pay item, or items, under which the Contractor will receive payment for the work performed. The intent is not to preclude payment for both the item of removal and the item under which the materials are used, if, in the opinion of the Engineer payment under both items are justified, but to allow the Department to share in any savings realized by the Contractor in the use of such materials.

The Contractor shall not excavate or remove any material from within the highway location that is not within the grading limits, as indicated by the slope and grade lines, without written authorization from the Engineer.

Any coal or other valuable mineral found within the construction limits as defined by the slope and grade lines considered to be unsuitable for reuse on the project shall be removed by the Contractor. In no case shall any coal or other mineral be removed from outside the slope lines or below subgrade except that removed as unsuitable material as directed by the Engineer (not to exceed 30 inches

{750 mm} below subgrade), unless otherwise shown by plan details or with written authorization of the Transportation Director. The Contractor shall assume full responsibility and liability for insuring that any legal rights due the holder of the mineral rights are satisfied prior to the disposition of any mineral. By agreement with the owner of the mineral rights, the Contractor may dispose of this material by direct sale and payment of royalty to the owner or by stockpiling for immediate removal by the owner. The Contractor shall hold the State harmless in all matters pertaining to the disposition of any mineral.

106.09 Quality Control and Quality Assurance (QC/QA) Requirements for Hot Mix Asphalt (HMA) Pavement.

(a) GENERAL.

The following modifications apply only to the materials and work performed under Sections 327 (327-E, Permeable Asphalt Treated Base only), 410, 420, 423, 424 and 429.

In all cases, the Department's testing will be separate from the Contractor's testing and both shall be conducted by certified technicians.

All **Quality Control** aspects of this provision shall be the responsibility of the Contractor. Quality Control is defined as the activities that are related to the production of Hot Mix Asphalt Pavement which meet all the requirements of the Specifications, including mix design, process control testing, sampling and acceptance testing (when so designated by the Department) for determination of Pay Factors, and necessary adjustments to the production process.

All **Quality Assurance** aspects of this provision shall be the responsibility of the Department and will be accomplished in the following ways:

1. By conducting assurance/verification testing, on a random basis, of independent samples obtained by the Department, at a frequency of one or more per day;
2. By periodically observing tests performed by the Contractor;
3. By monitoring required Contractor control charts exhibiting test results of control parameters.

Any Superpave Gyratory Compactor may have its angle of gyration verified by the Engineer following the procedure in ALDOT 404, "Evaluating the Superpave Gyratory Compactor's (SGC's) Angle of Gyration using the FHWA SGC Angle Validation Kit". This includes all design, quality control, and quality assurance SGC's. The average Peak-to-Peak 1/2 angle Average Summary should be validated to be 1.25 +/- 0.05 degrees (between 1.20 & 1.30 degrees). This should be done using standard mixes supplied by the State. If the SGC can not meet this specification, adjustments to the SGC’s angle of gyration may be required.

(b) QUALITY CONTROL.

The Contractor shall provide and maintain a quality control system that will provide reasonable assurance that all materials, products, and completed construction submitted for acceptance conform to contract requirements whether manufactured or processed by the Contractor or procured from subcontractors or vendors. Quality control managers, laboratory technicians and roadway technicians will be certified by the Department as outlined in ALDOT-374, "Certification Requirements for Hot Mix Asphalt Technicians". This quality control system shall conform to ALDOT-375, "Contractor Quality Control System for Hot Mix Asphalt". Sampling and testing frequencies are shown in Table I.

TABLE I **SECTION 327-E and 420 MIXES**

SAMPLING AND TESTING REQUIREMENTS FOR QC/QA PROJECTS

Control Parameter	Sample Size	Sampling Methods	Sampling Location	Testing Methods	ALDOT Testing Frequency	Contractor Testing Frequency
1. Asphalt Content *	ALDOT Sample = 55 lb {25 kg} Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-354 or AASHTO TP53 +++	1 per LOT	++ 1 per increment of production tonnage
2. Mixture Gradation * *	Contractor Sample = 55 lb {25 kg} Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-371 AASHTO TP53	1 per LOT	1 per increment of production tonnage

* See ALDOT-353 Determining H.M.A. Laboratory Quality Control / Assurance Parameters.

* * If the test results are out of specification tolerance on two consecutive tests for the same size sieve, production shall cease until proper plant adjustments are made.

\+ Beginning each production day, no sample for acceptance purposes shall be taken prior to the production of 50 tons. If the random number selected falls within the first 50 tons, the sample shall be taken from the first loaded truck following the truck containing the fiftieth ton produced.

++ The testing frequency for mainline paving (including shoulders, ramps, acceleration/deceleration lanes and uniform thickness leveling), unless otherwise noted on the plans, shall be one sample of 55 lb {25 kg) for each 700 tons {700 metric tons} or fraction thereof.

The testing frequency for other than mainline paving (patching, widening, crossovers, and non-uniform leveling shall be one sample of 55 lb {25 kg) for each 400 tons {400 metric tons} or fraction thereof.

Note: The testing increment shall have a 150 ton buffer between each increment.

+++ Under AASHTO TP53, mixture calibration shall be used. The ignition furnace shall be equipped with an internal weighing system with microprocessor control where sample weight {mass} and percent weight {mass} loss is computed and produced on hard-copy output.

TABLE I (*CONT'D.*) SECTION 423 MIXES (*STONE MATRIX ASPHALT*)

SAMPLING AND TESTING REQUIREMENTS FOR QC/QA PROJECTS

Control Parameter	Sample Size	Sampling Methods	Sampling Location	Testing Methods	ALDOT Testing Frequency	Contractor Testing Frequency
1. Asphalt Content *	ALDOT Sample = 90 lb {40 kg} Split into 2 equal samples Contractor Sample = 90 lb {40 kg} Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-354 or AASHTO TP53 ++++	1 per LOT	++ 1 per set of Marshall samples
2. Maximum Specific Gravity *		AASHTO T 168 & ALDOT-210	+ Loaded Truck	AASHTO T 209 (Flask determination with dry back)	1 per LOT	++ 1 per set of Marshall samples
3. Air Void Content & VMA * and Marshall Stability & Flow		AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-353 & ALDOT-307	1 per LOT As needed	++ 1 per set of Marshall samples Marshall Stability & Flow- 1 test per Production lot
4. Mixture Gradation * * *		AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-371 AASHTO TP53	1 per LOT	1 per set of Marshall samples
5. Retained Tensile Strength	25 lb {12 kg}	AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-361	1 set of 6 for each test strip(s) and 1 set of 6 for the next 10,000 tons {10,000 metric tons} thereafter 1 set of 6 for each additional 20,000 tons {20,000 metric tons} or portion thereafter	1 set of 6 for each test strip(s) and 1 set of 6 for the next 10,000 tons {10,000 metric tons} thereafter 1 set of 6 for each additional 20,000 tons {20,000 metric tons} or portion thereafter
6. Mat Density *		ALDOT-210	Roadway	ALDOT-222 & ALDOT-350 AASHTO T 166 ALDOT-403	1/2000 lane feet/lift	1/1000 lane feet/lift {1/300 lane m/lift} ° ° 1/5000 lane feet/lift {1/1500 lane m/lift}
7. Clay Content	Adequate Quantity	AASHTO T 2	Aggregate Stockpiles	AASHTO T 176	As required	As required

* See ALDOT-353 Determining H.M.A. Laboratory Quality Control / Assurance Parameters.

* * If the test results are out of specification tolerance on two consecutive tests for the same size sieve, production shall cease until proper plant adjustments are made.

° ° Cores shall be taken by the Contractor and the density will be determined by the Department.

\+ Beginning each production day, no sample for acceptance purposes shall be taken prior to the production of 50 tons {50 metric tons}. If the random number selected falls within the first 50 tons {50 metric tons}, the sample shall be taken from the first loaded truck following the truck containing the fiftieth ton {fiftieth metric ton} produced.

++ The testing frequency for mainline paving (including shoulders, ramps, acceleration/deceleration lanes and uniform thickness leveling), unless otherwise noted on the plans, shall be one set of three Marshall samples+++ for each 700 tons {700 metric tons} or fraction thereof.

The testing frequency for other than mainline paving (patching, widening, crossovers, and non-uniform leveling shall be one set of three Marshall samples+++ for each 400 tons {400 metric tons} or fraction thereof.

Note: The testing increment shall have a 150 ton buffer between each increment.

+++ When slag is used as an aggregate in the mixture, four Marshall samples shall be compacted. The test result the furthest away from the average of the four test results shall be discarded and the remaining three test results shall be averaged for use in the computation of air voids.

++++ Under AASHTO TP53, mixture calibration shall be used. The ignition furnace shall be equipped with an internal weighing system with microprocessor control where sample weight {mass} and percent weight {mass} loss is computed and produced on hard-copy output.

TABLE I (*CONT'D.*) SECTION 424 MIXES (*SUPERPAVE*)
SAMPLING AND TESTING REQUIREMENTS FOR QC/QA PROJECTS

Control Parameter	Sample Size	Sampling Methods	Sampling Location	Testing Methods	ALDOT Testing Frequency	Contractor Testing Frequency
1.Asphalt Content *	ALDOT Sample = 135 lb {60 kg} Split into 2 equal samples Contractor Sample = 135 lb {60 kg} Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-354 or AASHTO TP53 ++++	1 per LOT	++ 1 per set of gyratory samples
2. Maximum Specific Gravity *		AASHTO T 168 & ALDOT-210	+ Loaded Truck	AASHTO T 209 (Flask determination with dry back)	1 per LOT	++ 1 per set of gyratory samples
3. Air Void Content & VMA and % G_{mm} @ N_i, N_d *		AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-384 ALDOT-388 ALDOT-353	1 per LOT As needed	++ 1 per set of gyratory samples
4. Mixture * * * Gradation & Dust to Asphalt Ratio *		AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-371 AASHTO TP53	1 per LOT	1 per set of gyratory samples
5. Retained Tensile Strength	25 lb. {12 kg}	AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-361	1 set for each test strip(s) and 1 set for the next 10,000 tons {10,000 metric tons} thereafter 1 set for each additional 20,000 tons {20,000 metric tons} or portion thereafter	1 set for each test strip(s) and 1 set for the next 10,000 tons {10,000 metric tons} thereafter 1 set for each additional 20,000 tons {20,000 metric tons} or portion thereafter
6. Mat Density *		ALDOT-210	Roadway	ALDOT-222 & ALDOT-350 AASHTO T 166 ALDOT-403	1/2000 lane feet/lift {1/600 lane m/lift}	1/1000 lane feet/lift {1/300 lane m/lift} °° 1/5,000 lane feet/lift {1/1500 lane m/lift}
7. Fine Aggregate Angularity * *	Adequate quantity to run AASHTO T 304, Method A or ASTM C 1252,Method A	AASHTO T 2	+ Loaded Truck	AASHTO T 304, Method A Or ASTM C 1252, Method A	1 for each test strip(s) and 1 for the next 10,000 tons {10,000 metric tons} thereafter 1 for each additional 20,000 tons {20,000 metric tons} or portion thereafter	1 for each test strip(s) and 1 for the next 10,000 tons {10,000 metric tons} thereafter 1 for each additional 20,000 tons {20,000 metric tons} or portion thereafter
8. Clay Content	Adequate quantity	AASHTO T 2	Stockpile	AASHTO T 176	As required	As required

* See ALDOT-353 Determining H.M.A. Laboratory Quality Control / Assurance Parameters.

* * In virgin mixes, the sample may be taken from the cold feed conveyor.

*** If the test results are out of specification tolerance on two consecutive tests for the same size sieve, production shall cease until proper plant adjustments are made.

°° Cores shall be taken by the Contractor and the density will be determined by the Department.

\+ Beginning each production day, no sample for acceptance purposes shall be taken prior to the production of 50 tons {50 metric tons}. If the random number selected falls within the first 50 tons {50 metric tons}, the sample shall be taken from the first loaded truck following the truck containing the fiftieth ton {fiftieth metric ton} produced.

++ The testing frequency for mainline paving (including shoulders, ramps, acceleration/deceleration lanes and uniform thickness leveling),unless otherwise noted on the plans, shall be one set of two gyratory samples+++ for each 700 tons {700 metric tons} or fraction thereof.

The testing frequency for other than mainline paving (patching, widening, crossovers, and non-uniform leveling shall be one set of two gyratory samples+++ for each 400 tons {400 metric tons} or fraction thereof.

Note: The testing increment shall have a 150 ton buffer between each increment.

+++ When slag is used as an aggregate in the mixture, three gyratory samples shall be compacted. The test result the furthest away from the average of the three test results shall be discarded and the remaining two test results shall be averaged for use in the computation of air voids.

++++ Under AASHTO TP53, mixture calibration shall be used. The ignition furnace shall be equipped with an internal weighing system with microprocessor control where sample weight {mass} and percent weight {mass} loss is computed and produced on hard-copy output.

TABLE I (*CONT'D*) SECTION 429 MIXES (*IMPROVED BITUMINOUS*)

SAMPLING AND TESTING REQUIREMENTS FOR QC/QA PROJECTS

Control Parameter	Sample Size	Sampling Methods	Sampling Location	Testing Methods	ALDOT Testing Frequency	Contractor Testing Frequency
1.Asphalt Content *	ALDOT Sample = 90 lb {40 kg} Split into 2 equal samples Contractor Sample = 90 lb {40 kg} Split into 2 equal samples	AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-354 or AASHTO TP53 ++++	1 per LOT	++ 1 per set of Marshall samples
2. Maximum Specific Gravity *		AASHTO T 168 & ALDOT-210	+ Loaded Truck	AASHTO T 209 (Flask determination with dry back)	1 per LOT	++ 1 per set of Marshall samples
3. Air Void Content & VMA and Marshall Stability & Flow *		AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-353 & ALDOT-307	1 per LOT As needed	++ 1 per set of Marshall samples Marshall Stability & Flow- 1 test per production lot
4. Mixture * * * Gradation & Dust to Asphalt Ratio *		AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-371 AASHTO TP53	1 per LOT	1 per set of Marshall samples
5. Retained Tensile Strength	25 lb {12 kg}	AASHTO T 168 & ALDOT-210	+ Loaded Truck	ALDOT-361	1 set of 6 for each test strip(s) and 1 set of 6 for the next 10,000 tons {10,000 metric tons} thereafter 1 set of 6 for each additional 20,000 tons {20,000 metric tons} or portion thereafter	1 set of 6 for each test strip(s) and 1 set of 6 for the next 10,000 tons {10,000 metric tons} thereafter 1 set of 6 for each additional 20,000 tons {20,000 metric tons} or portion thereafter
6. Mat Density *		ALDOT-210	Roadway	ALDOT-222 & ALDOT-350 AASHTO T 166 ALDOT-403	1/2000 lane feet/lift {1/600 lane m/lift}	1/1000 lane feet/lift {1/300 lane m/lift} ° ° 1/5000 lane feet/lift {1/1500 lane m/lift}
7. Fine Aggregate Angularity * *	Adequate quantity to run AASHTO TP33-93, Method A or ASTM C 1252, Method A	AASHTO T 2	+ Loaded Truck	AASHTO TP33-93, Method A or ASTM C 1252, Method A	1 for each test strip(s) and 1 for the next 10,000 tons {10,000 metric tons} thereafter 1 for each additional 20,000 tons {20,000 metric tons} or portion thereafter	1 for each test strip(s) and 1 for the next 10,000 tons {10,000 metric tons} thereafter 1 for each additional 20,000 tons {20,000 metric tons} or portion thereafter
8. Clay Content	Adequate Quantity	AASHTO T 2	Aggregate Stockpiles	AASHTO T 176	As required	As required

* See ALDOT-353 Determining H.M.A. Laboratory Quality Control / Assurance Parameters.

* * In virgin mixes, the sample may be taken from the cold feed conveyor.

*** If the test results are out of specification tolerance on two consecutive tests for the same size sieve, production shall cease until proper plant adjustments are made.

° ° Cores shall be taken by the Contractor and the density will be determined by the Department.

\+ Beginning each production day, no sample for acceptance purposes shall be taken prior to the production of 50 tons {50 metric tons}. If the random number selected falls within the first 50 tons {50 metric tons}, the sample shall be taken from the first loaded truck following the truck containing the fiftieth ton {fiftieth metric ton} produced.

++ The testing frequency for mainline paving (including shoulders, ramps, acceleration/deceleration lanes and uniform thickness leveling), unless otherwise noted on the plans, shall be one set of three Marshall samples+++ for each 700 tons {700 metric tons} or fraction thereof.

The testing frequency for other than mainline paving (patching, widening, crossovers, and non-uniform leveling shall be one set of three Marshall samples+++ for each 400 tons {400 metric tons} or fraction thereof.

Note: The testing increment shall have a 150 ton buffer between each increment.

+++ When slag is used as an aggregate in the mixture, four Marshall samples shall be compacted. The test result the furthest away from the average of the four test results shall be discarded and the remaining three test results shall be averaged for use in the computation of air voids.

++++ Under AASHTO TP53, mixture calibration shall be used. The ignition furnace shall be equipped with an internal weighing system with microprocessor control where sample weight {mass} and percent weight {mass} loss is computed and produced on hard-copy output.

(c) QUALITY ASSURANCE.

1. ACCEPTANCE PROCEDURES.

All materials will be evaluated for acceptance through the Department's Acceptance Procedures specified herein. The Department will be responsible for determining the acceptability of the construction and materials incorporated therein. The Department will utilize test results from the Contractor's QC System for acceptance purposes. In addition, the Department will conduct limited testing and monitor and observe the Contractor's sampling and testing procedures to verify the data

used for acceptance purposes. The Department's data will be compared with data from the Contractor's QC system as described in Item 3 below and Subarticle 410.08(c) to verify computed test result values to be used in the computation of LOT pay factors. Acceptance test sampling and testing will be conducted on a random basis according to frequencies shown in Table I. The Department will determine the point in production for sampling at the plant (for mixture testing) and the locations for sampling and testing on the roadway (for mat density testing).

All conforming and nonconforming inspections and test results will be monitored in accordance with ALDOT-370 and shall be recorded on approved forms and charts which shall be kept up to date and complete and shall be available at all times to the Department during the performance of the work. Only those tests designated by the Department in advance as acceptance tests will be utilized in the computation of pay factors. Test properties shall be charted on forms that are in accordance with the applicable requirements of the Department. A copy of each chart and form to be used by the Contractor will be furnished by the Department. The Contractor shall furnish his own supply of the charts and forms. The Contractor or Producer may design their own forms and charts; however, these must be approved by the Engineer prior to their use.

A LOT is normally defined as one day's production. Each LOT shall be accepted on the basis of the actual number of test sets run for that LOT. If the decision to terminate a LOT is made during the production of a yet unsampled LOT, samples for asphalt content and air voids content will be immediately taken prior to LOT termination.

All sampling, testing and computations for a LOT will be completed and pay factors provided the Contractor as soon as possible.

All sampling and testing of materials, including frequency of samples and tests for the Contractor's Quality Control and the Department's verification shall be performed in strict conformance with the Department's Testing Manual as modified in Table I. This Manual, developed and distributed by the Bureau of Materials and Tests, contains guidance for sampling and testing procedures from AASHTO, ASTM and ALDOT procedures.

2. ACCEPTANCE OR REJECTION.

The decision of the Engineer will be final as to the acceptance, rejection, or acceptance at an adjusted payment of each LOT. Rejected LOTS shall be removed at no cost to the Department and replaced at the contract unit bid price.

3. SAMPLING OF LOTS AND SUBLOTS.

It is the intent of these specifications that each LOT (for mixture testing) and each SUBLOT (for mat density testing) will meet specification requirements at the time of initial evaluation. No resampling or retesting (other than referee testing described below) will be allowed. The Department will, however, perform at least one liquid asphalt binder content, one maximum specific gravity and one set of three laboratory compacted air void content tests per day, as specified in Table I, to verify the Contractor's test results.

The Contractor will be notified by the Engineer as to the point in production at which to procure mixture acceptance samples. The Contractor shall sample the mixture and split it into two samples: the Contractor's primary sample and a referee sample. The portions of mixture for the referee sample shall be bagged, labeled and stored for testing, if required. All referee samples will be kept by the Department until they are tested (if required). The Contractor shall obtain a sample for each Lot for verification testing by the Department. These samples shall be taken independently from the Contractor’s sample at locations directed by the Engineer. The verification sample will be split into two samples: the Department’s sample and a Contractor verification sample. The sampling of Hot Mix Asphalt is outlined in ALDOT-380, Forms and Examples for Sampling and Computing Pay Factors for Hot Mix Asphalt.

4. TESTING AND LOT VERIFICATION.

Air voids shall be computed on the Contractor’s primary sample by using the running average of the Contractor’s last four maximum specific gravities. If slag is used as an aggregate in the mixture, the running average of the Contractor’s four most recent determinations for the bulk specific gravity of the compacted mixture shall be used in the computation of the air voids for the Contractor’s primary sample. Air voids shall be computed on the Department’s verification sample by using the Department’s individual maximum specific gravity and bulk specific gravity. The Department and the Contractor shall compare test results with each other for the above mentioned testing increments. If there are no differences or if the differences are within the tolerances listed in Table V, Section 410,

for each parameter, no further testing and analysis will be necessary and the Contractor's test values will be used in the computation of the appropriate LOT pay factor.

If the results of the Department's verification test and the Contractor's primary test do not compare within the tolerances in Table V, Section 410, but yield the same pay factor for the LOT when the Department's result is substituted for the Contractor's result, no further testing will be required. Also, if the Contractor's air voids do not compare with the Department's test results, the Contractor shall re-compute test results using the individual maximum specific gravity for that particular testing increment and re-compare with the verification test result. If the results compare within the tolerances in Table V, Section 410, using the individual maximum specific gravities, no further testing will be required and the Contractor's running average of the last four maximum specific gravities will be used to compute air voids for pay factor determination.

When differences between test results of the verification samples are not within the tolerances listed in Table V, Section 410, and can not be resolved by the above mentioned methods, referee testing will be required. All referee samples will be tested by the Bureau of Materials and Tests, Central Laboratory, 3704 Fairground Road, Montgomery, AL 36110. The Bureau of Materials and Tests Central Laboratory is an AASHTO accredited laboratory (see AASHTO R 18, Recommended Practice for Establishing and Implementing a Quality System for Construction Materials Testing Laboratories).

5. REFEREE TESTING.

All testing increments of the referee samples for the entire LOT shall be tested in the Bureau of Materials and Tests Hot Mix Laboratory for the parameter(s) in question (liquid asphalt binder content and/or laboratory compacted air voids). The Contractor's results (using the individual bulk and maximum specific gravities) will be compared to the Bureau of Materials and Tests results (using Materials and Tests individual bulk and maximum specific gravities) for each testing increment in the LOT. When the Contractor's results and the Bureau of Materials and Tests results are within the tolerances listed in Table V, Section 410, the Contractor's results will be used. When the Contractor's results are not within the tolerances listed in Table V, Section 410, the Bureau of Materials and Tests Central Laboratory results will be used for final pay factors. The Bureau of Materials and Tests Central Laboratory will record the Contractor's field results and the Central Laboratory's results of the parameter(s) in question on form BMT-135.

For each testing increment these results, either the Contractor's or the Bureau of Materials and Tests' will be used in the computation of the appropriate LOT pay factor.

Should differences between test results, that are not within the tolerances listed in Table V, Section 410, for liquid asphalt binder content and air voids continue for two consecutive days, operations shall be halted until testing discrepancies can be resolved. The Bureau of Materials and Tests will monitor testing procedures by Department and Contractor technicians until consistent test results are achieved.

6. ADJUSTED PAYMENT FOR DEFICIENCIES.

The payment for each LOT will be adjusted on the basis of acceptance test results in accordance with the requirements of this special provision. Accurate records shall be kept of the quantity (tonnage) of plant mix in each LOT

Pay factors shall be determined for each Lot from the values given in Tables II, III and IV, Section 410, in accordance with the following:

Pay Factor For:	Mix 327E	Mix 420	Mix 423	Mix 424	Mix 429
Air Voids	N/A	N/A	Table II	Table III	Table II
Asphalt Content	Table II	Table II	Table II	Table III	Table II
Mat Density	N/A	N/A	Table IV	Table IV	Table IV

The lowest numerical pay factor will be applied to the total tonnage {metric tonnage} in each LOT resulting in an adjusted quantity for the LOT for payment purposes. The adjusted quantity will be used to compute payment by applying the appropriate contract unit bid price.

Pay factors above 1.00 will not be applied to mixes that are tested on fewer than three characteristics. When the pay factor is calculated to be greater than 1.00, a pay factor of 1.00 will be applied.

(d) ADJUSTMENT PERIOD.

During start-up operations, an adjustment period as described below shall be utilized to begin production. An adjustment period will be required when production of a new job mix formula is started. The purpose of the adjustment period will be to permit the Contractor to adjust his production

process and for Contractor QC personnel and ALDOT QA personnel to calibrate and coordinate their testing procedures.

A test strip of 500 tons {500 metric tons} shall be constructed. Production shall stop until the Contractor has completed one liquid asphalt binder content, one void content, and four mat density tests. The production point at which the mix shall be sampled shall be determined by the Contractor. This sample does not have to be randomly selected, but should be representative of the mix produced. Mat density tests shall be performed with nuclear density gages that have been calibrated for the layer being placed according to ALDOT-222 or ALDOT-350. Also, the Contractor shall put up one TSR test on this test strip. However, the plant may resume production before the TSR results are completed provided the Contractor uses a previously approved job mix that has produced satisfactory TSR results or executes Form BMT-73, Materials Guaranty. The Department will conduct the same tests for verification at the same time the Contractor is conducting his tests. If a pay factor of less than 1.00 is obtained, a second test strip consisting of 200 tons {200 metric tons} shall be constructed. If a pay factor of less than 1.00 is obtained in the second test strip, additional 200 ton {200 metric ton} test strips shall be constructed until pay factors are equal to 1.00, at which time production can begin.

The Engineer reserves the right to have any test strip removed at no cost to the Department and replaced if the pay factor for any characteristic for the test strip is 0.80. For actual payment purposes, a pay factor of 1.00 will be used for all first and second test strips allowed to remain in place. Pay factors will be applied to the third and all subsequent 200 ton test strips at the average of the computed rate and 1.00.

No contract time will be charged during an adjustment period provided that the pavement operation is the controlling item of work.

SECTION 107
LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

107.01 Laws to be Observed.

The Contractor shall keep fully informed of all Federal and State laws, all local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. He shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the State and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by himself or his employees.

The Contractor shall provide for the safety of his employees and the public along with protection of property in the performance of the work. Particular reference is made to the Federal Occupation Safety and Health Act Title 29, CFR Part 1926 (Published December 16, 1972, and all applicable amendments) for construction work and Part 1910 (Published May 29, 1971, and all applicable amendments) for general industry standards for those materials not covered in Part 1926, which is a condition of the contract and shall be a condition of any subcontract entered into pursuant thereto.

All ocean shipping of materials and products used on Federal-aid highway projects shall comply with the requirements of Part 381, Title 46, CFR. The prime Contractor shall submit copies of all commercial ocean bills of lading to the Maritime Administration in Washington at the following address:

Chief, Division of National Cargo MAR 822
Maritime Administration
400 7th Street, S.W.
Washington, DC

The Contractor's letter of transmittal shall show his address, the project number, project location, and the type materials involved.

107.02 Permits, Licenses and Taxes.

The Contractor shall procure all permits, and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work.

107.03 Patented Devices, Materials, and Processes.

If the Contractor employs any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The

Contractor and the Surety shall indemnify and save harmless the State, any affected third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the State for any costs. expenses, and damages which it may be obliged to pay by reason of an infringement, at any time during the prosecution or after the completion of the work.

107.04 Restoration of Surfaces Opened by Permit.

The right to construct or reconstruct any utility service in the highway or street or to grant permits for same, at any time, is hereby expressly reserved by the Department for the proper authorities of the municipality in which the work is done.

When an individual, firm or corporation is authorized through a duly executed permit from the Department, the Contractor shall allow parties bearing such permits, and only those parties, to make openings in the highway. When ordered by the Engineer, the Contractor shall make in an acceptable manner, all necessary repairs due to such openings and such necessary work will be paid for as extra work, or as provided in these specifications, and will be subject to the same conditions as original work performed.

107.05 Federal Aid Participation.

When the United States Government participates in the cost of the work covered by the contract, the work shall be under the supervision of the State but subject to the inspection and approval of the proper officials of the United States Government and in accordance with the applicable Federal Statutes and rules and regulations made pursuant thereto (Reference Title 23, U.S. Code as amended).

Such inspection shall in no sense make the Federal Government a party to this contract and will in no way interfere with the rights of either party hereunder.

The Contractor and Subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of 49 CFR 26 in the award and administration of USDOT assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy, as the ALDOT deems appropriate.

107.06 Sanitary, Health and Safety Provisions.

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements of the State and local Board of Health, or of other bodies or tribunals having jurisdiction.

Attention is directed to Federal, State and local laws, rules and regulations concerning construction safety and health standards. The Contractor shall not require any worker to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his health or safety.

107.07 Public Convenience and Safety.

(a) CARE OF TRAFFIC.

The Contractor shall at all times conduct his work so as to insure the least possible obstruction to traffic. The safety and convenience of the general public and residents along the highway shall be provided for by the Contractor as specified under Article 104.04.

The Contractor shall have no greater length or amount of work under construction than he can prosecute properly with due regard to the rights of the public.

The Contractor shall immediately clean up any spillage resulting from hauling operations along or across any public traveled way.

The Contractor shall notify the Engineer before starting any construction work that might inconvenience or endanger traffic and shall make such arrangements for the safety and convenience of traffic as may be required by the Engineer.

(b) GENERAL PUBLIC.

In general, vehicles of the traveling public shall have preference over those of the Contractor to the end that vehicles of the traveling public shall not be unduly delayed for the convenience of the Contractor. When so directed the Contractor shall station flagmen, whose sole duties shall consist of directing traffic safely and expeditiously through or around the work.

Materials and equipment on the right of way shall be so placed as to insure minimum danger to the traveling public.

Where traffic passes through construction, a suitable width shall be maintained level and smooth to provide satisfactory passage. This width shall be watered or treated with dust control agents

as directed to prevent dust nuisance. Soil aggregate, aggregate, or other suitable material shall be spread where and as directed by the Engineer to facilitate movement of traffic over soft portions of this width. Traffic shall be maintained over or around structures and culverts.

(c) COOPERATION WITH FIRE DEPARTMENT.

The Contractor shall arrange his work so that there will be no undue or prolonged blocking of business establishments. Fire hydrants shall be kept accessible at all times. In the absence of local ordinances, no obstruction shall be placed within 15 feet {5 m} of a fire hydrant. The Contractor shall notify the Chief of the Fire Department in writing 24 hours before it becomes necessary to block a cross street.

(d) COMPENSATION.

The Contractor shall comply with all the requirements for public safety and convenience listed in this Article without extra compensation, except for the items of temporary surface material, Section 430, which shall be paid for at the contract unit price, or as extra work if the contract does not contain unit prices for these items.

107.08 Railway-Highway Provisions.

(a) NOTIFICATION.

No work of any character shall be commenced on the railroad right of way until the railroad company has been duly notified by the Contractor in writing (with a copy forwarded to the Engineer) of the date he proposes to begin work and until an authorized representative of the railroad company is present, unless the railroad company waives such requirement.

(b) INSPECTION BY RAILROAD COMPANY.

All changes in approved plans and all work performed by the Contractor involving railroad crossings shall be subject to the inspection and approval of the chief engineer of the railroad company, or his authorized representative. Any precautions considered necessary by said chief engineer to safeguard the interests of the railroad company shall be taken by the Contractor without extra compensation. The State shall not be held responsible for delay to the Contractor's work due to any delay in securing such approval of construction features or changes therefrom; and any additional cost incurred by the Contractor due to such delay shall be considered as completely covered by the contract unit prices for the various items of work involved in the contract. For such delays, working days will not be charged on working day contracts, and appropriate time extensions will be granted for contracts on a calendar day or date basis.

(c) TEMPORARY GRADE CROSSING.

The Contractor shall make all arrangements with Railway Companies for the establishment of any temporary crossing to be used by the Contractor for transporting materials and equipment across their tracks. Permission for such a crossing must be obtained from the Railway Engineer prior to establishment of the crossing. All costs for installation, maintenance, any necessary watching and flagging thereof, and the removal shall be borne by the Contractor. The Contractor shall so plan his work so as not to delay Railroad Company operations.

107.09 Construction Over or Adjacent to Waters of the United States.

(a) GENERAL.

Section 404 of the Federal Water Pollution Control Act of 1972 sets forth certain restrictions and requirements for materials placed in waters of the United States that are applicable to construction over or adjacent to waters of the United States. The Department will obtain any special permits necessary for the construction of the project within the scope of the design details of the contract plans and the specifications for the project. Generally, compliance with the above law can be accomplished by following the plan details along with adhering to the Specification requirements of Articles 107.13, 107.20, 107.21, 107.22 and Section 665, utilizing the methods outlined in Section 665.

The Contractor will be required to operate within the limits of any special permit issued for the construction work on a project.

Attention is directed to the fact that construction methods or work in the flood plain area varying from plan details, specifications and permit proposed strictly for the convenience of the Contractor will require additional permit clearance. Any additional clearance, permit, etc. necessary to comply with the above noted laws shall be the sole responsibility of the Contractor and clearance for such work must be in the Engineer's hands before he will allow such work to proceed.

(b) WORK OVER NAVIGABLE WATERS.

In addition to the provisions of Subarticle (a) above, all work over or on navigable waters shall be so conducted that free navigation of waterways will not be interfered with and that the existing navigable depths will not be impaired except as allowed by permit issued by the U.S. Coast Guard and/or U.S. Army Corps of Engineers, as applicable. The Department will obtain the necessary permit for the construction of the project within the scope of the design details shown by the plans, any special conditions will be noted on the plans or included in the contract documents. Should the Contractor, for his convenience, wish to use construction methods or perform work outside of the scope of the permit obtained by the Department, he shall be solely responsible for obtaining any additional work permit from the appropriate authority.

107.10 Barricades and Warning Signs.

The Contractor shall provide, erect and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs, and other traffic control devices; shall provide qualified flagmen where necessary to direct traffic; and shall take all necessary precautions for the protection of the work and safety of the public. Highways or parts of the work closed to traffic shall be protected by effective barricades; obstructions shall be delineated; suitable warning signs shall be provided to properly control and direct traffic. All signs, barricades, etc. shall be reflectorized in an approved manner and if directed by the Engineer, supplemented with warning lights or illumination to increase their effectiveness.

The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be placed and maintained in accordance with the plans furnished. No signs, barricades, lights or other protective devices shall be dismantled or removed without permission of the Engineer.

All barricades, warning signs, lights, temporary signs, and other protective devices shall conform with the MUTCD.

107.11 Use of Explosives.

(a) GENERAL.

It is the intent of this Article to provide general guides for the handling and use of explosives. The Contractor shall use all precaution, control, and safety features outlined by this Article as well as any additional requirements felt necessary to insure the safety of life or property in the area of operations.

(b) CONTROL.

When the use of explosives is necessary for the prosecution of the work, the Contractor shall use the utmost care not to endanger life or property. Blasting operations shall be performed under the most skilled supervision. Where necessary and at any point of special danger, the Contractor shall use suitable mats or other approved methods to smother his blast. No loaded hole shall be left unattended.

Where blasting is to be done in streams, the Contractor shall notify the Conservation Department sufficiently in advance to permit on-the-site observation by Conservation Department personnel at the time of the blast.

Where blasting is performed in urban areas or areas that are heavily populated, extreme care shall be taken to minimize the amount and degree of ground vibration, noise, overpressure, and flying debris.

(c) STORAGE OF EXPLOSIVES.

All explosives shall be stored in a safe manner, in compliance with local, State, and Federal laws and ordinances.

(d) WARNING OF BLASTING.

The Contractor shall warn each utility company having structures in proximity to the blasting area of his intentions to use explosives. Such warning shall be sufficiently far in advance of blasting to enable the company to protect its property. Such warning, however, shall not relieve the Contractor of responsibility for any damage resulting from blasting. The Contractor shall erect suitable signs on all roads in the immediate vicinity of blasting operations, warning of blasting activity. The signs shall also include warning that all portable radio transmitters should be turned off while in the vicinity. If required, the Contractor shall control traffic by use of flagmen and guards in the danger zone of blasting.

In all urban areas, and other heavily populated areas when designated by the plans or proposal, the Contractor or his insurer shall conduct a pre-blast survey of all structures to determine the existing or preblasting condition, such survey being a written description with special emphasis on defects and documented with appropriate photographs. This survey is intended to serve as a basis of comparison for any post-blast claims that may arise. The Contractor or his insurer shall obtain the services of a competent vibration or seismologist consultant to conduct both blast noise, vibration and overpressure surveys at periodic intervals during the progress of the blasting operations. It is the intent of this Section to serve as protection to the Contractor to minimize the post-blast claims and not to require unwarranted work. The Contractor shall use every precaution available and practical to minimize ground vibration, noise and overpressure.

The Contractor and his surety shall indemnify and save harmless the State, the Director and all its representatives from all claims for damages arising out of the use, transportation, or storage of explosives.

107.12 Protection and Restoration of Property, Landscape and Utility Facilities.

(a) PROPERTY AND LANDSCAPE.

The Contractor shall not enter upon private property for any purposes without first obtaining permission from the owners and lessees. He shall be responsible for preservation of all public and private property, utilities, monuments, highway signs, etc. on or adjacent to the highway. He shall not remove, injure, or destroy without proper authority trees or plants that are shown on the plans or ordered by the Engineer to remain on or adjacent to the right of way. He shall protect from disturbance all land markers until an authorized agent has witnessed or referenced the locations and shall not move them until directed. He shall notify the Engineer immediately upon discovery of artifacts or other articles of possible archeological value revealed by his operations, and shall carefully preserve them and prevent disturbance of the site until the Engineer has had opportunity to arrange appropriate disposal. Highway signs and markers shall be carefully removed as the grading operations progress and stored in a manner to keep them clean and dry.

When the work affects the foundation support of any building along the work, the Contractor shall give property owners and lessees direct and sufficient notice to support such buildings. The Contractor and his surety shall hold the State, the County, the Municipality, the Director, and the Engineer harmless from any damage resulting from undercutting any such buildings.

When any damage is done to public or private property by or due to any act, omission, or negligence of the Contractor he shall make good such damage in an acceptable manner.

(b) UTILITIES.

1. Where the Contractor's operations are adjacent to utilities or other property, damage to which might result in expense, loss, or inconvenience, work shall not be begun until all arrangements necessary for property protection has been made.

The Contractor shall be responsible to the owners and operators of such property for any damage, loss, or inconvenience. He and his surety shall defend any suits, actions, or claims of any character brought due to injuries or damages resulting from performance of the work under this contract. If required by the Director, he shall furnish a certificate of his public liability and property damage insurance to each utility company or individual owning or operating any of the properties affected in the guarantee of this responsibility.

2. The Contractor shall cooperate with the owners of any utilities in their removal and rearrangement operations so that the utility companies may conduct their operations in a reasonable manner with a minimum of duplication of the work and interruption of services. The Contractor will be furnished by the Department information that is reasonably available in regard to existing or proposed new utilities, but the accuracy of such information is not guaranteed by the Department. It shall be the Contractor's responsibility to secure information necessary for proper handling and coordination of utility work. He shall give at least 48 hours written notice to owners or operators of all properties that may be affected by his operations before beginning such operations. He shall not hinder or interfere with utilities in protection or operations of the properties. When such properties are endangered, the Contractor at his own expense shall maintain flagmen or watchmen and other necessary precautions to avoid interruption of service or danger to life or property. He shall promptly replace, restore, or make good in an acceptable manner any injury or damage caused by his operations.

3. In event of interruption to water or utility services as a result of the Contractor's operations, he shall notify promptly the proper authority and cooperate with the said authority in restoration of service as promptly as possible.

107.13 Woodland Protection, Conservation, Abatement of Water Pollution and Quarantine Regulations.

The Contractor shall comply with all regulations of the State Fire Marshal, Conservation Department, Forestry Department, or regulatory body governing the protection of forests and other conservation areas, and the carrying out of work within such areas, and shall observe all laws and regulations with respect to the performance of work in such areas. He shall keep the areas in an orderly condition, dispose of all refuse, obtain permits for the construction and maintenance of all construction camps, stores, warehouses, residences, sanitary facilities, and other structures in accordance with the requirements of the Forest or Conservation supervisor.

It shall be the Contractor's responsibility to contact the local representatives of the Alabama Department of Agriculture and Industries, and the U.S. Department of Agriculture in order to advise himself, his agents, and his employees regarding quarantined areas and quarantine restrictions affecting his organization while operating within, from or through such areas. Special attention is directed to soil and/or machinery treatment which may be required when operating in, from or through quarantined areas. A list of agents of these two Departments will be furnished the Contractor upon request prior to beginning of his construction or maintenance operations. The State will not be liable for any additional compensation for extra costs arising from quarantine restrictions or penalties.

The Contractor's attention is directed to the requirements for control and abatement of water pollution and erosion control as noted in Article 107.21 along with the taking of all reasonable precautions to prevent and suppress fires and other detrimental items which may be caused by construction operations. This includes protecting streams, lakes and reservoirs from contamination by siltation or other harmful materials, and the use of conservation practices of the Conservation Services by the Contractor, his employees and subcontractors during the work, which will include but are not limited to the following:

(a) Diligently undertake precautions for the prevention of and for suppressive action in the event of fire resulting from highway construction. This will require the Contractor to -

1. Comply with all State laws, rules and regulations for prevention and suppressive action for forest fires.

2. Prepare and submit to the Department a fire prevention and control plan. The fire prevention and control plan must be on file and in effect before work on the item of Clearing and Grubbing will be permitted.

3. Comply with the fire plan noted in Item 2 above. When a burn permit is required, the permit number shall be provided to the Engineer prior to performing the burning operation.

(b) Unmerchantable material including tops, branches, etc., may be disposed of by piling and burning as directed. Alternate methods of disposal, including any of the following methods or combinations of methods (lop and scatter, chip, broadcast, burn, remove, pile only) must be approved in advance by the Engineer.

(c) Protect and preserve the soil and vegetative cover and scenic and aesthetic values on the right of way and on adjacent lands so far as practical and consistent with the construction, operation and maintenance of the highway. Any disturbance of soil and vegetation cover outside the construction limits must have the approval of the Engineer.

(d) The Contractor shall be responsible for the prevention and control of soil erosion and gullying within the right of way covered by the project and the lands immediately adjacent thereto as a result of the road construction, and shall revegetate with grass, or other herbaceous plants, ground where the soil has been exposed. Slopes in channel changes on all branches and creeks shall be seeded and fertilized above the water line and in no case will the toe of fill slopes be allowed to fall within stream or creek channels unless adequate slope protection is placed in accordance with plan details or as directed by the Engineer. All soil left within the right of way shall be leveled off and/or dressed out and seeded or sprigged in a manner that will permit healing of ground surface and present a pleasant appearance.

(e) Construction operations shall be planned and conducted in such a manner so as to prevent when necessary and otherwise minimize pollution of streams, lakes and reservoirs with sediment or other harmful material used in the construction of the project.

(f) Waste, loose soil or other materials removed from the roadway or channel changes shall not be deposited in live streams. Depositing material into the streams or stream channel where it would be washed away by high stream flows will not be permitted. Surplus material may be deposited only in disposal areas approved by the Engineer. Disposal areas outside of the project right of way must be operated so as to blend into the surrounding area utilizing an erosion control plan, etc. as prescribed for local pit operations in Subarticle 106.01(b) with any cost thereof considered incidental to the use of the disposal area. Disposal areas within the project right of way shall be dressed and treated as directed using erosion control items provided in the contract for payment of directed work.

(g) The hauling of materials, including logs, brush, and debris by fording live streams will not be permitted. Temporary bridges or other structures must be provided for this purpose.

(h) Operations of mechanized equipment in live streams or stream channels will not be permitted except in areas where channel changes, retaining walls, temporary or permanent bridges or other such work is required by the plans, or directed.

(i) Fuels, oils, bitumen or other greasy or chemical substances originating from construction operations shall not be allowed to enter or be placed where they may enter a live steam.

(j) The discharge ends of all channel changes shall be so laid out and aligned as to provide direct flow into old stream beds without an abrupt direction change.

(k) The operations for any material pit located within sight of the project right of way or any other State or Federal highway shall be conducted in accordance with Subarticle 106.01(b), allowing adequate space for conservation of existing natural screenings or permit the installation of screen planting between the road surface and the disturbed area. Pit sites shall be dressed to obliterate any unsightly appearance and treated in such a manner that erosion of the pit will not occur and result in the pollution of the water shed area.

107.14 Responsibility for Damage Claims.

(a) GENERAL.

The Contractor shall indemnify and save harmless the State, the Department, the County, the Municipality, the officers and employees from all suits, actions, or claims of any character brought because of any injuries or damages received or sustained by any person, persons, or property due to the operations of the Contractor; or because of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of the Contractor; or because of any claims or amounts arising or recovered under the "Workmen's Compensation Act" or any other law, ordinance, order, or decree; and so much of the money due the Contractor under and by virtue of his contract as may be considered necessary by the Department for such purpose, may be retained for the use of the State; or, in case no money is due, his surety will be held liable until such suit or suits, action or actions, claim or claims for injuries or damages as aforesaid shall have been settled and suitable evidence to that effect furnished to the Department; except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that he is adequately protected by public liability and property damage insurance.

The State will not be liable to the Contractor for damage or delays resulting from work by third parties or by injunctions or other restraining orders obtained by third parties except as noted in Subarticle 108.07(b).

(b) TEMPORARY STREAM CROSSINGS.

When the Contractor is required to construct temporary stream crossings, the responsibility of the Contractor as above set forth shall extend to and include such structures together with their approaches.

(c) REPORTING ACCIDENTS.

The Contractor shall submit a verbal report to the Engineer no later than the next working day after their occurrence all accidents occurring on the work which involve the public or the Contractor's forces. Accidents involving fatalities shall be verbally reported within eight hours. The Contractor shall follow this verbal report with a written report within ten calendar days after the accident. The report shall contain complete information on the accident including names, addresses of persons involved, and names and addresses of witnesses.

107.15 Liability Insurance.

The Contractor, without extra compensation, shall carry insurance of the following kinds and amounts in addition to any other forms of insurance or bonds required under the terms of the contract specifications. All insurance shall be by companies authorized to do business in Alabama involving these types of insurance. Before beginning work, the Contractor shall have on file with the Department's Bureau of Office Engineer a valid insurance certificate showing the amounts of insurance carried and the risks covered thereby, or a copy of the policies, covering the requirements outlined herein in this Article, along with Workmen Compensation coverage, before he will be allowed to perform any work on a contract.

It shall be the Contractor's responsibility to provide the information on his coverage in a timely and acceptable manner. The Department will not be responsible for delays or damages caused by failure on his part to provide this information in a timely, acceptable manner.

Certificates of coverage shall be on the Department's Form OE-04, or a form acceptable to the Department, that provides all of the information required by Form OE-04. Certificates shall have an original signature of the local (within the State of Alabama) representative of the insurance company providing coverage.

The insurance coverage shall be provided on a continuous basis from the date work begins until the contract has been completed. Certificates of insurance shall indicate the policy period of the coverage. Should insurance coverage expire before the work is complete or the insurance company cancels the policy (30 day notice required), work on the project for the construction firm involved will be halted until a notice of renewal of the coverage is received by the Bureau of Office Engineer. The Department will not be responsible for any delays, damages, or claims on the part of the contracting firm not providing renewal certificates in a timely and acceptable manner. If work is halted as outlined above, working time will be charged as outlined in Subarticle 108.08(a).

(a) CONTRACTOR'S BODILY INJURY LIABILITY AND PROPERTY DAMAGE LIABILITY INSURANCE.

The Contractor without extra compensation shall carry for himself, and shall require from all Subcontractors on the contract, until the contract is completed, with respect to the operations he or the Subcontractors perform, both premises operations and independent contractor's coverages, contractor's bodily injury liability insurance providing for a limit of not less than $100,000 for all damages arising out of bodily injury to or death of one person, and subject to that limit for each person, a total limit of $300,000 for all damages arising out of bodily injury to or death of two or more persons in any one occurrence.

The Contractor without extra compensation shall carry for himself, and shall require from all Subcontractors on the contract, until the contract is completed, with respect to the operations he or the Subcontractors perform, both premises operations and independent contractor's coverages, contractor's property damage liability insurance providing for a limit of not less than $50,000 for all damages arising out of injury to or destruction of property in any one occurrence and a total of $100,000 for all occurrences during the policy period.

(b) RAILROAD'S PROTECTIVE BODILY INJURY LIABILITY AND PROPERTY DAMAGE LIABILITY INSURANCE.

When the contract specifies such, the Contractor shall carry insurance for himself and insurance in the name of the railroad company in the amounts and under the terms specified in special provisions provided in each contract; otherwise, the provisions of Subarticle 107.15(a) shall apply.

(c) AUTOMOBILE AND TRUCK BODILY INJURY LIABILITY AND PROPERTY DAMAGE LIABILITY INSURANCE.

The Contractor without extra compensation shall carry for himself, and shall require from all Subcontractors and all owners of automobiles or trucks rented or hired on the contract, until the contract is completed, automobile and truck bodily injury liability and property damage liability insurance for not less than the limits prescribed by the Alabama Financial Responsibility Law. The Contractor also shall carry for himself insurance for non-owned and hired automobiles and truck coverage to at least the limits prescribed by the Alabama Financial Responsibility Law.

107.16 Opening Sections of Project to Traffic.

Opening of sections of the work to traffic prior to completion of the entire contract may be desirable from a traffic service standpoint, or may be necessary due to conditions inherent in the work,

or by changes in the Contractor's work schedule, and may be necessary due to conditions or events unforeseen at the time of the contract. Such openings as may be necessary due to any of the foregoing conditions shall be made when so ordered by the Engineer. Under no condition shall such openings constitute acceptance of the work or a part thereof, or a waiver of any provisions of the contract.

The plans and/or special provisions shall state, insofar as possible, which sections shall be opened prior to completion of the contract. On any section opened by order of the Engineer, whether covered on the plans or in the special provision or not, the Contractor shall not be required to assume any expense entailed in maintaining the road for traffic. Such expense shall be borne by the Department, or compensated for in a manner provided in Article 109.04. On such portions of the project which are ordered by the Engineer to be opened for traffic, in the case of unforeseen necessity which is not the fault of the Contractor, compensation for additional expense, if any, to the Contractor and allowance of additional time, if any, for completion of any other items of work on the portions of the project ordered by the Engineer to be opened in the event of such unforeseen necessity, shall be as set forth in a change order mutually agreed on by the Engineer and the Contractor as set forth herein.

If the Contractor is dilatory in completing shoulders, drainage structures, or other features of the work, the Engineer may so notify him in writing and establish therein a reasonable period of time in which the work should be completed. If the Contractor is dilatory or fails to make a reasonable effort toward completion in this period of time, the Engineer may then order all or a portion of the project opened to traffic. On such sections which are so ordered to be opened, the Contractor shall conduct the remainder of his construction operations so as to cause the least obstruction to traffic and shall not receive any added compensation due to the added cost of the work by reason of opening such section to traffic.

On any section opened to traffic under any of the above conditions, whether stated on the plans or in the Special Provisions or opened by necessity of Contractor's operations, or unforeseen necessity, any damage to the highway not attributable to traffic which might occur on such section (except slides) shall be repaired by the Contractor at his expense. Slide corrections performed by the Contractor shall be compensated for in accordance with the provisions of Article 210.10.

107.17 Contractor's Responsibility for Work.

Until final written acceptance of the project by the Engineer, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution or from the nonexecution of the work. The Contractor shall rebuild, repair, restore and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God such as earthquake, tidal wave, tornado, hurricane or other cataclysmic phenomenon of nature, or acts of the public enemy or of governmental authorities.

Where a roadway is open to traffic, damage caused by public traffic to any acceptably installed permanent item(s) of work shall be repaired by the Contractor before final acceptance. Damage to portable impact attenuators shall be repaired by the Contractor as necessary. If the damage to these items was not caused by the fault or negligence of the Contractor, then the Contractor will be compensated for the repair work either at the contract unit bid price(s) of the original item(s) of work or as extra work, as determined by the Engineer.

In case of suspension of work, the Contractor shall be responsible for the project, provide for normal drainage and shall erect any necessary temporary structures, signs, or other facilities at his expense. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings, and soddings furnished under his contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

107.18 Furnishing Right-Of-Way.

The Department will be responsible for the securing of all necessary rights-of-way in advance of construction. Any exceptions will be indicated in the contract.

107.19 Personal Liability of Public Officials.

In carrying out any of the provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contract, there shall be no liability upon the Director,

Engineer, or their authorized representatives, either personally or as officials of the State, it being understood that in all such matters they act solely as agents and representatives of the State.

107.20 No Waiver of Legal Rights.

Upon completion of the work, the Department will expeditiously make final inspection and notify the Contractor of acceptance. Such final acceptance, however, shall not preclude or estop the Department from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Department be precluded or estopped from recovering from the Contractor or his surety, or both, such overpayments as it may sustain, or by failure on the part of the Contractor to fulfill his obligations under the contract. A waiver on the part of the Department of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract, shall be liable to the Department for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Department's rights under any warranty or guaranty.

107.21 Prevention of Soil Erosion.

When an Erosion Control Plan (ECP) is included in the plans, the Contractor shall comply with the requirements of the design details as shown on the plans. A Department provided ECP included in the plans will detail a specific erosion control plan for sites where water is leaving the project. For sites where erosion control may be needed within the project (internal erosion control), the Contractor shall be responsible for the accomplishment of acceptable erosion control measures. If the Contractor's method for constructing the project conflicts with a Department provided ECP, the Contractor, prior to beginning work in any affected area, may submit to the Engineer, in writing, a detailed alternate plan for the accomplishment of acceptable erosion control on the affected areas of the project. This alternate plan shall include both temporary and permanent erosion control measures for the work within the affected areas of the project and the time sequence proposed for the placement of such measures. The work included in any alternate plans shall comply with the requirements of Department obtained stormwater permits, where required. These alternate plans must be approved by the Engineer before the work in the affected areas will be permitted to commence.

When an Erosion Control Plan (ECP) is not included in the plans, the Contractor shall be required to submit a detailed plan for the accomplishment of acceptable erosion control on the project meeting the requirements of Section 665.

It is a condition of this contract that the Contractor exercise planning and forethought in coordinating the work of protecting the project and adjoining properties from soil erosion by effective and continuous erosion control methods of either a temporary or permanent nature in accordance with the provisions of Article 107.13, Sections 650 through 659 and Section 665.

Special attention is directed to Subarticle 665.01(b) which will be applied to all work regardless of whether pay items of Section 665 are provided in the contract or not. In the event no pay items for temporary erosion control work are provided and such is deemed necessary, the work may be performed at an agreed unit price as provided by Article 104.03 or the work may be performed on a force account basis.

107.22 Environmental Protection.

The Contractor shall comply with all Federal, State and local laws and regulations controlling pollution of the environment. He shall take all reasonable precautions to prevent pollution of streams, lakes, ponds, and reservoirs with fuels, oils, bitumens, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

Attention is directed to Articles 107.13 and 107.21 concerning Woodland Protection, Conservation, Abatement of Water Pollution and Prevention of Soil Erosion.

Attention is further directed to ADEM and the local air pollution control programs within the State, and their rules and regulations regarding air pollution matters, especially "open burning", "fugitive dust", and "asphalt batching plant" restrictions. A valid permit for "open burning" or operation of an "asphalt batching plant" will be required from the air pollution control agency within whose jurisdiction the work is to be performed before such operations will be allowed.

107.23 Hazardous and Toxic Waste.

When the Contractor's operations encounter or expose any abnormal, or potentially abnormal, condition which may indicate the presence of a hazardous and/or toxic waste, such operations shall be discontinued in the vicinity of the abnormal condition and the Engineer shall be notified immediately.

The presence of barrels, discolored earth, metal, wood, visible fumes, abnormal odors, excessively hot earth, smoke or anything else which appears abnormal may be indicators of hazardous and/or toxic wastes and shall be treated with extraordinary caution.

The Contractor shall not resume operations in the vicinity of the abnormal condition until so directed by the Engineer. Disposition of the hazardous and/or toxic waste shall be made in accordance with the requirements and regulations of the Alabama Department of Environmental Management, these specifications, and as directed by the Engineer.

Where the Contractor performs work necessary to dispose of hazardous and/or toxic waste, payment will be made at the unit prices for pay items included in the contract which are applicable to such work. When the contract does not include such pay items, payment will be made as provided in Article 109.04 for extra work.

SECTION 108
PROSECUTION AND PROGRESS

108.01 Subletting and Assignment.

(a) SUBLETTING.

1. LIMITATIONS.

The Contractor shall not sublet the contract or any portion thereof, or of his right, title, or interest therein, without written consent of the Engineer. If such consent is given, the Contractor will be permitted to sublet a portion of the work, but shall perform with his own organization, work amounting to not less than 30 percent of the total contract cost.

Any items designated in the contract as "specialty items" may be performed by sub-contract and the cost of such specialty items performed by sub-contract may be deducted from the total cost before computing the amount of work required to be performed by the contractor with his own organization. No sub-contracts, or transfer of contract, shall relieve the Contractor of his liability under the contract and bonds.

The Department reserves the right to disapprove a request for permission to sublet when the proposed Subcontractor has been disqualified from bidding for those reasons listed in Subarticle 102.02(b) and Article 103.03.

2. SUBCONTRACTOR'S STATUS.

A Subcontractor shall be recognized only in the capacity of an employee or agent of the Contractor and his removal may be required by the Engineer, as in the case of an employee.

(b) ASSIGNMENT.

The performance of the contract may not be assigned, except upon the written consent of the Director. Consent will not be given to any proposed assignment which would relieve the original Contractor or his surety of their responsibilities under the contract nor will the Director consent to any assignment of a part of the work under the contract.

The Contractor may assign moneys due or to become due him under the contract, if such assignment is approved by the Director, to the extent permitted by law, but any assignment of moneys shall be subject to all proper set-offs in favor of the Department and to allow deductions provided for in the contract and particularly all money withheld, whether assigned or not, shall be subject to being used by the Department for the completion of the work in the event that the Contractor should be in default therein.

An assignment by operations of law or assignment for the benefit of creditors, or the bankruptcy of the Contractor, shall not vest any right in this contract in the Trustee in bankruptcy, the Contractor's creditors, or the agent of the creditors.

In no case will the Department make the warrant payable to anyone other than a party to the contract and; therefore, if the contractor assigns the proceeds of his contract to a bank or other individual or company, approval of the assignment by the Director only constitutes an agreement to make the warrants payable to the contractor and for it to be mailed to the address of the party to which the contract is assigned.

108.02 Notice to Proceed.

(a) GENERAL.

A notice to proceed shall be issued by the Engineer within 15 calendar days after final execution of the contract by the Director and approval by the Governor, unless both parties agree in writing to a stipulated extension in time for the issuance of a notice to proceed. Unless the Contractor is otherwise notified in writing, it shall be understood that the mailing or the delivery to the Contractor or his authorized agent, of a copy of the executed and approved contract and bonds or the mailing of written notice by the Engineer or receipt of telegraphic notice from the Engineer, that the contract has been approved by the Governor, shall constitute the notice to proceed. If the Contractor is notified in writing that none of the above shall constitute notice to proceed, he shall not commence work until receipt of a written notice to proceed signed by the Engineer.

(b) TIME OF BEGINNING WORK.

Unless otherwise directed in writing by the Engineer, the Contractor will be expected to begin work within 15 calendar days after issuance of notice to proceed.

108.03 Progress Schedule of Operations.

Prior to the Preconstruction Conference, the Contractor shall submit a satisfactory, comprehensive bar graph schedule of operations to the Division Engineer on all projects which have a contract time in excess of 90 working days or 180 calendar days. This schedule shall be on Form C-10 furnished by the Department at the time of contract award. Said schedule of operation shall provide a bar for each major phase of construction such as, but not limited to, clearing and grubbing, grading, drainage structures, bridges, base, shoulders, paving, etc. with an estimated start and completion date for each bar and an overall project completion date, all within the specified contract time. The Engineer may order the submittal of a bar graph schedule of operation on any project which has a contract time less than that specified above should he deem such necessary for project control.

A revised bar graph schedule and completion update may be required within ten days of the occurrence of any one of the following conditions: (1) at each major change from the original submitted, (2) when a time extension is granted, and (3) when a revised bar graph schedule is requested by the Engineer.

When a Critical Path schedule is required in the proposal, this schedule will be used in lieu of the bar graph schedule of operation in evaluating work progress. In such case, the same time frame noted in this Article for the original submittal along with the update requirements will apply.

The Engineer's approval of the aforementioned Schedule of Operations does not waive any contract requirements.

108.04 Prosecution of Work.

(a) NOTICE OF INTENT.

The Contractor shall give the Engineer definite notice of his intention to start work at least 72 hours in advance of beginning work and at least 24 hours in advance of beginning particular features of construction, such as driving piles, placing concrete, et cetera. Should prosecution of the work be discontinued by the Contractor with the consent of the Engineer, the Contractor shall give the Engineer at least 48 hours notice in writing before resuming operations.

(b) GENERAL.

The Contractor shall prosecute the work continuously and diligently in the order and manner set out in his schedule or prescribed by the Engineer. He shall provide sufficient satisfactory materials, labor, and equipment to guarantee the completion of the project in accordance with the plans and specifications within the time specified in the contract.

Should the Contractor fail to maintain a satisfactory rate of progress, the Engineer will require that additional forces and equipment be placed on the work to bring the project up to schedule and maintain it at that level. Failure to maintain the quality and progress of the work shall be cause for the Engineer to withhold all estimates which are or may become due, until satisfactory quality and progress are maintained; or the contract may be annulled as provided in Article 108.12.

(c) DISQUALIFICATION FOR UNSATISFACTORY PROGRESS.

Should the Contractor fail to maintain a satisfactory rate of progress in performance of the work, prior to expiration of the contract, the following regulation shall apply:

After preparation of the Contractor's monthly estimate, the Department will review the progress of the work comparing the dollar value of work performed to the percentage of contract time elapsed. If the percentage of the dollar value of work performed as compared to the percent of contract time elapsed is behind by more than 25 percentage points, a warning notice of possible disqualification will be sent to the Contractor by certified mail, return receipt requested (appropriate credit will be allowed for any extension previously approved in conformity with Article 108.09). Said warning notice will note the unsatisfactory progress revealed by the computation and that ten days will be allowed from the date of receipt of the warning in which to bring his progress within the allowed 25 percent or furnish acceptable reasons why he should not be given a final notice of disqualification. At the end of the 10-day period, if the Contractor's progress is not within the allowed percentage, nor has acceptable reason been furnished to waive final disqualification, the Department will issue a final notice of disqualification. After the final notice of disqualification has been issued, the Contractor will be disqualified from further bidding or for approval as a Subcontractor so long as the unsatisfactory percentage ratio exists. Further bidding shall mean bidding as an individual, firm, partnership, corporation, joint venture, or any combination thereof.

Disqualification under the above provision will be removed immediately upon receipt of proof, in the form of a check period estimate or otherwise, that the percentage lag described above has been brought up within the specified limit.

108.05 Limitation Of Operation.

The Contractor shall conduct the work at all times in such a manner and in such sequence as will insure the least interference with traffic. He shall have due regard to the location of detours and to the provisions for handling traffic. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional section if the opening of such section is essential to public convenience.

108.06 Character of Workmen, Methods, and Equipment.

The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by these specifications.

All workmen shall have sufficient skill and experience to perform properly the work assigned to them. Workmen engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or by any Subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed forthwith by the Contractor or Subcontractor employing such person, and shall not again be employed in any portion of the work without the approval of the Engineer.

Should the Contractor fail to remove such person or persons as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until compliance with such orders.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that no injury to the roadway, adjacent property, or other highways will result from its use.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed in the contract, the Contractor is free to use any methods or equipment that he demonstrates to the satisfaction of the Engineer will accomplish the contract work in conformity with the requirements of the contract.

When the contract specifies the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than those specified in the contract, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing work in conformity with contract requirements. If, after trial use of the substituted methods of equipment, the Engineer determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer

may direct. No change will be made in basis of payment for the construction items involved nor in contract time as result of authorizing a change in methods or equipment under these provisions.

108.07 Temporary Suspension of Work.

(a) AUTHORITY TO SUSPEND.

The Engineer shall have the authority to suspend the work wholly or in part by written order to the Contractor for such period or periods as he may deem necessary due to either of the following reasons:

1. Failure on the part of the Contractor to carry out orders given or to perform any provision of the contract in which case time will be charged and no time extension will be granted, or
2. Unsuitable weather or other essential conditions of a highly unusual or unpredictable nature which he considers unfavorable for the suitable prosecution of the work in which case either time charges will be suspended or a time extension will be granted.

Upon suspension, the work shall be put in proper and satisfactory condition, carefully covered and properly protected, as directed by the Engineer. Reference is made to Article 105.13.

(b) LEGAL STOPPAGE OR TERMINATION.

Should the progress of the work be stopped by a temporary injunction, court restraining order, process of judgment of any kind directed to either of the parties hereto, then such period of delay will not be charged against the contract time. The State shall not be liable to the Contractor for the said legal delays of 120 calendar days or less, or for termination of the contract because of a legal order except as provided in Subarticle 108.14(b). Consideration will be given to properly documented added costs for a legal delay in excess of 120 calendar days, if submitted in accordance with Section 110, Claims. If a herein noted delay is of such duration as not to be in the best interest of the State, as determined by the Director, he may, by written order, terminate the contract in the same manner prescribed in Subarticle 108.14(c) for termination of a contract.

(c) AUTOMATIC TIME SUSPENSION.

Time will be suspended on calendar day projects during periods when no work can be performed on the project due to operational check periods or seasonal limitations when such periods are required by the specifications. Time will also be suspended for specification mandated curing periods for placement of permanent traffic stripe when all other work has been completed and the traveling public has full use of the highway.

(d) SUSPENSION CONSIDERATIONS.

If the performance of all or any portion of the work is suspended or delayed by the Engineer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the Contractor shall submit to the Engineer in writing a request for adjustment within seven calendar days of receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.

Upon receipt, the Engineer will evaluate the Contractor's request. If the Engineer agrees that the cost and/or time required for the performance of the contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the Engineer will make an adjustment (excluding profit) and modify the contract in writing accordingly. The Engineer will notify the Contractor of his determination whether or not an adjustment of the contract is warranted.

No contract adjustment will be allowed unless the Contractor has submitted the request for adjustment within the time prescribed.

No contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of this contract.

108.08 Determination of Contract Time.

(a) GENERAL.

The number of working days or calendar days allowed or the calendar date specified for completion of the work included in the contract will be fixed by the Department, will be stated in the proposal and contract, and will be designated as the contract time.

(b) BEGINNING AND END OF CONTRACT TIME.

Contract time charges shall begin when the Contractor begins work on a pay item or on incidental work that will interfere with traffic, but in no case later than 15 calendar days after date of issue of "notice to proceed." Time charges shall end upon satisfactory completion of all pay items in the contract.

(c) DAYS WORK NOT PERMITTED.

The Contractor shall not permit work on any pay item to be done on Sundays and the following holidays: Fourth of July, Labor Day, Thanksgiving Day and Christmas Day, except with written permission of the Engineer.

(d) MONTHLY STATEMENT AND TIME CHARGES.

1. CONTRACTS ON A WORK DAY BASIS.

For projects on a working day basis, the Engineer will furnish the Contractor a monthly time statement for the preceding month. This time statement will show the number of working days charged as outlined in the definition of Working Day in Subarticle 101.01(b), the number of working days in the contract, and the number of working days remaining to complete the contract.

Under the provisions of Article 105.01, the Engineer will determine the controlling item or items of work based on consideration of the Contractor's approved Schedule of Operations and the operations that should be in progress at the time to provide for the orderly completion of the work within the contract time. Consideration to not charging time will be given when delays of six hours or more occur when the causes for delays may be due to, but not restricted to the following:

1. Unavoidable causes beyond the control of the Contractor, without fault or negligence on his part.
2. Contractor's proof (in form of letters from suppliers) of inability to obtain materials due to a regionwide shortage of such materials.
3. Failure on the part of a utility company to diligently perform work not under the control of the Contractor.
4. Acts of the Department.
5. Recovery Time.
6. Strikes.

Upon receiving the monthly time statement, the Contractor shall review the statement and compare the time charges with his records. If the Contractor disagrees with the time charges on the statement, he shall file a written protest setting forth the reasons why he considers the monthly time statement incorrect. The Contractor is encouraged to file any such protest as soon as possible after receiving the time statement.

2. CONTRACTS ON A CALENDAR DAY OR DATE BASIS.

For projects on a calendar day or calendar date basis a similar statement will be furnished the Contractor indicating the number of calendar days remaining in the contract.

108.09 Extension of Contract Time.

(a) GENERAL.

An extension of contract time will be granted in the event the total cost of the completed work exceeds the total contract bid price. For the purpose of this item, the following costs will be excluded from the computation for total cost: (i) supplemental agreements on which time has been granted, (ii) bituminous material price adjustments, (iii) liquidated damages, (iv) incentive or disincentive payments, (v) price adjustments for pavement rideability, and (vi) compensation for delay claims. The extension of contract time shall be in the same ratio as the increase in the total cost.

If the Contractor finds it impossible for reasons beyond his control to complete the work within the contract time as specified or as extended in accordance with the provisions of this Article, he may at any time prior to the expiration of the contract time as extended, make a written request to the Engineer for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion. If the Contractor disagrees with the decision of the State Construction Engineer, he may appeal directly, in writing, to the Director. The

Director shall have final authority to approve or disapprove the request for an extension of time. The Director may, at his discretion, refer the appeal to the Claims Committee for a recommendation before making his decision. Reference is made to Section 110, Claims. Time extension requests will not be referred to the Claims Appeal Board.

(b) CONTRACTS ON A WORKING DAY BASIS.

When the time set for completion of the work is a number of working days, extensions of contract time will be handled as outlined in Subarticle (a) above.

(c) CONTRACTS ON A CALENDAR DAY OR CALENDAR DATE BASIS.

When the time set for completion of the work is a number of calendar days or a calendar date, working days are not applicable. Extension of time beyond the said calendar days or date will be made as follows:

When the notice to proceed is delayed more than 15 calendar days after execution of the contract, the date of completion will be extended the number of calendar days in excess of 15 days between the date of execution of the contract and the date of actual issuance of the notice to proceed.

Where work is suspended by order of the Engineer due to no fault of the Contractor, and time is not suspended, a time extension will be granted for the number of calendar days the work is so suspended.

A time extension will be granted as provided in Subarticle 107.08(b).

A time extension will be granted as outlined in the first paragraph of Subarticle (a) above.

The following are valid reasons for time extensions when delays due to these causes are considered by the Department of Transportation to be beyond the control of the Contractor:

1. Utility Work being performed by others not under the Contractor's control that prohibit the Contractor's construction operations from proceeding with the normal working forces he would otherwise employ in performing the controlling item, or items, of work which normally would be in progress at the time said Utility work is being accomplished.
2. Recovery time as defined in Article 101.01.
3. If in the course of work material delivery time is in excess of that normally anticipated due to demands beyond the supplying industries' capabilities provided such materials are necessary for the prosecution of the controlling items of work at that time and such can be substantiated by the Contractor in the form of letters from suppliers, the Department will consider a time extension for the delay caused by the lack of available materials.
4. If in the course of this project the Contractor feels he has been unjustly penalized because of delays in Departmental decisions, he may submit for consideration by the Engineer written specific data covering the item or items and the time element involved. The Department will consider only an extension for the actual work delay caused by the delay in obtaining a decision.
5. If in the course of the work, strikes occur while the Contractor is working in good faith and such was not caused by action of the Contractor, the Department will consider a time extension for the delay caused by the strike.

When allowing a time extension under the provisions noted in this Subarticle, consideration in determining the adjusted completion date for the work will be given to allow additional time to compensate for seasonal conditions, weather and other factors not under control of the Contractor. Should the Contractor, after exercising a concerted effort to diligently prosecute the work taking full advantage of every available work day, not be able to complete the work within the adjusted completion time because of non-availability of days in which work can be performed, the Department may consider an additional extension of time for the work.

108.10 Failure to Complete Work Within Contract Time.

Should the Contractor, or in case of default, the surety, fail to complete the work within the time stipulated in the contract or the adjusted time as granted under the provisions of Article 108.09, a deduction for each calendar day or work day that any work shall remain uncompleted, an amount indicated by the Liquidated Damages Schedule shown in Article 108.11 or provided in the contract documents shall be deducted from any monies due the Contractor on monthly estimates. Any adjustments due to approved time extensions or overruns in the contract amount will be made on the monthly, semi-final or final estimate as may be appropriate.

Liquidated damages assessed as provided in these Specifications is not a penalty, but is intended to compensate the State for increased time in administering the contract, supervision, inspection and engineering, particularly that engineering and inspection which requires maintaining normal field project engineering forces for a longer time on any construction operation or phase than originally contemplated when the contract period was agreed upon in the contract.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a waiver on the part of the Department of any of its rights under the contract.

108.11 Schedule of Liquidated Damages.

Original Contract Amount		Liquidated Damages Daily Charge	
More Than	To and Including	Calendar Day or Fixed Date	Work Day
$ 0	$ 100,000	$ 120	$ 200
100,000	200,000	180	300
200,000	500,000	300	500
500,000	1,000,000	480	800
1,000,000	2,000,000	660	1,100
2,000,000	5,000,000	840	1,400
5,000,000	10,000,000	1,020	1,700
10,000,000	- - - - - -	1,200	2,000

When the contract time is on the calendar day or date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used.

108.12 Default of Contract.

If the Contractor:

1. Fails to begin the work under the contract within the time specified in the "Notice to Proceed," or
2. Fails to perform the work with sufficient workmen and equipment or with sufficient materials to assure the prompt completion of said work, or
3. Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or
4. Discontinues the prosecution of the work, or
5. Fails to resume work which has been discontinued within a reasonable time after notice to do so, or
6. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or
7. Allows any final judgement to stand against him unsatisfied for a period of 10 days, or
8. Makes an assignment without the consent of the surety and approval of the Department, or
9. Fails to furnish documentation necessary for final acceptance and payment, or
10. Fails to carry out provisions of the contract, or
11. For any other cause whatsoever, fails to carry on the work in an acceptable manner,

the Engineer will give notice in writing to the Contractor and his surety for such delay, neglect, or default.

If the Contractor or surety, within a period of 10 days after such notice, does not proceed in accordance therewith, then the Department will, upon written notification from the Engineer of the fact of such delay, neglect or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the prosecution of the work out of the hands of the Contractor. The Department may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Department, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due said Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the Surety shall be liable and shall pay to the Department the amount of such excess.

Notice to the Contractor shall be deemed to be served when delivered to the person in charge of any office used by the Contractor, to his representative at or near the work, or by certified letter, return receipt requested, addressed to the Contractor at his last known place of business.

In addition to the provisions provided in this Article, failure of the Contractor to sign the final estimate within the time limits prescribed in Subarticle 109.12(d) will be classified as a default.

108.13 Blank.

108.14 Termination of Contractor's Responsibility.

(a) GENERAL.

The Contract will be considered complete when all work has been finished, the final inspection made by the Engineer, the project accepted by the Department, the necessary advertisements published, all in accordance with the provisions of Article 105.15, and the final estimate paid. Upon completion of the above, the Contractor's responsibility will then cease, except as set forth in his bonds.

(b) SPECIAL CONDITIONS.

Should the Department find that the Contractor is unable to complete his contract work due to the inability to obtain specified materials or satisfactory substitutes therefor or labor, because of laws, rules or regulations placed into effect or the inability of industry to produce specified materials within a reasonable time; the Director may, by written notice, relieve the Contractor from that portion of the contract which cannot be performed. Also, should the State determine that further prosecution of the work on a project will not be in the best interest of the public, the Director may, by written order, eliminate or delete any or all remaining items of work on a contract.

The deletion or elimination of work under the above conditions will in no way affect the unit prices bid in the contract. Work actually performed will be paid for at the contract unit prices. Should relief from performance of the contract or any portion thereof directly cause the loss of any work or materials already furnished under the terms of the contract, the Contractor will be reimbursed for the actual cost of salvaging the materials or as mutually agreed to.

Materials obtained by the Contractor, which have been inspected, tested and accepted by the Engineer but not incorporated into the work may, at the option of the Engineer, be purchased in accordance with the provisions of Article 109.06.

If, by the deletion of work items, the volume of work completed is too small to compensate for the organization and moving of equipment to and from the work, consideration will be given to reimbursement for actual costs thereof; the intent being that an equitable settlement be made; compensation for this, however, shall not exceed the percentage differentiation between plan quantities and actual quantities performed, and if 75% of the estimated work was performed, no compensation for the organization and moving of equipment to and from the work will be allowed. In no event will a claim for loss of anticipated profits be considered. The deletion or elimination of work under the above conditions shall in no way relieve the Contractor from his responsibility for work actually performed nor any just claims as a result thereof.

Final termination of the contract shall be as noted in Subarticle (a) above, for the work completed.

(c) NATIONAL EMERGENCY.

The Director may, by written order, terminate the contract or a portion thereof when the Contractor is prevented from proceeding with the construction contract as a direct result of an Executive Order of the President with respect to the prosecution of war or in the interest of national defense.

When contracts, or any portion thereof, are terminated before completion of all items of work in the contract, payment will be made for the actual units or items of work completed at the contract unit price bid, or as mutually agreed for items of work partially completed or not started. No claim for loss of anticipated profits will be considered.

Reimbursement for organization of the work and moving equipment to and from the job will be considered where the volume of work completed is small to compensate the Contractor for these expenses under the contract unit prices, the intent being that an equitable settlement will be made with the Contractor.

Acceptable materials, obtained by the Contractor for the work, that have been inspected, tested, and accepted by the Engineer, and are not incorporated in the work may, at the option of the Engineer, be purchased from the Contractor in accordance with the provisions of Article 109.06.

Final termination of the contract shall be as noted in Subarticle (a) above, for the work completed.

SECTION 109
MEASUREMENT AND PAYMENT

109.01 Measurement of Quantities.

(a) GENERAL.

All work acceptably completed under the contract will be measured by the Engineer according to United States Standard Measures and Weights, unless otherwise provided on the plans or in the special provisions. No local rules or customs will be followed or considered.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, lumber, etc., and these items are identified by gage, weight {mass}, section, dimensions, etc., such identification will be considered to be nominal weights {masses} and dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

(b) BASE LAYER AND PAVEMENT AREAS.

All longitudinal measurements for computing area of base layers and pavements will be made along the actual surface of the roadway and not horizontally and no deductions will be made for individual fixtures in the roadway having an area of nine square feet {one square meter} or less. For all transverse measurements for area of base layers and pavements, the dimensions to be used in calculating the pay area shall be the neat dimensions shown on the plans or directed.

(c) STRUCTURES.

Structures will be measured according to neat lines shown on the plans or as ordered in writing, unless otherwise provided elsewhere in the specifications or in the special provisions.

(d) EXCAVATION.

In computing volume of excavation, embankment and borrow, the average end-area or other acceptable method will be used. It is stipulated and agreed that the electronic computer and/or planimeter shall be considered as instruments of precision adapted to the computation and measurement of these volumes and areas. Completed final cross sections and computed quantities will be made available to the Contractor upon request but shall not be removed from the Engineer's office.

(e) LINEAR MEASUREMENTS.

All items which are measured in linear measurement by the foot {meter}, such as pipe culverts, guardrail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise shown on the plans or indicated in these specifications.

(f) GAGE.

The term "Gage", when used in connection with the measurement of plates, shall mean the U.S. Standard Gage; when used with wire, shall mean U.S. Steel wire gage.

(g) BLANK.

(h) WEIGHT {MASS} MEASUREMENTS.

1. GENERAL.

The term "ton" shall mean the short ton {metric ton} consisting of 2,000 pounds avoirdupois {1000 kg}.

Scales for measuring materials shall be furnished by the Contractor at agreed locations and without extra compensation. Scales shall be suitable for the type of service for which they are to be used and shall be operated by a competent, qualified operator. Scales for quarry run materials shall be sensitive to 20 pounds {10 kg}; all other scales shall be sensitive to 10 pounds {5 kg} or less. For items being paid for by the ton {metric ton}, weights {masses} may be recorded on the weight {mass} ticket to the nearest 20 pounds {10 kg} except that weights {masses} for quarry run materials may be recorded to the nearest 100 pounds {45 kg}.

Electronic load cell weight {mass} systems shall be equipped with automatic zeroing devices. The maintenance tolerance of scales shall be 0.2 percent of the range in which they are to be used. The acceptance tolerance, applied to a new device or a device which has been condemned and repaired to be placed back in service, shall be 0.1 percent of the range in which they are to be used.

Scales shall be checked and serviced by a reputable scales company registered with the Alabama Department of Agriculture. The time between checks shall not exceed four months, except that checks for scales used in proportioning the component materials for Portland cement concrete shall not exceed six months. In addition, any time a plant is moved or substantially modified, the scales shall be checked. A copy of the check shall be sent to the Division in which the scale is located. It is the Contractor's responsibility to maintain suitable acceptable scales and any time a check indicates the scales to be inaccurate, the Engineer will reject them for use on the project until such time as they are recertified. Weights {Masses} above the acceptable capacity of a set of scales will not be acceptable.

2. WEIGHT {MASS} MEASURE FOR PAY PURPOSES.

If material is shipped by rail, the car weight {mass} may be accepted provided that only the actual weight {mass} of material is paid for and is certified by a car weight {mass} obtained from a certified scale after the unloading. However, car weights {masses} will not be accepted for steel reinforcement, structural steel or materials that are to pass through a mixing plant. Trucks used to haul material being paid by weight {mass} shall be measured empty daily, with the driver in the truck, and at such other times as directed by the Engineer and each truck shall bear a plain legible identification number.

Commercial materials, except reinforcing steel and structural steel, which are measured by weight {mass} for pay purposes shall be measured by a qualified "Weighmaster*" using acceptable weight {mass} tickets. As a minimum, the weight {mass} ticket shall contain the name of the producer, name of Contractor, Project Number and county, truck number, contract item number, date, gross weight {mass}, tare weight {mass}, net weight {mass}, and Weighmaster signature. For measurement systems capable of measuring net weight {mass} directly from the measuring hopper, the gross and tare weights {masses} will not be required. In lieu of bulk weight {mass}, the Department will accept weights {masses} of materials normally sold in bagged form (i.e. fertilizers, cement, etc.).

The Engineer will make at least one unannounced independent weight {mass} check for every three months of operation with at least one per project for each material delivered under the weighmaster program. Each check will include a check of both the gross and the tare weights {masses}. For these weight {mass} checks, the Contractor shall make necessary arrangements, meeting the approval of the Engineer, for the use of independent scales certified in accordance with Item 109.01(h)1.

It shall be the sole responsibility of the Contractor to insure that a weight {mass} ticket is delivered to the project with each load. Weight {Mass} tickets will not be accepted after the truck has left the project.

*Weighmasters must be qualified in accordance with the provisions of Section 8, Chapter 16, of the Code of Alabama, 1975, or in case of material purchased out of State complying with the appropriate State laws, rules and regulations for Weighmasters of the State involved. A copy of the "Weighmaster's Certificate" shall be furnished the Engineer and additionally a copy shall be displayed in a conspicuous place in the vicinity of the measuring operations.

3. WEIGHT {MASS} MEASUREMENT FOR PROPORTIONING, ETC. OF MATERIALS.

Scales used for proportioning mixtures within mixing plants shall comply with the following unless otherwise noted:

a. Asphalt Mixing Plants.

Scales may be either springless dial, multiple beam, or electronic load cell type. For multiple beam scales, a tare beam for balancing and a telltale device for accurate measuring, visible to the plant inspector on the mixing platform, shall be provided.

b. Concrete Mixing Plants or Units.

For obtaining weight {mass} of materials at a central plant, beam, springless dial, or electronic load cell scales, suitable for this class of service, shall be used. Unless separate measuring units are used for each kind of material measured, the scales shall be equipped with a multiple measuring beam with enough beams so that the required weight {mass} of each material to be measured can be separately set off and all material measured without changing the settings. Separate scales shall be provided for bulk cement and for bulk fly ash, as provided in Article 815.11.

Scales of the suspended hopper type shall have a telltale dial, tare beam, or other device that indicates to the operator the approach of not less than the last 50 pounds {25 kg} of the required hopper load for structure concrete plants or the last 200 pounds {90 kg} for concrete pavement plants. Telltale dials shall clearly show when overload is on the scale, and suitable provisions shall be made for disconnecting such dials, when necessary for balancing the scales and again connecting the dial without affecting the dead load balance.

Dial faces shall be of a material not affected by moisture and shall have a suitable transparent protective cover for the dial face and dial indicator. An acceptable method of marking the correct dial indicator position when predetermined loads are in the hopper shall be provided. Plants with operational automatic cutoff devices shall be an acceptable substitute for providing markings for predetermined loads.

For obtaining the weight {mass} of materials at the work site, scales shall be of appropriate capacity and shall meet the requirements noted above; however, for small structures in difficult locations use of platform scales suitable for measuring wheelbarrows will be permitted.

Scales for obtaining the weight {mass} of wheelbarrows shall have beams so arranged that the weight {mass} of the wheelbarrow may be set separately from the weight {mass} of the material. Separate scales shall be used for each aggregate, for bulk cement and for fly ash, unless the multiple beam type is used, with a separate beam for each material and release levers to throw each beam out of service.

Suspended hopper measuring equipment shall be of an approved type complying with the requirements of this Article.

c. Base Course Mixing Plants.

Measuring equipment shall meet the requirements of Subitem b. above with separate bins for each size aggregate and separate bins and scales for additives (calcium chloride, cement, etc.).

(i) LOOSE MEASUREMENT (VOLUMETRIC).

All materials to be measured by the cubic yard {cubic meter}, "loose measurement" or "measured in the vehicle", shall be hauled in approved vehicles and will be measured therein at the point of delivery. No allowances will be made for the settlement of material in transit. Approved vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. Each approved vehicle must bear a plainly legible identification mark indicating the specific approved capacity. All approved vehicles shall be loaded to not less than their water level capacity when they arrive at the point of delivery. Loads not hauled in approved vehicles or of a quantity less than the specifically approved quantity for the hauling vehicle, measured as specified herein, will be rejected and shall be removed from the work. If rejected, no compensation will be allowed for the rejected load.

(j) CONVERSION OF WEIGHT {MASS} TO VOLUME.

When requested by the Contractor and approved in writing, material specified to be measured by the cubic yard {cubic meter} may have its weight {mass} determined and such weight {mass} will be converted to cubic yards {cubic meters} for payment purposes. Ratios for conversion from weight {mass} measurement to volume measurement will be determined periodically by the Engineer. Each ratio as determined shall be agreed to by the Contractor before such method of measurement will be used.

(k) TIMBER.

Timber will be measured by the thousand feet board measure (MBM) {cubic meter} actually incorporated in the structure with no allowance for any waste except beveled ends. Measurement will be based on nominal widths and thickness and the extreme length of each piece.

(l) LUMP SUM.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the contract.

When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

109.02 Measurement of Asphaltic Material.

(a) WEIGHT {MASS}.

Asphaltic materials shall be measured in tons {metric tons} or gallons {liters} as specified on the plans or in the proposal. If measured by weight {mass}, each tank truck, drum or distributor shall have its weight {mass} obtained as the material is delivered to the location of the work, and the container vehicle shall have its weight {mass} obtained immediately after emptying; except that when this method cannot be used other means of accurately measuring the material may be substituted with permission of the Engineer.

(b) GALLONAGE {LITERS}.

When specified on the plans or in the proposal, bituminous material will be measured by the gallon {liter} in the railroad car, tank truck, distributor tank, or drums. Each railroad tank, tank truck, drum or distributor tank of bituminous material delivered for the project will be measured. The measurement shall be taken when the bituminous material is of a uniform temperature and free from air bubbles.

(c) TEMPERATURE CORRECTION.

The volumetric measurement of the bituminous material will be based upon a temperature of 60 °F {16 °C}, using the following correction factors:

0.00035 per degree F {0.00063 per degree C} for petroleum oils having a specific gravity above 0.966 at 60 °F/60 °F {16 °C/16 °C};

0.00040 per degree F {0.00072 per degree C} for petroleum oils having a specific gravity between 0.850 and 0.966 at 60 °F/60 °F {16 °C/16 °C};

0.00025 per degree F {0.00045 per degree C} for emulsified asphalts.

109.03 Scope of Payment.

(a) QUANTITIES.

The quantities listed in the bid schedule do not govern final payment. Payments to the Contractor for contract items will be made for the actual quantities of these items performed in accordance with the plans and specifications. If upon completion of the construction these actual quantities show an increase or decrease from those in the proposal, the contract unit prices will still govern except where modified by supplemental agreement or allowance made as provided in Articles 104.02 and 104.03. Quantities included in supplemental agreements will be paid for as stipulated therein. Force account work will be paid for as provided in Article 109.04.

(b) BASIS OF PAYMENT.

The Contractor shall accept the compensation as herein provided, in full payment for furnishing all materials, labor, tools, equipment and incidentals necessary to the completed work and for performing all work contemplated and embraced under the contract; also for all loss or damage arising from the nature of the work, or from the action of the elements except as noted in Article 107.17, or from any unforeseen difficulties which may be encountered during the prosecution of the work and until its final acceptance; also for all risks of every description connected with the prosecution of the work.

(c) UNIT PRICE COVERAGE.

In cases where the basis of payment clause in the specifications relating to any unit price in the bid schedule requires that the said unit price cover and be considered compensation for certain work or materials essential to the item, this same work or materials will not be measured or paid for under any other pay item which may appear elsewhere in the specifications. Reference is made to Item 101.01(c)1.

(d) REPAIR OR RENEWAL OF DEFECTIVE WORK.

The payment of any current estimate shall in no way affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for all damages due to such defects.

(e) BITUMINOUS MATERIAL PRICE ADJUSTMENTS.

1. GENERAL.

It is understood and agreed that the unit prices bid for bituminous materials in the accepted proposal are based on asphalt prices at the time of opening bids. The Department will determine an "Asphalt Index" based on monthly written base price quotes obtained from major

suppliers of asphalt products to the Alabama highway construction industry FOB the supplier's terminal. The "Index" will be composed of two entries. The PG Asphalt or Asphalt Cement index will be computed by determining the average unit price quoted for grade PG 67-22, to the nearest 0.1 cent for each month. The Emulsified Asphalt index will be computed by determining the average unit price quoted for Emulsified Asphalt, grade CRS2, to the nearest 0.1 cent for each month. The PG Asphalt or Asphalt Cement index will be used for all PG graded asphalts and all grades of asphalt cement. The Emulsified Asphalt index will be used for all grades of emulsified asphalts and cutback asphalts. The "Index" will be published monthly and will be used for price adjustments as noted in Items 2 and 3 below.

2. USAGE AND PAYMENT.

The "Base Index" will be the index published for the month in which the project is let. Price adjustments, plus or minus, will be computed each month that bituminous materials are used in the work. The amount of adjustment will be determined by multiplying the increase or decrease of the appropriate monthly index(es) from the base index by the amount of bituminous material used in the work during the period covered by the monthly estimate. Price adjustments will be applied to each monthly estimate as the adjustment amounts accrue. The amount of asphalt will be calculated as follows:

Bituminous Plant Mix Bases and Pavements - the number of gallons {liters} of new bituminous material required by the approved job mix formula. A conversion factor of 8.51 pounds per gallon {1.02 kg/L} will be used for figuring quantities. No measurement for adjustment will be made for the amount of asphalt rejuvenator used or for the amount of bituminous material recovered and used in surface recycling operations.

Surface Treatments - actual gallons {liters} of asphalt used within specification requirements with volumetric correction to 60 °F {16 °C} as per Subarticle 109.02(c).

Tack Coat - actual gallons {liters} of asphalt used within specification requirements with volumetric correction to 60 °F {16 °C} as per Subarticle 109.02(c).

Mulch Adhesive - actual gallons {liters} of asphalt used within specification requirements prior to dilution with volumetric correction to 60 °F {16 °C} as per Subarticle 109.02(c).

3. RESTRICTIONS.

Only those types of bituminous materials noted in Item 2 above shall be used in computation of any bituminous material price adjustment.

For bituminous materials used after expiration of contract time plus any approved time extension, a price adjustment will not be applied if the index for the month in which the material is used is more than the "Base Index"; however, a price adjustment will be applied if the index for the month in which the material is used is less than the "Base Index".

109.04 Extra and Force Account Work.

(a) GENERAL.

The Contractor will receive and accept payment for work performed under his contract either as contract items of work or as extra work. Contract items of work will be paid for at the unit prices stipulated in the contract. Extra work will be paid for at the unit prices or lump sum stipulated in supplemental agreement, or on a force account basis. Supplemental agreements shall be executed in accordance with Subarticle 104.03(b). Extra work performed on a force account basis will be compensated for in the following manner.

(b) FORCE ACCOUNT BASIS.

1. LABOR.

For all labor and foremen employed on the force account work, the Contractor shall receive the agreed hourly wages or scale for the number of hours the said laborers and foremen were actually engaged in such work. The wages or scale shall be comparable to the wages or scale paid by the Contractor for work of a like nature on his contract pay items and shall be agreed upon in writing by the Contractor and Engineer before the said force account work is begun.

To this sum shall be added an amount equal to 20 percent thereof.

No additional pay beyond the agreed hourly scale will be allowed for "overtime work" unless such overtime work is authorized in writing by the Engineer.

2. BOND, INSURANCE AND TAX.

For public liability and property damage insurance and workmen's compensation insurance premiums, increased bond premiums, unemployment insurance contributions and social security taxes, the Contractor shall receive the actual cost, to which no percent shall be added; in

addition on projects which the State Gross Receipt Tax is applicable, may include said tax. The Contractor shall furnish satisfactory evidence of the rates paid for such bond, insurance, and tax.

3. MATERIALS.

For materials accepted by the Engineer and used, the Contractor shall receive the actual cost of such materials delivered on the work (exclusive of machinery rentals as herein set forth) to which cost 15% will be added.

4. EQUIPMENT.

For rental rates of equipment (other than small tools) authorized by the Engineer for use on force account work, the Engineer will use the latest publication of the Rental Rate Blue Book for construction equipment published by PRIMEDIA Information Incorporated to determine payment to the Contractor. Payment will be made for the actual time that the authorized equipment is in operation on the force account work. The ***hourly rate*** for each piece of equipment will be the monthly rate shown in the equipment table divided by 176. Weekly and daily rates will not be used. In addition, for equipment solely dedicated to the force account work, consideration will be given to paying standby cost. Operating rates and standby rates for computing the equipment payment will be determined as follows:

Operating rates. The ***hourly rate*** will be multiplied by the appropriate rate adjustment factor and regional factor shown in the Rate Adjustment Table and on the Regional Adjustment Map, respectively, to obtain the ***adjusted hourly rate***. The estimated operating cost/hour from the equipment table will be added to the ***adjusted hourly rate*** to establish the ***operating rate***.

Standby rates. The use of a standby rate is appropriate when equipment has been ordered to be available for force account work but is idle for reasons which are not the fault of the Contractor. The ***standby rate*** will be determined by multiplying the ***adjusted hourly rate*** by 0.50.

Operating rates will be used only when the equipment is actually being used. Standby rates will be used under the following conditions:

a. The equipment must be totally dedicated to the force account work and not used intermittently on other work.

b. Standby cost will not be considered until after the equipment has been operated on the force account work.

c. If the equipment is dedicated for force account for a full calendar work week, the standby time will be 40 hours minus the operating time for the week. If the difference in these two figures is zero or less, there will be no payment for standby.

d. If the equipment is dedicated for force account for a partial week, the standby time will be computed on a daily basis. The standby time per day will be 8 hours minus the operating time for the day. If the difference in these two figures is zero or less, there will be no payment for standby.

The above will apply without further adjustment if overtime work is approved by the Engineer.

The above shall be full compensation for all equipment costs except operator cost. Payment for operators will be under Item 109.04(b)1, Labor.

If equipment is required that is not listed in the Rental Rate Blue Book, then payment will be made for that equipment based on a certified or paid invoice for the period of time covered by the invoice. In this case, the equipment must be totally dedicated to the force account work and no distinction will be made between operating cost and standby cost. If this equipment is owned by the Contractor, then rental rates for operating and standby costs shall be agreed upon between the Contractor and Engineer prior to its use.

5. MISCELLANEOUS.

No allowance shall be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.

6. ADMINISTRATIVE ALLOWANCE.

When force account work is accomplished by an approved subcontractor, the Contractor shall receive, as compensation for administration costs, an amount equal to three percent of the first $20,000 and one percent of all over $20,000 of the total amount paid under items 1, 3, and 4 of this Subarticle for force account work accomplished by an approved subcontractor.

7. COMPENSATION.

The compensation as set forth in this Subarticle shall be received by the Contractor as payment in full for extra work done on a force account basis. Said compensation shall cover all work,

profit, administrative costs, and incidental costs of whatever nature incurred in the work whether performed by the Prime Contractor or an approved subcontractor. At the end of each day, the Contractor's representative and the Inspector shall compare records of the cost of work done as ordered on a force account basis.

8. STATEMENTS.

No payment will be made for work performed on a force account basis until the Contractor has furnished to the Engineer duplicate itemized statements of the cost of such force account work, detailed as to the following:

a. Name, classification, date, daily hours, total hours, rate, and extension for each laborer and foreman.

b. Designation, dates, daily hours, total hours, rental rate and extension for each truck and other unit of machinery and equipment.

c. Quantities of materials, prices, and extensions.

d. Transportation of materials.

e. Cost of public liability and property damage insurance and workmen's compensation insurance premiums, increased bond premiums, unemployment insurance contributions, and social security tax.

Statements shall be accompanied and supported by original receipted invoices for all materials used and transportation charges, provided that, if materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then in lieu of the original invoices the statements shall contain or be accompanied by an affidavit of the Contractor certifying that such materials were taken from his stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

109.05 Compensation for Altered Quantities.

When the accepted quantities of work vary from the quantities in the bid schedule, the Contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract unit prices for the actual quantities of work done. No allowance or other adjustment, except as provided in Article 104.02, will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense on the part of the bidder and subsequent loss of expected reimbursement therefor or from any other cause.

Additional work caused by alterations of plans or changes in character of work will be paid for by supplemental agreement or on a force account basis.

109.06 Omitted Items and Cancelled Work.

(a) ELIMINATION OF ITEMS.

Should any items contained in the proposal be found unnecessary for the proper completion of the work contracted, the Engineer may eliminate such items from the contract, and such action shall in no way invalidate the contract and no allowance will be made for items so eliminated in making final payment to the Contractor except for such actual work as may have been done, materials actually purchased and bona fide equipment costs incurred for such eliminated item prior to notification of the elimination of the items.

(b) UNUSED MATERIALS.

For materials ordered and delivered for the unfinished portion of such cancelled or omitted items, the State will pay actual certified cost (material and handling or transporting cost) plus fifteen percent for both overhead and gross receipt tax charges; no anticipated profit will be considered. Material paid for shall become the property of the State and shall be disposed of as directed by the Engineer.

109.07 Partial Payment.

Once each month the Engineer will make an appropriate estimate on the regulation form of the work or portion of the work completed and the value thereof based on the contract Unit Prices, or proportional part thereof for Lump Sum items, less any assessed liquidated damages or other designated deductions.

This estimate may, if requested in writing by the Contractor and approved by the Engineer, include cost of certain commercial non-perishable items such as, but not limited to, base aggregates,

reinforcing steel, bridge piling, structural steel, prefabricated bridge components, traffic signal equipment, electrical equipment, fencing materials, sign materials and others as may be authorized by the Engineer within the following limitations:

1. The location of the storage site shall be at the project site or other designated location in the vicinity of such construction whenever practical. Off-site storage may be approved if the Engineer considers off-site storage to be more practical. In either case, all conditions of this Article concerning stored (stockpiled) material shall be met. Departmental Form C-21 will be used to document all payments for stored material.

2. All material approved for payment in storage must be manufactured for specific use on the project. It shall be stored in accordance with good construction practices, and shall be separated from other materials where it can be inventoried at any time. No payment will be made on any material which does not conform with the requirements of the plans and specifications. The Contractor will be responsible for the security of all storage sites.

3. Payment, unless otherwise provided under a specific item of work, shall not exceed 100% of the certified invoice cost (including applicable taxes) of the material actually delivered to the approved storage site or 75% of total bid price for the item of which the material is a part, whichever is less. An invoice or an accumulation of invoices for each eligible pay item must total $2,500 or more before consideration will be given for making partial payment. After payments are placed on monthly estimates, the Contractor shall furnish the Project Engineer with copies of certified paid invoices from the suppliers of the materials. Such certification shall read as follows: "I do hereby certify that this is a true and correct invoice and has been paid." Such wording shall be followed by the signature of an authorized representative of the supplier. Failure to furnish these certified invoices within thirty (30) days from the date of issuance of the monthly payment (check) covering the estimate for which the payment of materials was made by the State will result in the deletion of the payment from the next estimate following the expiration of said 30-day period.

4. As stockpiled materials are incorporated into the work, proportional deductions will be made in the monthly estimate for such partial payments.

5. Partial payment for materials on hand will not constitute acceptance and any faulty material will be rejected even though previous payment may have been made. The Contractor shall be solely responsible for furnishing and incorporating acceptable materials into the work and for any loss or damage regardless of the cause, for any material on which partial payment is made.

6. Transportation charges for delivery of eligible materials to the approved storage site may be included in partial payments for stockpiled materials if properly documented. Such charges may be included in the materials invoice or handled as a separate invoice, whichever is appropriate.

The estimate, less any payments previously made, will be certified by the Director for payment provided progress and quality of work is satisfactory and in conformity with Subarticle 108.04(b).

No monthly payment will be required to be made when the amount due on the project is less than $2,500. A statement of any sum due the State or County for equipment, labor, or supplies furnished under the provisions of these Specifications will be furnished along with the estimate and the amount of same will be deducted from the estimate before payment is made by the State.

The payment of any monthly estimate for any portion of the work as provided in the Specifications shall in no way affect the obligation of the Contractor to complete the work in accordance with the contract

109.08 Payments to Subcontractors.

The Prime Contractor shall make payment to all subcontractors, for the portion of the work satisfactorily completed by the subcontractors, within 14 calendar days of the Contractor's receipt of a partial payment from the ALDOT.

When the Subcontractor's work has been satisfactorily completed, the Prime Contractor shall, within 14 calendar days of receipt of partial payment from ALDOT, pay the Subcontractor all monies due including monies withheld as retainage.

The Contractor shall provide a letter from each Subcontractor, who was active on the project during the prior estimate period, certifying that they were paid for the previous estimate period’s work in accordance with the above requirements. These letters shall be provided to the project engineer prior to Estimate No. 2 and each subsequent monthly estimate. Failure to provide prompt payment, to return retainage or to provide the subcontractor certification letter of prompt payment may result in the withholding of further payment or the suspension of the work in accordance with Article 105.01.

109.09 Payment for Work.

Payment for work will be made by the State by warrants drawn against State funds that are legally available for such work.

All monies payable under the contract, or any part thereof, will be paid to the Contractor in accordance with the provisions of these specifications, and no assignment or order executed by the Contractor directing payment of any portion or all of such funds to any other person or persons will be recognized by the State unless such assignment or order specifies the amount to be so paid and the purposes for which the assignment or order is given. Such assignment or order shall have attached thereto, by endorsement or otherwise, the consent of the surety. No such assignment or order will be binding on the State.

109.10 Disputed Claims for Extra Compensation.

Claims shall be handled as provided in Section 110, Claims.

109.11 Time Limit for Final Adjustment.

It is understood that the Director will not be bound to consider applications for correction of estimates and payments, including assessed liquidated damages, after the Contractor has signed his final estimate, or after 30 days from the date when the final estimate is submitted to the Contractor for his signature or approval, unless in the latter case the Contractor submits written request within the 30-day period for adjustment of estimates and payment, including assessed liquidated damages.

109.12 Final Payment.

(a) FINAL QUANTITIES.

Within 60 calendar days after the final inspection as outlined in Article 105.15, the Engineer will prepare the list of final quantities for the various items of work performed. The Engineer will submit by certified letter, return receipt requested, the list of final quantities to the Contractor for his review and concurrence.

The Contractor will have 45 calendar days from the date of receipt to submit either written concurrence of the final quantities or a written statement of disagreement. The written statement of disagreement shall contain a list, item by item, of the quantities that the Contractor does not agree with and his reasons for disagreement on each item's final quantity. Failure by the Contractor to furnish the written statement within 45 calendar days shall be prima facie evidence that the Contractor considers the submitted final quantities to be satisfactory and waives any further consideration of the final quantities.

Upon notice from the Contractor of a dispute in quantities, the Engineer will promptly attempt to resolve the differences. Should he be unable to reach agreement with the Contractor, the matter will be referred to the Director for his resolvement. The Director may direct that the disputed quantities be handled as a claim as provided in Section 110, Claims.

If the Contractor requests the Department to make a resurvey which will require additional field and/or office work, the Director may grant the request with the understanding that the Contractor will be paid the final survey and/or computed quantities whether they be more or less than the original final quantities. If a resurvey is made at the Contractor's request, the Contractor and the Department shall share equally the additional cost of the resurvey and the Contractor's portion of this cost will be deducted from the final estimate.

(b) CLAIMS.

All claims for extra compensation will be handled in accordance with Section 110, Claims.

(c) FINAL ESTIMATE DOCUMENTATION.

Prior to submission of the final estimate voucher to the Contractor for his signing, the Contractor shall furnish the following documentation, as applicable:

1. A non-resident contractor must provide a certified "statement of good standing" from the State Department of Revenue and the appropriate County and/or City authority. This statement certifies that the non-resident contractor had paid all taxes due and payable to the State of Alabama or any political subdivision thereof. See Section 39-2-12 of the Alabama Code.
2. Proof of publication of advertisement of project completion as per Item 105.15(c)3.
3. A signed affidavit attesting that all known debts for labor and materials used on the project and all approved subcontractual obligations associated with the construction of the project have been paid or will be paid within 5 days after final payment. The affidavit shall be on a standard form furnished by the Department.

Failure by the Contractor to furnish any of the above documentation may be cause for the Department to disqualify the Contractor from future bidding as per Article 102.02.

(d) PAYMENT.

Upon resolution of the final quantities, all claims, and receipt of the above listed documentation, and written notice of final acceptance, the final estimate voucher will be prepared taking into consideration all prior partial payments. The Engineer will submit by certified letter, return receipt requested, the final estimate voucher to the Contractor for his signing. The Contractor shall have 30 calendar days after receipt of the voucher to sign and return the same for processing for final payment. Should the Contractor fail to sign and return the voucher within the 30 days, he will be declared in default in accordance with Paragraph 5 of Article 108.12.

Upon receipt of the signed final estimate voucher or default action taken per Paragraph 5 of Article 108.12, the Department will issue a warrant in the amount due the Contractor. The final warrant will be issued to the Surety in cases where the Contractor is placed in default under Article 108.12 and the contract is placed in the hands of the Surety. By agreement it is hereby stipulated that the Contractor and the Surety are forever barred and estopped from any recovery of claims whatsoever against the Department under the terms of the contract.

SECTION 110
CLAIMS

110.01 General.

When filing a claim, the Contractor shall follow the procedures set forth in this Section.

110.02 Notice of Intent.

In any case where the Contractor deems that extra compensation is due him for additional cost not clearly covered in his contract and not ordered by the Engineer as extra work as defined herein, the Contractor shall notify the Project Engineer in writing, with copy to the State Construction Engineer, of his intention to make claim for such extra compensation.

The written notice of intent shall be furnished to the Engineer prior to the time the contested work is started. Oral notification by the Contractor and confirmed in writing by the Contractor within three calendar days, will be accepted as complying with this requirement.

The written notice of intent shall set forth the reasons the Contractor believes additional compensation will be due, the nature of cost involved and insofar as possible the total amount of the claim.

The Contractor hereby agrees to waive any claim for additional compensation if notification, as provided in the foregoing, is not furnished or the Engineer is not provided facilities by the Contractor for keeping account of actual costs.

Such notice by the Contractor, and the fact that the Engineer has kept account of the cost as aforesaid, is not evidence of the validity of the claim. A separate determination of the validity of the claim will be made by the ALDOT.

110.03 Record Keeping.

After giving the ALDOT a notice of intent to file a claim, the Contractor shall keep daily records of all costs incurred for affected operations. These daily records shall identify each operation affected, the specific locations where work is affected, and the potential effect to the project's schedule. The ALDOT's Project Engineer will also keep records of all labor, material, and equipment applicable to affected operations. On Monday, or the first work day, of each week following the date of the notice of intent to file a claim, the Contractor shall provide the ALDOT's Project Engineer with the daily records for the preceding week. If the Contractor's records indicate costs greater than those kept by the ALDOT, the ALDOT will meet with the Contractor and present its records to the Contractor at the meeting. The Contractor shall notify the Engineer in writing within three work days of any inaccuracies noted in, or disagreements with, the ALDOT's records. The Engineer will review the matter, correct any inaccuracies he finds in the ALDOT's records, and notify the Contractor in writing of his decision.

Refusal or failure by the Contractor to attend the aforementioned meetings and present his records shall constitute a waiver by the Contractor of his claim.

To protect the integrity of the independent records maintained by ALDOT for comparison with those submitted by the contractor, ALDOT records, other than those mentioned above, will not be

made available to the Contractor until after ALDOT'S receipt of the Contractor's complete records documenting the claim, ALDOT will retain possession of the records and provide copying facilities with the contractor reimbursing the ALDOT for the expense of the copying. No amendment to the claim shall be made following receipt of the ALDOT's records.

110.04 Claims Process.

(a) GENERAL.

After the work has been completed on the disputed item(s) of work, the Contractor shall have 90 calendar days to submit his claim. Any claim not submitted within this 90 calendar day period is waived. The Contractor shall submit six copies of the claim, containing the required documentation listed in Article 110.03, to the Project Engineer. Once the claim is received, a joint review of the claim will be made by the Division and the Construction Bureau and a written response to the Contractor will be made within 90 calendar days. If the Contractor does not agree with this decision, he may request to make a presentation to the Claims Committee. This written request, along with six additional copies of the original claim, shall be made to the Project Engineer, by certified mail, within 30 calendar days from the date of the ALDOT's response. Failure to make the request within the required time period shall constitute waiver of the claim by the Contractor.

(b) CLAIMS COMMITTEE.

The Claims Committee will be composed of four ALDOT employees, appointed by the Director, who were not involved in the design or construction of the project. For Federal Aid projects, the FHWA will be invited to send an observer. The presentation will convene at the mutual convenience of the ALDOT and the Contractor. Issues not specifically presented in the claim package acted upon by the Construction Bureau and the Division are not subject to consideration by the Claims Committee. Following the presentation, the Claims Committee will provide a written recommendation to the Director. The Claims Committee's recommendation may be accepted, modified or denied by the Director. If accepted, the Director's decision shall be final, non-appealable, and not subject to judicial or other review except as provided in these Specifications.

If the Contractor does not accept the decision of the Director, he may request to make a presentation to the Claims Appeal Board. This request shall be made in accordance with Item 110.04(c)2. below.

(c) CLAIMS APPEAL BOARD.

1. COMPOSITION AND APPOINTMENT.

The Claims Appeal Board is a standing committee created to receive a presentation regarding a claim. The Claims Appeal Board will hear claims for additional monetary compensation which may include a request for a time extension; however, stand-alone time extension requests will not be considered by the Board. The Board consists of three primary members who are normally appointed for two-year terms. A three-member pool of alternates will be selected from which to provide a substitute for the primary member in the event that the primary member is unable to serve at a particular time or in the event that the Director declares the position vacant due to unfitness, death, illness, incapacity, conflict of interest or any other circumstance which would make service on the Board by that member impossible, difficult or unobjective. The three primary members of the Board and three alternates are appointed in the following manner. The Transportation Director appoints the primary and one alternate for one position. The Alabama Road Builders' Association appoints the primary and one alternate for a second position. The Transportation Director and the Alabama Road Builders' Association jointly appoint the primary and one alternate for a third position. The jointly appointed primary member will be the Board Chairman. The jointly appointed alternate will be the alternate Board Chairman. At least two Board Members must be registered Professional Engineers in the State of Alabama.

In the event that an alternate member is elevated to permanently replace a primary member of the Board, then a new alternate shall be appointed in the same manner as was the departing alternate. Such will also be the case if an alternate position is declared vacant by the Director due to death, illness, incompetence or other reasons. In the event that both the primary member and the alternate member are unable to serve or must recuse themselves due to conflict of interest, etc., on a particular claim(s) hearing, a new member of the Board will be appointed in the same manner as the primary member to sit for that particular hearing.

The ALDOT will notify the Contractor in writing of the date of the presentation and the names of the Board members. The Contractor will have ten calendar days from receipt of the letter to

file with the Director, by certified mail, an objection as to the composition of the Board which specifically details the nature of the objection. The Director shall have final authority in determining the composition of the Board.

Each Board member will be paid $60 per hour for actual time spent on reviewing the plans, specifications, and claim; attending the presentation and for preparing the report to the Director. This payment will cover all compensation and expenses.

2. PRESENTATIONS.

The Contractor may initiate a request for a Board presentation by submission of a written notice by certified mail to the Director within 30 calendar days from the date of the Director's decision on the recommendation of the Claims Committee. Failure to make the request within the required time period shall constitute waiver of the claim by the Contractor. The Board presentation will convene at the mutual convenience of the Board, the Department, and the Contractor. Issues not specifically presented in the original claims package are waived and are not subject to consideration by the Board.

The FHWA will be invited to send an observer for Federal Aid projects.

The Contractor shall pay for 50 percent of the expenses of a Board presentation. The written recommendation of the Board will be sent to the Director following the presentation. The Claims Appeal Board's recommendation may be accepted, modified, or denied by the Director. After receiving the recommendation of the Claims Appeal Board, the Director has 45 calendar days to report his decision to the Contractor.

The Director's decision in the resolution of any and all claims shall be final, non-appealable and not subject to judicial or other review. The decision of the Director is binding upon all parties including, but not limited to, contractors, subcontractors, and third party beneficiaries. After the final ruling by the Director on a claim, a supplemental agreement shall be processed to make payment for any amount deemed payable by the Director.

110.05 Claim Compensation.

(a) GENERAL.

1. COMPENSABLE ITEMS.

The liability of the Department for claims will be limited to the following specifically identified compensable items:

a. Additional job site labor expenses.

b. Additional costs for materials.

c. Additional job-site overhead.

d. An additional 10 percent of the total of Subitems a, b, and c above for home office overhead and profit.

e. Equipment costs, which shall be determined in accordance with the requirements of Item 109.04(b)4.

f. Bond costs.

g. Subcontractor costs as determined by, and limited to, those items identified as payable under Subitems a, b, c, d, e, and f above.

h. Administrative allowance, to the Prime Contractor, equal to three percent of the first $20,000 and one percent of all over $20,000 of the total amount for processing a claim on behalf of a subcontractor.

i. Gross receipts tax.

j. Interest that accrues after 30 calendar days from the date of the Governor's signature on the supplemental agreement that makes payment for a claim.

2. NON-COMPENSABLE ITEMS.

The Department will have no liability for the following specifically identified non-compensable items:

a. Profit, in excess of that provided herein.

b. Loss of anticipated profit.

c. Labor and equipment inefficiencies.

d. Home office overhead in excess of that provided herein.

e. Consequential damages, including but not limited to loss of bonding capacity, loss of bidding opportunities and insolvency.

f. Indirect costs or expenses of any nature.

g. Attorneys fees, claims preparation expenses or costs of litigation.

h. Interest prior to the final resolution of the claim as defined in Subitem 110.05(a)1.j. above.

(b) CLAIMS FOR DELAY.

The Department will have no liability for damages due to delay, beyond those items which are specifically identified as compensable under Subarticle 110.05(a) above. Equipment costs, for equipment involved in a delay claim, shall be determined in accordance with the requirements for Standby Rates as provided in Item 109.04(b)4.

The Department will be liable only for those delay damages caused by or arising from acts or omissions on the part of the Department which violate legal or contractual duties owed to the Contractor by the Department. Such delays may constitute a basis for a claim for delay damages and/or a request for a time extension. The Contractor assumes the risk of damages from all other causes of delay.

(c) CLAIMS FOR ACCELERATION.

The Department will have no liability for any constructive acceleration unless the Department gives express written direction for the Contractor to accelerate his effort beyond that required by the original contract. Any acceleration related costs will be handled as extra work as provided in Article 104.03.

110.06 Required Claim Documentation.

All claims shall be submitted in writing, and shall be sufficient in detail to enable the Engineer to ascertain the basis and the amount of each claim. All information submitted to the Department under this Article will be used solely for analyzing and/or resolving the claim. As a minimum, the following information shall be provided for all claims:

(a) A copy of the "Written Notice of Potential Claim" filed for the specific claim by the Contractor.

(b) The date on which actions resulting in the claim occurred or conditions resulting in the claim became evident.

(c) A detailed factual statement of the claim providing all necessary dates, locations and items of work affected by the claim.

(d) The specific provisions of the Contract which support the claim, and a statement of the reasons why such provisions support the claim.

(e) The amount of additional compensation sought and a break-down of the amount into the categories specified as payable under Article 110.05, Claim Compensation.

(f) The name, function, and activity of each Department official, or employee, involved in, or knowledgeable about facts that give rise to such claim.

(g) The name, function, and activity of each Contractor or Subcontractor official, or employee, involved in, or knowledgeable about facts that give rise to such claim.

(h) The identification of any pertinent documents, and the substance of any material oral communication relating to such claim.

(i) If an extension of time is also sought, the specific days for which it is sought and the basis for such request.

For delay claims, in addition to the above, a description of the operations that were delayed, the reasons for the delay and how they were delayed will be required.

110.07 Auditing Of Claims.

All claims filed against the Department shall be subject to audit by the Department’s External Auditor at any time following the filing of such claim. The audit may begin on ten days notice to the Contractor, Subcontractor, or Supplier. The Contractor, Subcontractor, or Supplier shall cooperate with the auditors. Failure of the Contractor, Subcontractor, or Supplier to maintain and retain sufficient records to allow the Department's auditor to verify the claim shall constitute a waiver of that portion of such claim that cannot be verified and shall bar recovery thereunder.

Without limiting the generality of the foregoing, and as a minimum, the auditors shall have available to them the following documents:

(a) Daily time sheets and foreman's daily reports.

(b) Union agreements, if any.

(c) Insurance, welfare, and benefits records.

(d) Payroll register.

(e) Earnings records.
(f) Payroll tax returns.
(g) Material invoices, purchase orders, and all material and supply acquisition contracts.
(h) Material cost distribution worksheet.
(i) Equipment records (list of company equipment, rates, etc.).
(j) Vendor rental agreements, and Subcontractor invoices.
(k) Subcontractor payment certificates.
(l) Canceled checks (payroll and vendors).
(m) Job cost report.
(n) Job payroll ledger.
(o) General ledger, general journal, (if used) and all subsidiary ledgers and journals together with all supporting documentation pertinent to entries made in these ledgers and journals.
(p) Cash disbursements journal.
(q) Financial statements for all years reflecting the operations on this project.
(r) Income tax returns for all years reflecting the operations on this project.
(s) Depreciation records on all company equipment whether such records are maintained by the company involved, its accountant, or others.
(t) If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents.
(u) All documents which reflect the Contractor's actual profit and overhead during the years this Project was being performed and for each of the five years prior to the commencement of this Project.
(v) All documents related to the preparation of the Contractor's bid including the final calculations on which the bid was based.
(w) All documents which relate to each and every claim together with all documents which support the amount of damages as to each claim.
(x) Worksheets used to prepare the claim establishing the cost components for items of the claim including, but not limited to, labor, benefits and insurance, materials, equipment, subcontractors, and all documents which establish the time periods, individuals involved, the hours and the rates for the individuals.

DIVISION 200
EARTHWORK

SECTION 201
CLEARING AND GRUBBING

201.01 Description.

The work of clearing and grubbing under this Section shall consist of clearing, grubbing, removing and disposing of all vegetation and debris, except such objects as are designated to remain or are to be removed in accordance with other sections of these specifications, within designated limits of the right of way and easement area. This work shall also include the preservation from injury or defacement of all vegetation and objects designated to remain. Special attention is directed to Section 665 which governs Erosion Control operations.

The work of selective clearing under this Section shall consist of removing and disposing of dead, diseased, poorly formed, or other trees designated by the Engineer to be undesirable and shall include removal and disposal of undergrowth, stumps of uprooted trees, logs, vines, other undesirable vegetation, and all debris designated by the Engineer.

The work of clearing under this Section shall consist of the clearing of the roadside by removal and/or chipping as shown on the plans or as required in these specifications.

201.02 Materials.

Herbicides shall be as currently approved by the Department.

201.03 Construction Requirements.

(a) GENERAL.

The Engineer will establish right of way and easement lines, construction lines and designate all trees, shrubs, plants and other items to remain. Any damage to natural terrain or to vegetation or objects designated to remain shall be repaired, replaced, or otherwise compensated for, as determined by the Engineer, at the expense of the Contractor.

The Contractor shall visit the proposed sites for clearing prior to bidding on this work and shall be familiar with all areas to be cleared under this contract.

(b) ITEM 201-A, CLEARING AND GRUBBING.

1. CLEARING.

The area within the construction lines shall be cleared of all surface objects and all trees, stumps, roots and other objectionable obstructions resting on or protruding through the surface of the original ground not designated to be retained.

Areas outside of the construction lines shall be selectively cleared of designated dead wood, undergrowth, rubbish and other objectionable matter, designated trees and stumps (stumps may be permitted to remain in this area provided they are cut off as near as practical to the ground line and treated with a Department approved herbicide), including trimming and treatment of damaged trees (in accordance with good tree surgery practice). Natural ground cover shall be protected insofar as practical.

2. GRUBBING.

All areas within the construction lines shall be grubbed of all objectionable matter on or projecting through the ground surface. All fill areas shall be grubbed to a depth at least 1 foot {300 mm} below the natural ground.

3. BRIDGE SITES.

The roadway Contractor shall clear and grub the entire right of way including all bridge and underpass sites, including excepted areas, within extreme limits of his contract unless otherwise specified on the plans or in the proposal, or directed by the Engineer. Grubbing outside actual foundation excavation lines at bridge sites and channel changes will be limited as directed, so that stumps which aid in erosion control may be left in place.

If the bridge contract is let in advance of the roadway contract, or if there is no roadway contract involved, clearing and grubbing of bridge and underpass sites shall be performed by the bridge Contractor.

Clearing and grubbing for any necessary channel change within or near the bridge site area shall be performed by the Contractor who constructs the channel change.

Bridge site as used above is defined as the area bounded by the right of way width and straight lines extending through points 1 foot {300 mm} outside the extreme limits of the structure wings, end bents or abutments to the R.0.W. lines.

4. DISPOSAL OF MATERIALS.

The Contractor shall submit, prior to beginning work, a plan for the satisfactory disposal of material and debris from the clearing and grubbing operations for approval by the Engineer.

Said plan shall provide for the satisfactory disposal of perishable materials and rubbish within 30 days after accumulation, unless a longer period is authorized in writing by the Engineer, to prevent infestation of pests.

Some acceptable methods of disposal may include:

a. Burning.

Burning of perishable materials will be permitted only when authorized in accordance with Articles 107.13, 107.22, and the following:

Any burning must be performed under the constant care of a competent watchman, at such times and in such a manner that will not jeopardize or cause damage or injury to surrounding vegetation, public or private property or anything designated to remain on the right of way.

Burning within the right of way in urban or populated areas or in the vicinity of roads or streets shall be kept to a minimum.

b. Removal From Right of Way.

Material and debris removed from the right of way shall be disposed of in a manner acceptable to the Engineer. Indiscriminate dumping of these materials on abutting property with or without the owners consent will not be considered satisfactory disposal. The Contractor must comply with all local, State and Federal laws and ordinances pertaining to the type material being disposed of and secure and submit written permission from the property owner for any disposal area. In addition he shall include in the disposal plan an acceptable plan for treatment of the area so as not to present an unsightly appearance, create a public nuisance or incur future maintenance problems for the Department.

c. Recycling.

The use of mechanical brush clippers or other recycling methods of vegetation growth will be considered for approval.

(c) ITEM 201-B, SELECTIVE CLEARING.

Selective Clearing shall comply with all requirements shown on the plans or as directed by the Engineer.

(d) ITEM 201-C, CLEARING.

1. GENERAL

Off-road equipment shall not be permitted to travel, stand or lift on the wearing surface. Any damages to the paved or grassed shoulders by the Contractor shall be restored to the original condition, at no additional cost to the Department.

Special care shall be exercised to do minimal damage to the existing terrain during this contract. When conditions are favorable to cause deep rutting or other grade disturbances by machinery, work shall cease or alternate methods shall be chosen to complete this work.

Where trees cannot be felled without danger to traffic, encroachment on the roadway, injury to other trees, structures, or property, they shall be cut down in sections.

All areas cleared under this contract that have cross-sectional slopes of 2:1 or flatter shall be bushhogged to a height of 6 inches {150 mm}(max.) with a rotary type cutter in one continuous operation after all trees and underbrush have been removed prior to final acceptance of the project.

Material and debris removed from the right of way shall be disposed of in a manner acceptable to the Engineer. Indiscriminate dumping of these materials on abutting property with or without the owner's consent will not be considered satisfactory disposal. The Contractor must comply with all local, State and Federal laws and ordinances pertaining to the type material being disposed of and secure and submit written permission from the property owner for any disposal area. In addition,

he shall not leave a cleared area in a condition which would present an unsightly appearance, create a public nuisance or incur future maintenance problems for the Department.

No burning will be permitted on the state right of way unless approved in writing by the Engineer.

Areas that are required to be cleared by chipping of the timber and spreading of the chips will be shown on the plans. If chipping and spreading of the chips is not required, the Contractor may remove the debris by cutting or chipping.

2. CLEARING WITH REMOVAL OF TIMBER.

The Contractor shall remove trees and bushes, with stumps left at or just below ground line or as detailed on the plans. On slopes of 2:1 or flatter, no part of the stump shall be left above ground level at any point. Stump removal shall be accomplished by cutting or grinding. Chips resulting from any grinding may be spread on surrounding slopes as directed by the Engineer. Hardwood tree stumps shall be treated immediately after cutting with a Department approved, dyed, herbicide. Herbicide will not be required for hardwood tree stumps removed a minimum of 1 foot (300 mm) below the ground line by grinding. The Contractor shall remove and dispose of any debris created by the clearing operation and any pre-existing debris, such as dead trees and limbs, to leave the area suitable for mowing. The clearing method used shall be one which will minimize damage to existing ground cover.

Tree trunks and limbs 4 inches {100 mm} or greater in diameter shall be removed from the project site by the end of the workday on which they are cut.

3. CLEARING WITH CHIPPING OF TIMBER.

The Contractor shall remove trees and bushes by chipping, with stumps chipped to a depth of 1 foot {300 mm} below ground line. Tree trunks, limbs and bushes shall be cut into chips using a chipping machine. The largest dimension of a chip should not average greater than 4 inches {100 mm}. The spread layer of chips shall not be thicker than 4 inches {100 mm}.

The Contractor shall chip any debris created by the clearing operation and any pre-existing debris, such as dead trees and limbs, to leave the area suitable for mowing.

201.04 Method of Measurement.

(a) GENERAL.

For Item 201-A, the area to be cleared and grubbed will include the entire area within the right of way lines and easement lines as designated on the plans. For bridge contracts let in advance of roadway contracts, the area to be cleared and grubbed by the Bridge Contractor will be that defined in Item 201.03(b)3. for a bridge site.

For Item 201-B, the roadside areas required to be selectively cleared at designated locations on the plans, the area will be measured in acres {hectares}, computed from surface measurements of the area ordered selectively cleared.

For Item 201-C, roadside areas required to be cleared, at designated locations on the plans, this work will be measured per lump sum.

(b) PARTIAL PAYMENT (ITEM 201-A).

The lump sum item of Clearing and Grubbing shall be measured for payment as covered by either Case 1 or Case 2 below, whichever applicable.

1. Case 1 - If the price bid for Item 201-A is equal to or less than 8% of the original contract amount.

The estimated percentage of the total area cleared and grubbed each month will be multiplied by the Contractor's bid price for Item 201-A. These percentage payments will be made each month work is performed on this item until the entire project has been cleared and grubbed.

2. Case 2 - If the price bid for Item 201-A is greater than 8% of the original contract amount.

The estimated percentage of the total area cleared and grubbed each month will be multiplied by 8% of the original contract amount. These percentage payments will be made each month work is performed on this item until the entire project has been cleared and grubbed. The maximum amount to be paid for clearing and grubbing prior to completion of the entire project will be 8% of the original contract amount, regardless of the amount bid for Item 201-A. The excess amount bid over 8% of the original contract amount will not be paid until payment of the final or semi-final estimate.

201.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

For Item 201-A, accepted clearing and grubbing will be paid for at the lump sum price bid in the contract for the entire right of way and easement area, and such lump sum bid shall be full compensation for furnishing all materials, equipment, tools, labor and incidentals necessary to complete and maintain the work item until acceptance of the project.

Where plans show the work extending beyond the beginning or end of the project, payment for necessary clearing and grubbing of the areas affected by such work beyond the project limits shall be included in the contract price bid.

In case changes in location, R.0.W. widths, or easement areas result in changes in areas from those shown on the plans, payment will be handled as Extra Work as defined by Article 104.03.

For Item 201-B, accepted selective clearing will be paid for at the contract unit price bid, measured as noted above, and such payment shall be full compensation for furnishing all materials, equipment, tools, labor and incidentals necessary to complete and maintain the work item until acceptance of the project.

For Item 201-C, accepted clearing will be paid for at the contract price bid, measured as noted above, and such payment shall be full compensation for cutting, removal of debris, chipping, spreading of chips, bushhogging, repairing of damage to the existing ground surface (including blading, topsoil, seeding, etc.), and for furnishing all materials, equipment, tools, labor and incidentals necessary to complete and maintain the work item until acceptance of the project.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

201-A Clearing & Grubbing (Approximately _____ acres {hectares}) - per lump sum
201-B Selective Clearing - per acre {hectare}
201-C Clearing - per lump sum

SECTION 205
REMOVAL AND RELOCATION OF STRUCTURES

205.01 Description.

The work under this Section shall cover the disposal or the re-establishment of structures, such as buildings, dwellings, etc., as designated on the plans or in the proposal. This work shall also include all appurtenances such as out buildings, fences, walks, driveways, utility facilities, other man-made objects, established lawns, shrubs, and designated trees associated with the structure.

The Department assumes no responsibility for furnishing building sites for structures other than those designated for relocation by the plans and assumes no responsibility for moving permits.

205.02 Materials.

Any material necessary for the re-establishment of a relocated structure shall meet the requirements of applicable building codes and regulations. In all cases new material shall be equal to or better than the material in the original structure.

205.03 Construction Requirements.

(a) GENERAL.

The disposition of structures will fall into two basic categories as follows:

Removal - The razing or otherwise disposing of structures from the location shown on the plans or in the proposal.

Relocation - The moving and re-establishment of a structure from the location shown on the plans or in the proposal to a new location shown on the plans. Relocation shall also include the removal of a structure and re-establishment at the right of way line.

All applicable State, City and County rules, regulations, or ordinances covering moving, re-establishing, demolition or disposal of structures or appurtenances shall be complied with. Particular attention is directed to rodent control and other health and safety regulations. Any utility service requiring connections or disconnection to a structure shall be made in accordance with the affected utility's regulations and shall meet the approval of the Utility.

After a structure has been moved or demolished, the Contractor shall remove all debris and dress up the entire R.0.W. parcel involved, filling all holes, etc. so as to present a neat appearance and eliminate possible hazards. While it is the intent of this specification that the R.0.W. parcel be left in a neat condition, the dressing up of the area shall be performed in such a manner that no conditions detrimental to adjoining areas will be created.

Reference is made to disposal methods and requirements for disposing of material as noted in Section 201.

When clearing and grubbing is not a part of the contract, the Engineer may give permission to cut certain trees that will interfere with future construction where they block structure demolition or removal. The Contractor will be required to dispose of trees cut prior to, or during, this contract in the same manner noted in Section 201.

(b) REMOVAL OF STRUCTURES.

All structures under this classification become the property of the Contractor and shall be removed by razing or otherwise disposing of the structure from the R.0.W. Stone, bricks, broken concrete, concrete blocks, and concrete masonry of all types may be used to fill low areas, existing wells, basements, and other depressions as approved by the Engineer. All other waste material from structures must be disposed of to the satisfaction of the Engineer as noted in Subarticle 201.03(e).

(c) RELOCATION OF STRUCTURES.

1. GENERAL.

No structure under this classification shall be relocated until it has been inspected by the Engineer in company with the Contractor and the owners and/or lessees and its actual condition determined. An itemized written report of the condition of the structure at the time of such inspection shall be prepared by the Contractor and signed by the Engineer, Contractor, owners and/or lessees and a copy given to all parties concerned. Photographs, from negatives, not less than 4 inches {100 mm} by 5 inches {125 mm} in size shall be made of the structure as directed by the Engineer. Prints of the photographs shall be attached to and become a part of each copy of the report before the report is signed. Once a Contractor begins moving a structure, he shall vigorously and continuously prosecute its moving and re-establishment in such a manner that the owner or lessee will be inconvenienced the shortest time possible. If the work is not expedited, the Engineer may order all work stopped or withhold estimates until the work on the structure in question is satisfactorily completed.

Structures that are moved to new locations or elevations shall be set upon substantial foundations conforming to the new elevations and sites. Sound materials salvaged from the same unit may be used, supplemented by necessary new materials similar to those in the existing foundations. Any damage or injury occasioned by moving shall be repaired by the Contractor without additional compensation.

Certain structures may be designated to be cut off and re-established at the right of way line. Care shall be taken to avoid damage to the remainder of the structure and any damage thereto shall be repaired by the Contractor without additional compensation. The cutoff portion of the building outside the right of way shall be braced and refaced along the right of way line as directed, using new or suitable materials salvaged from the same unit.

Established shrubs and lawns, along with designated trees, are considered a part of a structure relocation, hence, they shall be either transplanted or replaced in kind. Transplanting procedures shall be consistent with details noted in these specifications for transplanting trees and shrubs and for grassing work.

2. STRUCTURE RELEASE.

Structures and appurtenances shall not be considered satisfactorily relocated until the Contractor has furnished the Engineer with a release from the owners and lessees (if applicable) prepared on the form prescribed by the Department for the purpose. This release from the owners and the lessees shall not preclude the Engineer from inspecting the moved structure and requiring any corrective work to be done that he considers necessary. No disposition or modification of the structure, other than that shown on the plans, will be made by any agreement between the Contractor and owner without the prior written approval of the Engineer.

If the owners or lessees of any structure refuse to execute a release for the Contractor and, if after inspection, the Engineer determines that the Contractor has done all that could be reasonably expected to be done to affect a satisfactory removal and re-establishment of the structure, the Engineer may certify such upon the Department's form, which will be sufficient to release monies due to the Contractor; however, such certification and release of monies to the Contractor will in no

way be construed as a release of the liability or responsibility of the Contractor under Subarticle 107.14(a), but shall be a release only for the purpose of releasing monies to the Contractor.

205.04 Method of Measurement.

The removal or relocation of structures will be measured per each structure removed or relocated.

205.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Payment will be made at the contract unit price which shall be payment in full for the removal and disposal off the right of way or the relocation and re-establishing of the structures including utilities, all appurtenances, the furnishing of any materials needed, equipment, tools, labor and incidentals necessary to complete all work required by this Section. This shall include all utility deposits, bonds, tie-in fees, etc., and other actions necessary to re-establish the structure in an operable condition. Any site grading, including basement excavation for structures, shall be considered a part of the structure unless otherwise provided by plan details.

The removal or relocation of any or all structures may be deleted from the contract at the discretion of the Engineer.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

205-A Removal of Structures, Structure No. _____ - per each
205-B Relocation of Structures, Structure No. _____ - per each

SECTION 206
REMOVAL OF MISCELLANEOUS EXISTING DRAINAGE AND OTHER FACILITIES

206.01 Description.

The work under this Section shall cover the removal, wholly or in part, and the satisfactory salvaging or disposal of miscellaneous facilities and obstructions which will not be permitted to remain within the right of way except those items removed and disposed of under other sections of these specifications. Salvaging of materials for reuse by the State will be required only when such is designated by the plans or proposal; otherwise, the materials shall become the property of the Contractor.

Quantities and limits of this type work indicated on the plans are approximate only, subject to the Engineer's evaluation of the actual site condition.

206.02 Materials.

All new material required shall meet the applicable requirements of Division 800, Materials.

206.03 Construction Requirements.

No existing facility shall be removed or closed to traffic until satisfactory provisions for the passage of traffic have been made and approved by the Engineer.

On navigable streams, provisions shall also be made for waterway traffic in accordance with U.S. Coast Guard and/or Corps of Engineers, Rules and Regulations.

Use of methods or equipment which might damage completed structures, structures to be retained, or portions of structures, will not be permitted.

Blasting will not be permitted without prior written approval of the Engineer. Blasting, if approved, shall be in accordance with Article 107.11.

Where portions of existing pavement, curb and gutter, walks, and similar items are to remain and join the surface of the new work, they shall be removed to an existing joint or cut off to a neat line with vertical face using saws or other approved equipment that will not damage the retained portion of the work.

Pipe that is not to be salvaged shall be removed or, if concrete, it may be broken up in place.

In removing manholes, inlets, etc., any live sewers connected with them shall be satisfactorily bypassed, rebuilt, and reconnected without additional compensation.

Removing railway or street railway tracks shall include removal of all rails, paving, switches, frogs, guardrails, ties, track, encasement, and other appurtenances. Ballast and concrete foundations shall be included unless otherwise directed.

Removing pipe headwalls shall include removal and disposal of the encased joint of pipe unless otherwise directed.

When the plans provide for using old bridge substructures or parts of them as permanent parts of a new structure, only those portions shall be removed which are so indicated on the plans. All portions of existing structures, including debris, above the bed of the stream or ground surface shall be removed unless otherwise specified on the plans. Concrete and masonry piers or abutments under embankment may be either removed entirely or broken down to an elevation of at least 3 feet {1 m} below subgrade.

Walls and foundations, not needed, shall be removed to an elevation at least 2 feet {600 mm} below excavation limits in excavation areas, 3 feet {1 m} below subgrade in embankment areas and to ground level or as directed elsewhere.

All trenches and excavations resulting from the removal or breaking down of old culverts or structures shall be filled with suitable materials placed in accordance with Section 210.

Any reinforcing steel to be left in place to serve as dowels or ties shall not be injured by the removal of the concrete. Such dowels or ties shall be cleaned and straightened or bent as required to fit new work.

206.04 Disposal of Materials.

(a) DESIGNATED SALVABLE MATERIALS.

1. Where designated on the plans or in the proposal to be salvaged, all sound materials having salvage value shall be carefully removed without undue splitting or breakage and all bolts, nails, etc. shall be removed therefrom. The use of equipment or facilities which might damage members or portions of the structure to be salvaged will not be permitted. The Contractor will be held responsible for any damage due to his negligence in removing salvageable materials, and a sum, fixed by the Engineer as the value of the material so damaged shall be deducted from the Contractor's estimate.

No salvaged material shall be used in the construction of the new work, except where so provided on the plans or in the proposal, The Contractor shall not make temporary use of any materials or parts from old structures without the written permission of the Engineer, and any materials and parts so used shall be left at a designated point at the same site and in substantially the same condition in which they were removed from the old structure.

2. Structural steel, timber, or other salvable materials removed from old structures, unless otherwise specified or directed, shall be stored in a neat and presentable manner on blocking at designated locations within the right of way. Structures or portions thereof which are specified on the plans or in the proposal to be salvaged for reerection shall be stored in separate piles.

Special attention is directed to handling of salvaged bridge materials in that steel superstructures and frames, unless otherwise provided, shall be match marked and dismantled in an approved workmanlike manner and removed carefully so as to avoid damage.

3. Guardrail designated for salvage shall be carefully dismantled in condition for reerection and rail, cable, hardware, and posts stored as directed at accessible points for removal. Cable shall be rolled or spooled in suitable condition for hauling.

(b) UNDESIGNATED MATERIALS.

When the plans or proposal do not provide for the salvaging of materials from existing roadway or bridge structures designated for removal, all materials from such become the property of the Contractor to be removed or disposed of by methods of his selection provided such does not conflict with other requirements of the specifications or will damage any existing work or facilities to be incorporated into the work.

(c) DISPOSAL OF MATERIALS OFF THE RIGHT OF WAY.

Materials and debris not salvaged shall be disposed of in accordance with Subarticle 201.03(e).

206.05 Method of Measurement.

Each old bridge or portion thereof, each box culvert or culvert type structure, exclusive of pipe culverts to be removed and for which direct payment is to be made, will be designated on the plans by

its station number and description, and for the purpose of measurement and payment will be considered a complete and separate unit.

The quantity of plain or reinforced concrete pavement, plain or reinforced concrete base, and cement treated base removed, including overlying surface, will be measured and the surface area computed in square yards {square meters}. The quantity of other surfaces and bases removed will be measured by cross sections as unclassified excavation.

Removing concrete or stone curb, combination curb and gutter, gutter and valley gutter, including any overlying surface material, will be measured in linear feet {meters}.

Concrete sidewalk and concrete crosswalk removed as directed will be surface measured and the area computed in square yards {square meters}.

The length of culvert pipe removed will be measured in linear feet {meters}.

The quantity of pipe headwalls, manholes, inlets, and catch basins removed will be the number of separate units.

Guardrail removed as directed will be measured in linear feet {meters} along the top of the rail in place between extreme limits of an installation.

Railway track removed will be measured in linear feet {meters} of separate two-rail track. A turnout will be measured as a separate two-rail track beginning at the point of frog. Where rails have previously been removed, removal of the remaining crossties, concrete foundation, and all remaining track appurtenances will not be measured and paid for but considered as a part of clearing and grubbing.

206.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

When the contract contains a unit price for any pay item listed in this Section, such item will be paid for at the contract unit price, which shall include removal, excavation and subsequent backfill incident to removal, and furnishing all materials, tools, equipment, labor, and incidentals necessary to complete the work as described. It shall also include necessary and required salvage, preservation, storage on the right of way, or disposal of the materials, all as provided herein.

The unit price for removal of concrete pavement or concrete base shall include removal of any overlying surface.

Payment for removal or partial removal of old bridges at designated stations will be made at the lump sum contract price for each bridge removed or partially removed as specified.

Payment for removal of all box culverts and culvert type structures will be made at the lump sum contract price for each culvert which shall include removal or partial removal as specified on the plans.

Material required for backfilling structures removed, in excess of overlying material excavated in their removal, will be paid for at the contract unit price for excavation of the classification used.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

206-A Removal of Old Bridge, Station _____ - per lump sum
206-B Removal of Old Box Culvert, Station _____ - per lump sum
206-C Removing __*__ - per square yard {square meter}
206-D Removing __**__ - per linear foot {meter}
206-E Removing __***__ - per each

* Concrete Sidewalk, Concrete Pavement, Concrete Crosswalks, Concrete Bases, etc.
** Pipe, Guardrail, Curb, Curb & Gutter, Railroad Tracks, etc.
*** Headwalls, Inlets, etc.

SECTION 208
REMOVAL AND REINTERMENT OF GRAVES

208.01 Description.

This Section shall cover the services necessary to remove, disinter, and reinter graves or remains found within the limits of the highway right of way. The removal, disinterment, and reinterment shall be in compliance with all State, County, and/or City rules and regulations. Reinterment shall be in approved, established cemeteries or burial grounds.

The number of graves specified in the contract is approximate only; the actual number may vary and will depend upon a close investigation of the existing burial site during preliminary grading operations. Only the number of graves actually moved as directed will be paid for at the contract unit price, and no claim will be allowed for extra compensation due to overruns or underruns of the items provided under this Section.

208.02 Materials.

All materials furnished for use in connection with work under this item must be acceptable to the Engineer and suitable for the particular work with which it is associated.

208.03 Construction Details.

(a) GENERAL.

In areas where graves or cemeteries have been located or suspected, the Engineer may direct the Contractor to perform such clearing and grubbing, stripping or excavation work as may be deemed necessary in a manner which will allow an examination of the area to ascertain if all graves have been properly located. After the area has been checked and disinterment of the graves or remains properly accomplished, the Engineer will authorize the Contractor to commence full grading operations. Cost of any clearing and grubbing, stripping, and/or excavation to accomplish the above details shall be considered as a part of the type work under which it is performed, and no additional compensation will be considered.

(b) DISINTERMENT AND REINTERMENT.

The removal, disinterment, and reinterment of remains shall be performed under the supervision of a qualified undertaker licensed to practice in the State of Alabama.

The Contractor shall be responsible for obtaining all of the necessary permits required by State, County, or City Authorities prior to beginning work under this Section.

In addition, the following services are considered to be essential and a part of the requirements of this operation:

1. Providing for ministerial service at the place of disinterment and reinterment.
2. Furnishing of a grave space at an approved established burial ground, unless otherwise noted on the plans or proposal.
3. Providing for proper legal notices for disinterment and reinterment.
4. Providing for opening and closing of each grave at the place of disinterment and reinterment.
5. Providing for the displacement of the existing burial box or, in case deterioration of the original box has occurred, providing a satisfactory new burial box for the displacement of the remains.
6. Providing for the relocation of existing grave markers and/or monuments or, in case none exist, providing a granite grave marker of at least 20 inches {500 mm} by 10 inches {250 mm} by 4 inches {100 mm}.

208.04 Method of Measurement.

The removal, disinterment, and reinterment of graves, when provided by the plans or proposal, shall be measured in individual grave units, with each grave actually removed and relocated considered as a separate individual unit.

208.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Each grave directed and actually removed and reintered shall be paid for at the contract unit price per each which shall be full compensation for furnishing all materials and services necessary to properly remove and reinter the remains on an approved site furnished by the Contractor or, when provided by plans or proposal, reinterment on a designated site all in accordance with State, County and/or City rules and regulations, and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

208-A Removal and Reinterment of Grave - per each
208-B Removal and Reinterment of Grave at Designated Site - per each

SECTION 209
MAILBOX RESET

209.01 Description.

This Section shall cover the work of permanently resetting mailboxes required to be removed from their original position inside the right of way.

209.02 Materials.

All new mailboxes and new support materials furnished shall meet the requirements shown on the plans.

The Contractor may re-use existing mailboxes or support materials if approved by the Engineer. Other materials shall be returned to the property owner if requested or disposed of by the Contractor.

209.03 Construction Requirements.

All work shall be done in a workmanlike manner in accordance with the requirements of local codes, ordinances, and U.S. Postal Service Regulations. Any materials lost or rendered unfit for re-use on account of negligence or improper handling by the Contractor shall be replaced by him without additional compensation.

209.04 Method of Measurement.

The number of mailbox reset installations will be the number of each type installation (i.e. single, double, or multiple) permanently reset as directed and accepted. No measurement or direct payment will be made for mailboxes removed only and not reset, or for mailboxes removed and temporarily reset.

209.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of mailbox reset installations, measured as above provided, will be paid for at the contract unit price each which shall be payment in full for all excavation, backfilling, resetting mailboxes and providing and installing all necessary mailboxes, hardware and support materials, and for all equipment, tools, materials, and labor necessary to complete the work. Materials required for, and the construction of, the specified turnout will be paid for under other items of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

209-A Mailbox Reset, ___*___ - per each

* Specify "Single", "Double", or "Multiple", etc.

SECTION 210
EXCAVATION AND EMBANKMENT

210.01 Description.

The work under this Section shall cover the excavation, hauling, disposal, or compaction of all material not being removed under some other item which is encountered within the limits of the work and is necessary for all construction in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness, and typical cross sections shown on the plans or established by the Engineer. All excavation covered in this section will be classified as "Unclassified Excavation", "Muck Excavation", "Channel Excavation", or "Borrow Excavation", as described in this Section.

Attention is directed to the fact that the roadbed must be treated by one of the methods specified in Section 230, 231 or 232 before the placement of an overlying subbase, base, or paving structure will be permitted.

210.02 Materials.

(a) GENERAL.

All excavation within the right of way or easement limits will be known as Roadway and Drainage Excavation and will be classified as "Unclassified Excavation", "Muck Excavation" or "Channel

Excavation". Excavation outside of the right of way or easement limits will be classified as "Borrow Excavation."

(b) ROADWAY AND DRAINAGE EXCAVATION.

Soils data indicated on the plans is for estimating purposes only and the Department does not guarantee the accuracy thereof. Material designated for removal under embankment areas will be reclassified according to its condition at the time of removal.

1. UNCLASSIFIED EXCAVATION.

Unclassified Excavation shall consist of the excavation of all materials of whatever character encountered in the work, except Channel Excavation or Muck Excavation when such items are included as separate pay items in the plans or proposal.

2. CHANNEL EXCAVATION.

Channel Excavation shall consist of the excavation, removal, and disposition as noted or directed of all material necessary to provide inlet and outlet ditches or channels for drainage structures in accordance with plan details. However, unless specifically designated by plan details, such excavation will be classified as Unclassified Excavation.

3. MUCK EXCAVATION.

Material unsuitable for immediate reuse due to organic content, saturated to the extent it is somewhat fluid, and must be moved by dragline, dredge, or other similar type equipment which operates outside the area being excavated, will be classified as muck.

Unless explicitly authorized otherwise by the Engineer, before material is classified by the Engineer as muck, the Contractor will be required to demonstrate that the material cannot be removed by conventional methods and equipment normally used in the unclassified excavation operation. Conventional equipment includes all types of scrapers and dozers. If no item for Muck Excavation is provided in the plans or proposal, such excavation will be classified as Unclassified Excavation and payment will be made as outlined in Item 210.10(a)1.

(c) BORROW EXCAVATION.

Prior approval of all borrow sources must be given; however, this does not relieve the Contractor from the full responsibility for the quality and quantity of the material used. Materials for borrow shall be in accordance with the following:

1. EMBANKMENT.

Materials furnished for embankments above water and below subgrade shall be any stable material which can be compacted to the specified density.

2. IMPROVED ROADBED.

Materials furnished for the improved roadbed shall be any stable material meeting the requirements of Soil Classification A-1, A-2, A-3, or A-4, as determined by AASHTO M 145, within the following limitations.

a. Materials in the A-1 or A-3 Classification will not require consideration of a CBR value.

b. Materials in the A-2 or A-4 Classification shall have a CBR value of not less than 10.

c. Materials of the cherty or float gravel type which have a maximum of 50% passing the Number 8 {2.36 mm} sieve, 100% passing the 4 inch {100 mm} sieve, and CBR value of at least 25 will not be required to conform to the Soil Classification noted above.

d. Industrial waste, a residue from a manufacturing operation, may be used provided the material is taken from "cold" piles which are approved by the Materials and Tests Engineer and the material is broken down by roadway operations or pit operations or crushing methods to allow approximately 100 percent passing the 4 inch {100 mm} sieve. However, isolated oversize particles up to a maximum diameter of 1 inch {25 mm} less than the thickness of the compacted layer may be used, provided such does not exceed 10 percent of the weight {mass} based on 1 square yard {1 m^2}, 6 inches {150 mm} deep. The weight {mass} of 1 square yard {1 m^2} will be calculated on the weight {mass} per cubic foot {cubic meter} of the material. This material shall have a unit weight {mass} of not less than 100 pounds per cubic foot {1600 kg/m^3}, dry as determined by AASHTO T 99, Method "A" or "C", and conform to the following Composition Table:

Composition Sieve	% Passing By Weight {Mass}
4" {100 mm}	100
Liquid Limit (L.L.)	25 Max.
Plasticity Index (P.I.)	6 Max.
CBR	12 Min.

Material meeting this specification will not be required to conform to any Soil Classification noted above.

3. UNDERWATER BACKFILL MATERIAL.

Material for underwater backfill shall be selected sandy material of an A-3 Classification or an approved A-1 or A-2 material of which not more than 15 percent passes the Number 200 {75 µm} sieve. A rocky material that will form a firm foundation when deposited under water may also be acceptable.

4. UNDERWATER EMBANKMENT MATERIALS.

Material for underwater embankment shall be secured from quarries designated on the plans or from other approved sources, producing equally satisfactory material. The material shall consist of 1/2 cubic yard {0.5 m^3}, and smaller, size stone taken from approved natural rock formations. The material shall be free from earth or other foreign material consisting of predominantly larger size stones. Material to be used for choking or blanketing the surface of the underwater embankment shall be of sandy or fragmentary nature, such as stone spalls or screenings, float gravel, or gravel. Material that will slake or become plastic in water shall not be used as choking material or in the blanket course. NOTE: Certain materials within the roadway excavation limits may be authorized for use as improved roadbed material, underwater backfill, or underwater embankment; however, such authorization shall be in accordance with the provisions of Article 106.08.

210.03 Construction Requirements.

(a) GENERAL.

Prior to beginning excavation and embankment operations in any area, all necessary clearing and grubbing of the area shall have been performed in accordance with the provisions of Section 201, Clearing and Grubbing.

The excavation and embankment for the work shall be constructed and maintained so as to properly drain and have reasonably smooth and uniform surfaces. The final subgrade elevation and section of both cuts and fills shall be in reasonably close conformity to that specified by the plans or directed (i.e. plus or minus 1 inch {25 mm} from the designated grade and slope elevations). No material shall be wasted without permission of the Engineer. Excavation operations shall be so conducted that material outside of the limits of the slopes will not be disturbed.

Special attention is directed to the requirements of Section 665 and Sections 651 through 659 pertaining to the establishment of temporary and permanent erosion control work.

Choice of equipment to perform the work shall be that of the Contractor. The type and number of units shall be such as to perform the excavation and embankment operations in conformity with these specifications and secure the density specified. Supplemental equipment shall be furnished as necessary to keep the work properly shaped.

When the Contractor's excavation operations encounter artifacts of historical or archeological significance, the operations shall be temporarily discontinued. When directed by the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation, unless otherwise provided, will be considered and paid for as extra work.

(b) ROADWAY EXCAVATION.

1. GENERAL.

All intersecting roads, approaches, entrances, and driveways shall be graded and completed concurrently with the roadway grading and shall be kept passable at all times. During the grading operation, the area being graded shall be maintained reasonably smooth and well drained. Material used as directed by the Engineer for temporary surface to permit public use of the project will be paid for at the contract unit price of the materials so used. The Contractor shall maintain this temporary surface.

Cuts may be widened and the slopes varied as directed during construction, according to the stability of the material encountered and the need for embankment material; however, benching

of backslopes in order to obtain material will not be permitted unless authorized in writing. If widening of a cut is necessary after the backslope is completed, a width sufficient to accommodate normal grading equipment will be allowed. Unauthorized excavation beyond the slope stakes will not be paid for.

Old roadways within the Right of Way shall be obliterated as directed. Roadway obliteration will be paid for as Unclassified Excavation, unless otherwise designated on the plans.

2. REMOVAL OF TOPSOIL.

Topsoil within the construction limits shall be removed in the areas and to the depth as directed by the Engineer. Topsoil may include sod, but not tall vegetation or other debris, and shall be kept free from subsoil. It shall be stockpiled in approved locations with each stockpile not less than 4 feet {1.2 m} high, and containing not less than 200 hundred cubic yards {150 m^3}. Each stockpile shall be shaped as necessary to permit accurate cross sections. The work of removal and stockpiling of topsoil will be paid for as Unclassified Excavation.

3. SELECTIVE GRADING.

Certain designated zones or portions of cuts which afford the more suitable soils for roadbed construction shall be reserved as directed for use in forming the upper graded earth layer or layers for embankments or cuts, for backfilling, and for other purposes. Should it become necessary to stockpile selected material for use below the subgrade elevation of the same cut, it may be stockpiled nearby so that the excavated material can be measured for payment for the rehandling.

4. UNDERCUTTING.

Where the plans provide for an improved roadbed, all cuts shall be undercut and embankments graded to the elevation necessary for the placement of the improved roadbed. The surface of these undercut areas shall be further undercut if determined necessary for the removal of soft or yielding areas, then properly shaped to drain, backfilled with suitable material, and uniformly compacted to the density specified for embankment just prior to placing the improved roadbed layers. At all grade points, undercutting as directed will be required a minimum of 25 feet {8 m} into a cut. These undercut areas later shall be backfilled with suitable material and compacted.

Rock or other impervious material encountered in cuts shall be undercut to a depth of 2 feet {600 mm} below subgrade elevation where improved type roadbed is specified on the plans, and 1 foot {300 mm} below subgrade elevation elsewhere. All depressions in those undercut sections shall be cleaned out, provisions made for drainage, backfilled and compacted with selected materials approved by the Engineer.

Undercutting as described above will be measured and paid for as Unclassified Excavation.

5. EXCAVATION AND BACKFILL OF MUCK.

Excavation and backfill of muck areas shall be performed in a manner, acceptable to the Engineer, that will not permit the entrapment of muck within the backfill. The backfilling of the excavated area shall follow immediately behind the excavation so that any soft material that is pushed ahead of the backfill can be removed. After muck removal, the Contractor shall allow the Engineer adequate time to take all elevations and measurements necessary for determining the volume removed.

Normally, the material used to backfill the excavated muck areas will be selected Unclassified Excavation or Borrow Excavation, Item 210-A or 210-D, as shown on the plans or directed by the Engineer.

When directed in writing by the Engineer, the material used to backfill the excavated muck areas will be Borrow Excavation (Underwater Backfill or Underwater Embankment), Item 210-E or 210-F, meeting the requirements of Subarticle 210.02(c).

Backfill material placed in water shall be so deposited that its weight {mass} will displace and force any remaining muck outward and ahead of the backfill, and prevent trapping of muck pockets. Back-pressure from displaced muck against the toe of the advancing backfill shall be relieved promptly by excavating the displaced muck as fast as it accumulates. Dikes ordered constructed within the right of way limits for controlling the muck will be paid for as Unclassified Excavation.

In addition to the requirements of Article 210.05 for disposal areas, where directed, dikes shall be built (without extra compensation) to keep the deposited muck within the limits of the designated areas and as soon as the surface condition of the deposited material will permit, the Contractor shall remove all visible stumps, roots, logs, and other debris from the waste pile and shall

dispose of them as specified in Subarticle 201.03(e) without extra compensation. Before acceptance of the work, all parts of the waste pile shall be drained and dressed to a pleasing and reasonably uniform surface and any necessary erosion control work performed, all as directed by the Engineer.

6. EXCAVATION OF ROCK.

Unless otherwise shown on the plans, the Contractor shall use the presplitting technique to split the face of the rock cut in a relatively smooth plane along the designated backslope, prior to shooting the interior portion of the cut. Presplitting shall be accomplished by drilling holes at intervals of approximately 1.5 feet {500 mm} to 3 feet {1 m} to the proper depth along the designated slope, loading and stemming such holes with an appropriate light charge of explosive and detonating all holes simultaneously. The Contractor will not be required to presplit on slopes flatter than one to one. In the event the cut is too deep for the presplitting to be done in one operation, an 18 inch {450 mm} offset will be allowed for the subsequent presplitting operations after the initial presplitting and interior blasting.

Any material outside the designated side slopes that has been loosened or shattered by blasting shall be removed to provide a reasonably smooth and uniform slope. No rock shall project more than 1 foot {300 mm} inside the designated slope. Payment will be made for overbreakage and necessary backfill material for a distance not to exceed 1 foot {300 mm} outside the designated slopes or 1 foot {300 mm} below the designated elevation for undercutting; however, where presplitting is required, no overbreakage on side slopes will be paid.

All overbreakage in excess of the noted limits shall be removed and necessary backfill performed by the Contractor without additional compensation.

When authorized in writing, rock from roadway excavation may be used under other sections of the Specifications. In such event, payment will be made under the appropriate Section for which the rock is so used, and as provided in Section 106 for the replacement of materials for use in the embankment.

All rock that is not required for other construction shall be placed in embankment, insofar as possible, in accordance with the provisions for embankments. Large rock or boulders that cannot be used in embankment shall be disposed of by the Contractor.

7. BENCHING.

In cuts where unstable soil conditions occur, the plans may designate or the Engineer may direct the use of benching. The benching shall be accomplished by suitable drilling and blasting equipment when so directed. This benching will be measured and paid for as Unclassified Excavation.

Benching may also be ordered to provide a more stable foundation for heavy embankment. Benching shall be accomplished by excavating horizontally along the hillside down to or into rock or other suitable undisturbed foundation material, forming a series of stepped benches. Each bench shall be in excavation for its entire width. The benches generally shall parallel contour lines. They shall be constructed at least 10 feet {3 m} wide and may be required to be wider for better support of embankment. Benching of embankment will be measured and paid for as Unclassified Excavation only if it is required to be loaded onto equipment and hauled to another location.

(c) BORROW EXCAVATION.

Possible borrow sources may be shown on the plans, and the Contractor has the option of using such or other sources as provided by Subarticle 106.01(d); however, when sources are not shown or designated, the Contractor shall provide such as specified by Subarticle 106.01(d). Materials furnished shall conform to the appropriate specifications under any condition.

All stumps, logs, brush, roots, and other debris resulting from clearing and grubbing work in borrow pits shall be removed and disposed of as specified in Subarticle 201.03(e). No separate payment will be allowed for this operation.

Material unsuitable for use in the work shall be disposed of in a satisfactory manner and the amount of such deducted or eliminated from quantities measured for pay purposes.

All borrow areas shall be bladed and left in such shape as to permit accurate measurements after excavating has been completed. The Contractor shall notify the Engineer in sufficient time before beginning excavation so that the necessary cross sections may be taken. The finished borrow areas shall be left in a condition satisfactory to the Engineer and the property owner. Attention is directed to Subarticle 106.01(b) for conditions governing local pit operations.

The selection of areas of the source for use and sequence of excavation shall be as directed by the Engineer in order that material of the best available gradation and soil characteristics may be secured.

(d) EMBANKMENT.

1. GENERAL.

Only suitable, approved materials shall be used in the work. The Engineer shall be the sole judge of the suitability of materials and may require such selection of materials as may be necessary to insure a satisfactory embankment. Sandy or rocky materials available shall be used to the extent practical across wet areas to form a floor for supporting the required embankment.

After Clearing and Grubbing of the embankment areas is complete, all cavities and irregularities shall be enlarged to permit use of compaction equipment, backfilling and compacted as required. Foundation preparation shall consist of the work required to provide a stable foundation for the embankment. This may consist of undercutting and backfilling, flooring sufficient to support equipment, or other work as may be directed. Foundation preparation and compaction will be as directed by the Engineer.

Where embankment is to be placed on old concrete pavements or pavements having concrete bases, the treatment of the old concrete shall be as specified on the plans. Where embankment is to be placed on any other type of roadway pavement or surface, the existing pavement or surface shall be scarified to the extent necessary to provide ample bond between old and new material.

2. EMBANKMENT FORMATION.

Rocks, broken concrete, or other solid materials shall not be placed in embankment areas where piling is to be placed or driven.

Roadway embankment of earth material shall be placed in reasonably uniform layers not exceeding 8 inches {200 mm} (loose measurement) and, insofar as practical, the full width of the embankment section. Each layer shall be compacted as specified before the next overlying layer is placed. Care shall be taken during the compaction operations so that uniform density is obtained.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the thickness prescribed without crushing, pulverizing, or further breaking down of the pieces resulting from excavation methods, such material may be placed in the embankment as directed in layers not exceeding 2 feet {600 mm} in thickness. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments or earth. These type lifts shall not be constructed above an elevation of two feet {600 mm} below the finished subgrade. The balance of the embankment shall be composed of suitable material (no material larger than 4 inches {100 mm}) smoothed and placed in layers not exceeding 8 inches {200 mm} in loose thickness and compacted as specified for embankments.

Placing of large stones, up to two-thirds the remaining embankment height at the point of placement, will be allowed provided they are spaced so as to permit free access of proper equipment to compact the intervening fill in normal layers. Other large stones may be placed on fill slopes as directed.

When new embankment is to be placed against existing embankments, or when embankment is built one-half width at a time and slopes are steeper than 4:1 {1:4} when measured at right angles to the embankment, the old embankment shall be continuously benched and the new work brought up in layers. Benching shall be of sufficient width to permit operations of placing and compacting equipment, but in no case less than 6 feet {2 m}. Material thus cut out shall be recompacted along with the new embankment material at the Contractor's expense.

Underwater backfill and underwater embankment shall be deposited in one layer for the full width of the embankment, or as directed, to the elevation designated on the plans or directed. In the formation of underwater embankment, the rock shall be fully choked with a blanket of approved choking material before placement of the remaining embankment.

Embankment over, under, and around structures (pipes, culverts, arches, bridges and like), except pipes and arches 48 inches {1200 mm} or less in diameter, shall be selected embankment material placed and compacted or tamped as noted herein in a manner and by methods that will avoid unbalanced loading, cause movement, or place undue strain on any structure. Attention is directed to Section 530 for pipes and arches 48 inches {1200 mm} or less in diameter. The Contractor shall be solely responsible for protecting the structures and any damage to any part of a structure due to not providing proper protection shall be cause for ordering its replacement without additional compensation.

3. EMBANKMENT COMPACTION.

Layers of embankment shall be compacted as specified in Subarticle 306.03(b). Strict moisture control will not be required; however, it will be the Contractor's responsibility to maintain the moisture content necessary to satisfactorily compact the material. Compaction in a semi-dry condition will not be permitted.

Where improved roadbed design is specified, the layers up to the bottom of the improved roadbed shall be compacted as noted above and finished true to required line, grade, and cross section. The improved roadbed layers shall then be constructed as provided in Article 230.03.

Where improved roadbed design is not specified, the embankment layers shall be continued up to subgrade elevation with the same compaction requirement as noted herein. Just before placing a subbase or other material on this graded earth roadbed, the top 6 inches {150 mm} shall be reconstructed as provided in Subarticle 230.03(c) of these specifications.

No compaction or density test will be required for underwater embankment or underwater backfill.

210.04 Use of Materials.

All suitable materials removed from the Roadway Excavation shall be used, insofar as practicable, in the formation of the embankment, roadbed, base layers, shoulders, slopes, bedding, and backfill for culverts, and for such other purposes and places as directed. Suitable materials shall be defined as those suitable for any of the above listed uses.

No excavated material shall be wasted unless permitted in writing by the Engineer but shall be used uniformly to widen embankments, to adjust grades, to flatten slopes, or shall be deposited in such places and for such other purposes as may be directed. Such material shall be handled as follows:

Suitable Material.

Suitable material shall be used at the time of excavation for any of the purposes outlined herein in this Article. It is not intended to stockpile suitable material unless ordered in writing by the Engineer. Payment for second handling will be made only when reused from stockpiles previously ordered by the Engineer.

Unsuitable Material.

Unsuitable material that cannot be used at the time of excavation may, at the option of the Contractor, be temporarily stockpiled within the right-of-way, or the Contractor may make written request for disposal as waste in an approved area on or off the right-of-way. Payment for the second handling of stockpiled unsuitable material will be made only when ordered in writing for use by the Engineer for a specific pay item. The remainder of the stockpiled material may be used to widen embankments, flatten slopes, etc. as allowed by the Engineer, with no payment for the second handling, or shall otherwise be disposed of off the right-of-way with no payment for the second handling.

No payment will be made for the second handling of unsuitable material deposited outside the construction limits at the time of excavation and later spread onto a fill slope, etc. by use of a dozer or similar equipment.

Channel Excavation shall be used to fill old channels, in the construction of embankments, the flattening of slopes, or shall be disposed of as approved by the Engineer. If permitted by the Engineer, waste channel excavation may be spread in uniform layers, neatly leveled, shaped, and grassed with sufficient openings provided to permit surface drainage of adjacent lands; however, in no case will waste material piles be permitted to remain within 10 feet {3 m} of the edge of any ditch, channel, or cut. No payment will be made for any necessary rehandling of Channel Excavation material unless ordered for use by the Engineer from stockpiles for a specific pay item.

210.05 Disposal Areas for Surplus Material.

If no disposal areas are shown on the plans, the Contractor shall provide at his own expense disposal areas and submit along with the permission of the property owner a plan for treatment of the area which is acceptable to the Engineer. Said plan shall provide for dressing, grassing, or other treatment to avoid unsightly appearance and not create a public nuisance or incur future maintenance problems.

Disposal areas will not, in general, require clearing and grubbing or compaction of the waste pile; however, if clearing and grubbing or compaction is required, such will be designated by plan details or in the proposal.

Reference is made to Item (f) of paragraph 3 of Article 107.13 concerning handling of waste material and treatment of areas.

210.06 Finishing and Dressing.

All the completed work shall be dressed and maintained substantially to the lines, grades, and cross sections shown on the plans or as directed by the Engineer. Slopes shall be shaped, rounded, finished, or trimmed in a neat workmanlike manner to conform to the slope lines shown on the plans or as modified by the Engineer. Care shall be exercised that no material be loosened beyond the required slopes.

Compensation for all such finishing and dressing shall be included in the contract unit prices and no direct payment will be made for this work.

210.07 Erosion Control.

The Contractor shall incorporate into the work all permanent erosion control features provided in the contract at the earliest practical date. In addition, temporary erosion control features may be ordered by the Engineer to facilitate protection until the permanent control features can be installed. Particular attention is directed to Section 665 and Article 107.21 of these Specifications.

210.08 Blank.

210.09 Method of Measurement.

(a) GENERAL.

Measurement for all accepted Excavation, except for Borrow Excavation for Underwater Embankment, will be either by the cubic yard {cubic meter} of the material in its original position computed from cross sections by the average end area method or per ton {metric ton} as specified by the unit measure of the pay item.

Measurement for Borrow Excavation for Underwater Embankment will be either by the ton {metric ton} or by the cubic yard {cubic meter}, loose volume, of the material in the hauling vehicle at the point of use as specified by the unit measure of the pay item.

Embankment will not be measured for payment. All of the operations required for embankment formation described herein shall be considered necessary work incidental to and for which compensation is included in the contract unit prices for the pay items of the materials composing the embankment.

Muck excavation as described in Subarticle 210.03(b) will require the use of the following modified cross section and average end area method. The volume will be measured between theoretical vertical side slopes, a station or substation at a time, immediately after completion of muck excavation and before backfill is placed. No measurement or allowance will be made for necessary excavation of material for sloughing, subsidence, flattening sides, slumps, or rehandling materials or for shaping and dressing disposal areas. The sloughing, subsidence, flattening, or slump of side slopes in muck will not be classed as slides.

(b) MEASUREMENT LIMITATIONS.

Measurement of pay quantities will not include any excavated material used for purposes other than those designated except as provided under Article 106.08. Where material has been excavated beyond the designated slope line and wasted, the unauthorized wasted material will be measured and deducted from the excavation quantities. Any material excavated prior to the staking out and cross sectioning of the borrow sources by the Engineer, or in excess of that ordered for the work, will not be included in the quantity measured for payment. If the Contractor places more borrow than is necessary, thereby causing a waste of excavation, the amount of such waste will be deducted from the borrow excavation as measured in the borrow source. When a borrow area is adjacent to the right of way, the dividing line between unclassified excavation and borrow excavation shall be either a vertical plane through the right of way line or the proposed backslope as shown on the plans, whichever is most economically advantageous to the State.

210.10 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. ROADWAY AND DRAINAGE EXCAVATION.

The accepted volume of Unclassified Excavation - Item No. 210-A, Channel Excavation - Item 210-B, and Muck Excavation - Item No. 210-C, when provided in the plans or proposal, measured as provided above, will be paid for at the contract unit prices bid for these items which shall be payment in full for: excavation; disposal of surplus and unsuitable materials (see Articles 210.04 and

210.05); hauling; formation and compaction of embankment; preparation and completion of subgrade and shoulders except when this work is included in other pay items; the completion of all cuts, embankments, and channel excavation to conform to the lines, grades, and cross section indicated on the plans or otherwise directed; and the completion of the roadway together with its appurtenances of intersecting roads, streets, driveways, approaches, temporary drainage facilities, and other related incidental work for which the proposal contains no contract unit prices. The said contract unit prices for the excavation item shall be payment in full for all equipment, tools, labor, and incidentals necessary to complete the work.

If no contract items for Channel Excavation and/or Muck Excavation are provided, such work will be paid for as Unclassified Excavation.

Exceptions to the above will be made in the event of the following:

a. If a backslope already completed and dressed is destroyed by a slide, or if the Engineer orders additional material taken from a completed and dressed backslope, any redressing required will be paid for as provided in Article 104.03.

b. If a slide occurs after completion of the subgrade to line and grade or during subsequent work in the immediate area and is of such nature and extent that the Engineer, in order to avoid damage to the previous work, directs its removal, and such requires equipment other than equipment normal to the project, an adjustment in price may be made. However, in no case shall such increase exceed 25 percent of the unclassified excavation contract unit price.

c. If no item for Muck Excavation is provided in the plans or proposal, such excavation will be classified as Unclassified Excavation and payment will be made at two times the unit bid price for Unclassified Excavation.

2. BORROW EXCAVATION.

The accepted volume of Borrow material designated under Items 210-D, 210-E and 210-F, measured as noted above, will be paid for at the contract unit price bid for the items, which shall be payment in full for the royalty and other expenses incidental to procurement, construction and maintenance of haul roads, clearing and grubbing, stripping, excavating, loading, hauling, source moves, dumping, spreading, and also for formation and compaction of embankment, trimming slopes, disposing of surplus materials, preparation and completion of subgrade, shoulders, and intersecting roadways and furnishing of all equipment, labor and incidentals necessary to complete the work. This pay item also includes any necessary work as may be required by the Engineer or Owner in the final dressing of the pit, including grassing or other landscape work.

(b) BLANK.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

210-A Unclassified Excavation - per cubic yard {cubic meter}
210-B Channel Excavation - per cubic yard {cubic meter}
210-C Muck Excavation - per cubic yard {cubic meter}
210-D Borrow Excavation - per cubic yard {cubic meter}
210-E Borrow Excavation(Underwater __*_) - per cubic yard {cubic meter}
210-F Borrow Excavation(Underwater __*_) - per ton {metric ton}
* Specify either Backfill or Embankment.

SECTION 212
MACHINE GRADING SHOULDERS

212.01 Description.

This Section shall cover the work of reconstructing the shoulder of a roadway where the grading is of such character that the material can be moved, mixed, and shaped with a motor patrol of adequate power and weight {mass}.

In general this work shall consist of clipping the shoulder, where directed, prior to resurfacing and blading the shoulder after the resurfacing has been completed. Any additional material needed to bring the shoulder to the desired profile will be classified and paid for under the appropriate section for the type material furnished.

If seeding or other items are needed for erosion control, such items will be shown on the plans and paid for under the appropriate specification section.

Unless otherwise noted by plan details, the completed work shall conform to the shoulder requirements for lines, grades, and typical section indicated by the plans or established by the Engineer.

212.02 Material.

Material used under this Section shall be of the quality and character noted on the plans or ordered by the Engineer, suitable for the purpose intended and consistent with the requirements for such material noted in other parts of this specification.

212.03 Construction Requirements.

(a) GENERAL.

Clipping, or blading, of grass and soil from the shoulder, as provided by the plans or directed, shall be completed in advance of resurfacing operations. The removed material shall be windrowed a sufficient distance and in such a manner as not to pose a safety hazard to the motoring public. Where directed, the entire width of the shoulder shall be plowed, scarified or otherwise loosened. The shoulder then shall be re-formed by blading the material from the windrows, or by the addition of extra material as specified or directed, with the machine grader and compacting it to the satisfaction of the Engineer. Watering shall be used, as necessary, to aid compaction. The machine grading shall continue until the shoulder is completed to conform to the lines, grades, and typical section shown on the plans or directed.

(b) EQUIPMENT.

The Contractor shall provide appropriately sized equipment in sufficient numbers to perform the work within the guidelines noted herein and the time frame for the contract.

(c) ADDITIONAL MATERIAL.

It will be considered practicable to move material up to 100 feet {30 m} longitudinally by means of the machine grader and all material moved within that limit will be paid for in the contract price for machine grading shoulders. When it is necessary to waste surplus material, such material shall be wasted on the front slope of the roadway in the vicinity of the removal site, to the satisfaction of the Engineer. Material secured from sources outside the right of way will be classified under the applicable classification.

212.04 Method of Measurement.

Accepted machine grading of shoulders will be measured in hundred-foot {100 m} stations and fractions thereof to the nearest foot {1 m} of shoulder along the centerline of roadway, complete in place. Each shoulder graded will be measured separately.

Borrow Excavation, Topsoil, or other material ordered used will be measured and paid for as provided by their appropriate sections unless otherwise specified.

212.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Machine grading of shoulders, measured as noted above, will be paid for at the contract unit price per station for machine grading, complete in place, which price shall be full compensation for the preparation, construction, and maintenance of the work involved, including blading, spreading, compacting, and dressing and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

212-A Machine Grading Shoulders - per station

SECTION 214
STRUCTURE EXCAVATION AND BACKFILL FOR DRAINAGE STRUCTURES AND MINOR STRUCTURES

214.01 Description.

(a) GENERAL.

The work under this Section shall consist of the removal and disposal of all excavated materials of any nature required for the construction of all box type culverts (including bridge type), pipe culverts (including pipe arches), storm drains, and other minor structures in accordance with these Specifications and to reasonably close conformity with the lines and grades shown on the plans or designated by the Engineer. This Section shall further include backfilling of structure foundations with suitable material in accordance with plan details or as directed.

(b) CLASSIFICATION OF MATERIALS.

1. EXCAVATION.

All excavation for structures below natural ground or the designated subgrade, whichever is lower, or the elevation designated by the Engineer will be classified as Structure Excavation and shall include all materials encountered regardless of their nature, exclusive of water or other liquids which will not be classified as excavated material, necessary for the proper construction of the structure.

Excavation for ditches at the inlet and outlet ends of drainage structures and any other ditches indicated on the plans shall be constructed under "Roadway and Drainage Excavation" items.

2. BACKFILL.

a. Foundation Backfill.

Special selected material ordered placed under a structure to provide a suitable foundation for the structure shall be classified as Foundation Backfill.

b. General Backfill.

Material used for ordinary backfill shall include special material for areas immediately adjacent to weepholes and a drainage belt for large masonry structures.

214.02 Material.

(a) FOUNDATION BACKFILL.

Foundation Backfill is a special selected material suitable (approved free-draining commercial or local material) for use as foundation for the structure.

(b) GENERAL BACKFILL.

Material used for general backfill shall be a compactible soil of acceptable quality except that material for areas immediately adjacent to weepholes shall be free draining material conforming to the following:

1. Local material shall have a permeability coefficient of at least 0.1 mm/sec., measured by the AASHTO T 215 constant head permeameter, with 90% passing the 3/4 inch {19.0 mm} sieve and a maximum of 10% passing the Number 8 {2.36 mm} sieve.
2. Commercial material shall be aggregates meeting the requirements of ALDOT #467 or ALDOT #57. Other commercial aggregates will be considered and can be used if approved by the Materials and Tests Engineer.

214.03 Construction Requirements.

(a) GENERAL.

Foundation excavation shall be of the size and depth conforming to the outline for the structure shown on the plans or established by the Engineer. Unsuitable foundation material below the normal design elevation shall be removed as directed by the Engineer and paid for as Structure Excavation.

Where rock, gravelly soil, hard pan, or other unyielding material is encountered, it shall be removed as ordered by the Engineer for a depth of at least 12 inches {300 mm} below the designated grade. This extra depth of excavation shall be backfilled with suitable, approved material measured and paid for as foundation backfill.

Attention is directed to the special requirements for placement of pipe culverts in embankment areas noted in the plans.

(b) EXCAVATION.

Choice of equipment to perform the excavation within the limits of the lines and grades noted in this Section or directed shall, in general, be that of the Contractor provided such produces the desired results without injuring any adjacent or adjoining work.

Special care shall be taken not to disturb or loosen foundation material below designated foundation limits.

Unless otherwise indicated in the plans or directed by the Engineer, all sheeting and bracing used in making structure excavation shall be removed by the Contractor following the completion of the work.

(c) BACKFILLING.

1. FOUNDATION BACKFILL.

Foundation backfill shall be deposited uniformly for the full width of the excavation in horizontal layers not to exceed 6 inches {150 mm} in thickness with each layer compacted as directed by the Engineer.

2. GENERAL BACKFILL.

General backfilling consisting of all backfill except foundation backfill shall be performed in accordance with the requirements of Section 210 and Section 530 with particular attention directed to the requirements for protecting structures.

No backfill shall be placed against a newly constructed masonry or concrete structure for a period of 10 days unless authorized by the Engineer.

Large masonry or concrete structures such as box culverts and retaining walls, etc. shall have a deposit (belt), not less than 1 foot {300 mm} wide and 1 foot {300 mm} deep, of approved local or commercial free draining material placed full length along the back face of the vertical walls at the line of weepholes. This material must conform to the requirements specified under Subarticle 214.02(b).

Small structures such as inlets, etc. and top slabs of culverts having weepholes shall have approximately 1 cubic foot {0.03 m^3} of approved commercial free draining material, as specified in Subarticle 214.02(b), placed at each weephole.

Placing of the material at weepholes shall be done in such a manner as to provide maximum depth of filtering effect.

Prior to the placing of any free draining material, each weephole shall be protected by rough stones, a grooved concrete block, or hardware cloth to permit seepage yet prohibit loss of material through the weephole.

No direct payment will be made for the operation or the special material noted above for treatment of weepholes.

214.04 Method of Measurement.

(a) STRUCTURE EXCAVATION.

The quantity of excavation removed under this item will be the number of cubic yards {cubic meters}, measured in its original position, acceptably excavated in conformity with the plans or as directed and the following:

1. For retaining walls and similar structures, measurement will be made of material removed from the area bounded by vertical planes 1 foot {300 mm} outside of the neat lines of the footings and parallel thereto, and to the elevations shown on the plans or directed by the Engineer to provide installation on a suitable foundation. No measurement or payment will be made for material excavated outside these limits.

2. For box, arch, and pipe culverts with wing walls or headwalls or other minor structures including storm sewers, measurement will be made of the material removed in accordance with the following:

The excavation shall be considered to be a trench with vertical sidewalls. No separate measurement for minor structures (inlets, junction boxes, catch basins, manholes, etc.) other than noted below, such being considered incidental to work.

The length of the excavation shall be the actual length of the structure (including inlets, junction boxes, etc.) measured along the flowline plus 1 foot {300 mm} at each end. When headwalls or wing walls are used, the length shall be the average net length of the structure, tip to tip of wings.

The width of the excavation shall, in the case of pipe structures, be considered the inside diameter of the pipe plus 3 feet {1 m}. For box culverts, the width shall be the outside width of the barrels plus 4 feet {1.2 m}. On all culvert structures, no allowance will be made for wing flares or toe walls.

3. The depth of excavation will be as deep as required to install the structure on a suitable foundation to the flowline indicated. This depth shall then be measured in accordance with the following:

a. Pipe of inside diameter of 48 inches {1200 mm} or less shall be laid in a trench extending at least 1 foot {300 mm} above the elevation of the top of the pipe. The depth of excavation shall be measured from a point 1 foot {300 mm} above the top of the pipe, or from subgrade elevation in cut sections.

b. For box culverts and pipe larger than 48 inches {1200 mm} in diameter, cross sections of the original ground will be taken at major breaks in the ground line profile and at changes in the culvert barrel widths along the length of the culvert as defined in Item 2 above.

4. The average end area method shall be used in computing the volume and no measurement for payment will be made for material excavated outside of the limits noted above.

5. No measurement or payment will be made for excavation for side drain pipe of any size or for side drain culverts unless so provided by plan details. The cost of such excavation shall be included in the price bid for the items; however, pipe designated on the plans as storm sewer pipe will not be classified as side drain.

(b) FOUNDATION BACKFILL.

Foundation backfill will not be measured directly but the volume will be fixed at 150 percent of the volume of the excavation which it replaces that lies between the bottom of the structure and the bottom elevation of the trench ordered excavated. Where satisfactory structure foundation is provided by the normal process of removing and backfilling unsuitable material under fill areas, none of such backfill will be classified as foundation backfill.

214.05 Basis of Payment.

(a) STRUCTURE EXCAVATION.

Payment will be made for the number of cubic yards {cubic meters}, measured as detailed above, at the contract unit price bid for Structure Excavation.

Such payment shall be payment in full for furnishing all materials, equipment, tools, labor, pumping, bailing, draining, and all incidentals necessary to complete the work and shall include installation and removal of any cribs, cofferdams, shoring, sheeting, or other protection, the satisfactory disposal of any unsuitable material from the excavation, and the placement and compaction in backfill or embankment of the material excavated and suitable for such use.

(b) FOUNDATION BACKFILL.

Payment for the calculated cubic yards {cubic meters} of this material, determined as noted herein, will be made at the contract unit price bid which shall be full compensation of the item complete in place and includes furnishing of all material, placement, compaction and all equipment, tools, labor, and incidentals necessary to complete the work.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

214-A Structure Excavation - per cubic yard {cubic meter}
214-B Foundation Backfill, Local/Commercial - per cubic yard {cubic meter}

SECTION 215
EXCAVATION FOR BRIDGES

215.01 Description.

The work under this Section shall cover foundation excavation for bridge structures which includes the removal of all material, of whatever nature, necessary for the construction of foundations and substructures, including backfill, all in accordance with the plans or as directed by the Engineer. It shall, unless otherwise stipulated by the plans or proposal, include the furnishing of all necessary equipment and the construction of all sheeting and shoring, cribs, cofferdams, caissons, dewatering, etc., which may be necessary for the execution of the work. It shall also include the subsequent

removal of these items and the placement of all necessary backfill as hereinafter specified. It shall also include the disposing of excavated material, not required for backfill, in a manner and in locations as approved by the Engineer.

The item of Cofferdam and Pumping, when specified on the plans, shall not be covered under this Section. Attention is directed to Section 503 for the requirements of this item.

215.02 Classification of Material.

Excavation for bridges shall include all material removed except water or other liquids. Excavation of material for bridges not within the classification of roadway or drainage excavation will be Unclassified Bridge Excavation.

215.03 Construction Requirements.

(a) INSPECTION.

1. NOTIFICATION.

The Contractor shall notify the Engineer a sufficient time in advance of the beginning of the excavation for each structure, so that elevation and measurements may be taken of the existing ground. No payment will be made for material removed or excavated before these measurements have been taken.

2. APPROVAL.

Ample opportunity shall be given the Engineer for the inspection of foundation pits and the measurement of material removed. In no case shall a foundation be closed to view until it has been inspected and approved.

3. CHANGE IN FOUNDATION ELEVATIONS.

When in the Contractor's opinion, rock, or other firm foundation material of equal bearing value is encountered at an elevation above that shown for the footing, and at a location not subject to erosion or scour, the Contractor shall notify the Engineer in order that he may investigate and determine if it is advisable to raise the bottom of the footing.

When the excavation for a footing has been completed to the approximate elevation shown on the plans without encountering satisfactory foundation material, the Contractor shall notify the Engineer in order that he may make an inspection and investigation, such investigation to consist of drilling, probing or jetting by the Contractor, a maximum of 4 holes per footing, each hole a maximum depth of 20 feet {6 m}. No direct payment will be made for this operation. If additional holes are required they will be paid for as provided in Article 104.03. The Engineer will then fix the proper elevation of the footing or decide upon its treatment.

4. DRILLING OR PROBING.

When apparently satisfactory foundation material has been reached, the Contractor shall drill or probe not more than 4 exploratory holes to a maximum depth of 10 feet {3 m}. The drilling will not be required if a note is shown on the plans to waive this requirement. No direct payment will be made for this operation. If additional holes are required, they will be paid for as provided in Article 104.03.

(b) DEPTH AND SIZE OF EXCAVATION.

The excavation for the bottom of the footing shall be carried to the depth as shown on the plans or as designated. The design and elevation of footings are based on soundings taken at certain points for design purposes only. These soundings may or may not be representative of the actual conditions encountered during construction. Bidders must assume the risk of having to excavate to a greater or lesser depth without altering the contract unit prices in the proposal, except as hereinafter set forth, and the footing elevations shown on the plans shall be considered as approximate only. The Engineer may order in writing such changes in dimensions or elevations of footings as may be necessary to secure satisfactory foundations for the structure.

The size of the excavation shall in all cases be ample to accommodate necessary forms down to rock, marl, Selma chalk or similar hard material suitable for embedment of footings; excavation in such materials shall be as near as possible to the neat lines of the footings and the footings poured without the use of forms. In hard materials which cannot be cut to neat lines with a pneumatic spade, line drilling along the neat lines not to exceed 9 inch {230 mm} centers will be required. In dry soils, suitable for footing embedment, capable of providing stable, neat footing lines, permission may be given to allow pouring of footings without the use of forms; otherwise, the excavation shall be sufficient for forming the foundations.

The horizontal limits of excavation shall not extend beyond what is required for sheeting, bracing, forms and reinforcing cages.

(c) COFFERDAMS OR SHEETING AND SHORING.

Cofferdams or sheeting and shoring will be required in foundation excavation work when work is adjacent to pavement, sidewalks, railroad tracks, utilities, etc., when the material encountered is unstable, when such excavation will present a hazardous or undesirable condition as may be determined by the Engineer, or when necessitated due to water conditions. Materials and design to be used for this work will be determined by the Contractor. Working drawings and computations as specified in Article 105.02 shall not normally be required for this work. Where foundation is near a railroad track this submittal shall be required.

If a seal is required in a cofferdam covered under this Section, it shall meet all of the requirements, and be measured for payment in accordance with Section 503.

(d) GENERAL BACKFILL.

All material used for backfill shall be soil of an acceptable quality.

All spaces excavated and not occupied by abutments, piers or other permanent work shall be backfilled. Backfill around all units of a structure shall be completed as soon as practical after the unit has obtained the required strength. Bracing, forms and rubbish shall be removed from the excavated area before backfilling is commenced.

Backfill within the limits of the roadway shall be as required by Section 210; all other backfill, except that placed below water level, shall be tamped and compacted as required by the Engineer.

(e) FOUNDATION BACKFILL.

If the surface upon which the footing is to be placed becomes soft or muddy and will not dry out after the excavation has been dewatered, the Engineer may direct that a foundation course of approved free draining commercial material, as specified in Subarticle 214.02(b), be used under the footing.

If this soft and muddy condition occurred through no fault or negligence of the Contractor, the Engineer, at his discretion, may order payment to be paid under Item No. 214-B, Foundation Backfill, Commercial. If this Item is not in the contract, then payment will be made as Extra Work as specified in Article 104.03 and Article 109.04.

When the above condition was the result, in the opinion of the Engineer, of negligence on the part of the Contractor, no payment will be made for the required foundation backfill. Compaction shall be as directed by the Engineer.

(f) PRESERVATION OF STREAM BANKS AND CHANNEL.

The natural ground adjacent to the structure shall not be disturbed without permission of the Engineer. Unless otherwise specified, no excavation shall be made outside of caissons, cribs, cofferdams, steel piling or sheeting. The natural stream bed adjacent to the structure shall not be disturbed without permission from the Engineer. If any excavation or dredging is permitted at the site of the structure before caissons, cribs or cofferdams, or piling are placed, the Contractor shall, without extra compensation and after the foundation is in place, backfill all such excavations to the original or established ground surface or stream bed with satisfactory material. No material or debris shall be deposited in any designated navigation channel during construction except with the approval of the Engineer. Such material or debris shall be removed to the normal navigation channel depth prior to completion and acceptance of the contract. Any material or debris resulting from the Contractor's operations deposited outside any designated navigation channel or other streams during construction except such fill as may be ordered as a permanent part of the work shall be removed and the channel freed from all obstructions before completion of the work.

(g) DISPOSAL OF SURPLUS AND UNSUITABLE MATERIAL.

Surplus excavated material, after piers and abutments are backfilled, shall be used to obliterate construction scars at or near the bridge site, to smooth out depressions in and near the stream banks or as otherwise directed by the Engineer.

215.04 Method of Measurement.

(a) UNCLASSIFIED BRIDGE EXCAVATION.

When listed as a pay item in the contract, the quantity of Unclassified Bridge Excavation will be the number of cubic yards {meters} of material excavated, measured and calculated in its original position, subject to the following limitations:

a. The volume measured will be that actually removed (except for seal concrete footings); however, no measurement will be made for material removed outside of the area bounded by vertical planes 1 foot {300 mm} outside of the footing and parallel thereto down to hard material described in Subarticle 215.03(b) or for material excavated outside neat lines of footings in such hard material. For stepped footings the volume will be measured and computed separately for each step. When the size of a footing is reduced after the Contractor excavated for a larger footing as directed, the excavation will be measured based on the larger footing.

b. Water or other liquid will not be classed as excavated material and no measurement or direct payment will be made for their removal.

c. No measurement or payment will be made for excavation in pile abutments nor for any pile encasements.

d. No measurement or payment will be made for the excavation required for the construction of abutment caps on drilled shaft foundations.

e. No measurement will be made for material removed below the elevation designated to be the bottom of the footing, unless removal of said material is ordered. Excavation necessary and incidental to the cleaning or excavating of crevices in the floor of a foundation pit below the established footing elevation will not be measured for payment.

f. No measurement will be made for the removal of material raised by driving piles or for the removal of material that flows through or over cofferdams or caissons.

g. The measurement of the volume of excavation for a seal concrete footing shall be calculated from the following:

L = Length of footing shown on contract plans (feet {meters});
W = Width of footing shown on contract plans (feet {meters});
D = Final approved elevation of the bottom of the footing (feet {meters});
B = Average elevation of the mud line or groundline (river bottom) at the cofferdam (feet {meters});
Ve = Volume of excavation for which payment will be made (cubic yards {cubic meters}).

$Ve = L \times W \times (B - D) / 27$ {$Ve = L \times W \times (B - D)$}

Excavation outside of these limits of measurement may be required for the construction of a seal concrete footing, depending on the details of construction selected by the contractor. No direct payment will be made for any excavation outside of the footing plan dimensions shown on the contract plans.

(b) COFFERDAMS OR SHEETING AND SHORING.

Each accepted Cofferdams or Sheeting and Shoring unit will be measured for payment as a lump sum unit. A unit shall consist of all piers, bents, and abutments on a specific bridge which are not designated by the plans for Item 503-B, Cofferdam and Pumping. Partial payments will be allowed on monthly estimates in accordance with Subarticle 215.05(a)2.

215.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. UNCLASSIFIED BRIDGE EXCAVATION.

Payment for the yardage of Unclassified Bridge Excavation as provided above shall be payment in full for the furnishing of all materials, equipment, tools, labor, pumping, bailing, drainage, sealing crevices, backfilling (including foundation backfill), compacting, disposal of excavated material, and for all incidentals necessary to complete the work in accordance with the plans and these specifications.

If a footing is lowered below the elevation shown on the plans, adjustments in the unit price for all of the Unclassified Bridge Excavation of the footing involved will be made as follows:

Depth Lowered Below Plan Elevation	Bid Price Plus
0 to 3 feet {1 m}	0%
Over 3 feet {1 m} to 6 feet {2 m}	50%
Over 6 feet {2 m} to 10 feet {3 m}	75%
Over 10 feet {3 m}	100%

For stepped footings, the above adjustments will be computed separately for each step.

2. COFFERDAMS OR SHEETING AND SHORING.

Payment for a lump sum unit of Cofferdams or Sheeting and Shoring as provided above shall be payment in full for the furnishing of all materials, equipment, tools, and labor necessary to complete the construction of the specified piers, bents, and abutments and the removal and disposal of any cofferdams or other temporary construction used in the prosecution of the work.

Payment for each accepted Cofferdams or Sheeting and Shoring unit will be made at the contract lump sum price bid for each unit, complete in place.

Partial payments will be made on monthly estimates based on the percentage of the total work performed on each unit as estimated by the Engineer. In making this estimate each pier or bent considered as part of a unit will be given an equal percentage of the total unit. Upon completion of the foundation above ground line at a particular pier or bent, that percentage of the total unit may be paid.

No consideration will be given for additional compensation for this item when footing elevations are lowered less than 10 feet {3 m}, such being considered incidental to the work. If elevations are lowered 10 feet {3 m} or more, consideration will be given for additional costs caused by the revised elevations in accordance with Article 109.04.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

215-A Unclassified Bridge Excavation - per cubic yard { cubic meter}

215-B Cofferdams or Sheeting and Shoring, ___*___, ____**____ - per lump sum

* Station Number, Bridge Number, Ramp Number, etc.

** Lane, if applicable.

SECTION 217
SPECIAL PROTECTION FOR ROCK SLOPES

217.01 Description.

This Section shall cover the work of providing special treatments to rock slopes for protection against excessive weathering, popouts, and other detrimental conditions which may endanger the highway roadbed.

In general the following methods, used as directed by the Engineer, shall be applied to exposed rock surfaces or rock surfaces exposed by the construction.

Rock Bolting - This work shall cover the anchoring of large blocks of rock which may be bounded by joints or cracks that might prove unstable by bolting them to more solid sections of rock.

Seam Sealing - This work shall cover the partial removal of relatively thin seams of very soft unsatisfactory material and the resealing of the seams with a durable cap of concrete.

Asphalt Surfacing - This work shall cover the surfacing of relatively flat horizontal sections of rock berms with an asphalt surface to prevent excessive wear or weathering of soft, unstable rock.

Pneumatic Concrete Blanket - This work shall cover the construction of a protective blanket layer of concrete over an area of broken or loose boulders and/or unstable rock to prevent fallouts from erosion and weathering.

Special attention is directed to the fact that the items of work provided under this section are estimated and cannot be accurately determined until the work is exposed; therefore, only the amounts actually used will be measured for payment and no claims will be considered for extra compensation due to overruns or underruns of the items covered by this Section.

217.02 Materials.

(a) GENERAL.

All materials furnished for use under this Section shall conform to the applicable sections of Division 800, Materials, unless noted herein or provided on the plans.

(b) ROCK BOLTING.

Material fabricated for use in the rock bolting operations shall conform to the following:

1. BOLTS.

a. Slotted.

All slotted bolts shall be steel conforming to the requirements of ASTM A 588, Grade A.

b. Headed.

All headed bolts shall be steel conforming to the requirements of ASTM A 588, Grade A.

2. WEDGES.

All wedges shall be steel conforming to the requirements of ASTM A 588, Grade A.

3. EXPANSION SHELLS.

All expansion shells shall conform to the requirements of ASTM A 47, Specification for Malleable Iron Castings, Grade 32510. Tapered plugs used with expansion shells shall be forged from steel conforming to the requirements of ASTM A 663 and A 675, Grade 60 to 65.

4. ROOF PLATES.

All roof plates shall be steel conforming to the requirements of ASTM A 242, Type 2, or ASTM A 588, Grade A.

217.03 Construction Details.

(a) ROCK BOLTING.

1. GENERAL.

Rock bolts shall be installed at the direction of the Engineer at any point where the stability of the rock cut is questionable. When bolting is deemed desirable, it shall be done as quickly as possible. Rocks should be kept tight and not pulled back into place once it has been loosened by successive blasting or construction operations. The holes for the rock bolts shall be drilled as closely as possible to the diameter recommended by the manufacturer of the wedge or shell.

2. TORQUE.

The diameter and length of the rock bolt to be used shall be determined by the Engineer. All installations shall be in accordance with the recommended procedure or method as given by the manufacturer of the rock bolts. When directed by the Engineer, proper tests will be made to determine what torque the rock can withstand. If the tests show that the highest torque practical is of a certain value for a particular grade of rock, then torque shall be applied to the rock bolt provided the torque does not exceed the maximum recommended by the manufacturer of the rock bolts. It is recognized that any over-application of torque will only destroy the anchorage in the rock and in due time destroy the initial tightness of the bolt. It is desired that a minimum torque of 125 foot pounds {170 N•m} be applied in all cases where the rock will withstand such pressure.

3. INSTALLATION DETAILS.

Extreme care shall be taken to keep the drill hole aligned perpendicular to the plate bearing surface. The diameter of the drill hole shall be as recommended by the manufacturer for the type of expansion unit to be used for anchorage into the rock. Expansion units shall not be used in holes larger than that for which they are designed. When slotted type rock bolts are used, the bolt with wedge shall be inserted in the hole until the wedge hits the bottom of the hole. The bolt shall then be driven into the hole with an air-percussion hammer forcing the wedge into the slotted end of the bolt, thus anchoring the bolt in the hole. The plate and nut shall then be installed on the collar end of the bolt and the nut tightened to the torque recommended by the manufacturer.

(b) SEAM SEALING.

1. GENERAL.

The seam designated by the Engineer for sealing shall be examined carefully during the grading operations for evidence of seepage which will require construction of weep holes in the sealing cap as well as for the best method for placing the sealing cap.

2. CLEANING OF THE SEAM.

The material in the seam to be treated shall be routed out or otherwise removed to a depth at least equal to the thickness of the seam or layer to be treated or to a depth which will give firm support to the sealing material.

3. SEALING THE SEAM,

The clean seam shall be sealed or packed with one of the following types of concrete mixes. The method of packing or placing the sealant shall be left to the Contractor provided the method used produces the desired results and presents an acceptable appearance. Weep holes, when deemed necessary, shall be placed as directed.

a. Low Slump - Class "A" Structure Concrete as provided by Section 501 of the Standard Specifications.

b. Pneumatic Concrete of an approved mix of cement, additives, aggregates, and water applied pneumatically. (Mix designed by the Contractor to produce a 28 day cylinder strength of 5000 psi {35 Mpa})

c. Retempered - Class "A" Structure Concrete.

(c) ASPHALT SURFACING.

1. GENERAL.

An Asphalt Surface shall be placed on areas designated by the Engineer to prevent excessive erosion from surface runoff over relatively soft and erodible materials.

2. PREPARATION OF SURFACE.

The surface to receive the asphalt surfacing shall be fairly uniform, without excessive high and low spots, suitable for coverage with asphalt. The surface shall be clean and free from loose rock fragments before applying the surfacing material.

3. SURFACING MATERIAL.

The surfacing material shall be Asphalt Cement Grade 40 or an approved equal. The bituminous material shall be applied at the rate of 1.25 gallons per square yard {5 L/m^2}. The method of application shall be that of the Contractor's provided it is approved by the Engineer and it produces the desired results and presents a pleasing appearance.

(d) PNEUMATIC CONCRETE BLANKET.

1. GENERAL.

The exposed surface designated by the Engineer to receive this type treatment shall be carefully examined to determine the installation procedure which will be necessary to conform to the reinforcing details shown on the plans.

2. CLEANING THE AREA TO BE TREATED.

The area to be treated shall be cleaned of all loose scaly rock or soil fragments by the use of pressurized water and air jets or other approved means as directed by the Engineer.

3. PLACEMENT OF THE PROTECTIVE BLANKET.

a. Reinforcement shall be placed in accordance with the details shown on the plans or as directed. Anchorage of the reinforcement to the slope shall be accomplished by the use of the anchor bolts of the size and shape shown by plan details.

b. The pneumatic concrete blanket shall consist of an approved mix of cement, additives, aggregates, and water pneumatically applied to the surface to be treated. (The mix shall be designed by the Contractor so as to produce a 28 day cylinder strength of 5000 psi {35 Mpa}). Placement of the pneumatic concrete shall be in accordance with the supplying producer's recommendations, provided the method used produces the desired results and presents an acceptable appearance. (Note - It is not the intent of this specification to require a uniform surface, but to provide a fairly uniform layer of concrete of not less than the depth shown on the plans, which in general parallels the surface being treated.)

217.04 Method of Measurement.

(a) ROCK BOLTING.

The measurement for rock bolts will be the linear feet {meter} of the specific size designated by the Engineer, complete in place and accepted.

(b) SEAM SEALANT.

The seam sealing material will be measured in cubic yards {cubic meters}, complete in place. The volume of material actually placed will be computed from measurements of the actual length, width, and depth of the excavated seam opening. No allowance will be made for the replacing of material removed beyond the depth directed.

(c) ASPHALT SURFACING.

The Asphalt Surfacing material will be measured in gallons {liters}.

(d) PNEUMATIC CONCRETE BLANKET.

The measurement of the Pneumatic Concrete Blanket will be measured in square yards {square meters}, computed from the areas actually ordered treated. No allowances will be made for material placed outside of the designated areas nor for crevices, etc., required to be filled in order to obtain a continuous blanket over the area.

217.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. ROCK BOLTING.

The accepted length of rock bolts placed as directed will be paid for at the contract price per linear foot {meter}, complete in place, which price shall be full compensation for furnishing and installing all materials, including bolts, wedges, expansion shells, and accessories and for all equipment, tools, labor, and incidentals necessary to complete the work.

2. SEAM SEALANT.

The accepted volume of seam sealant, measured as noted above, will be paid for at the contract unit price bid for the seam sealant which shall be payment in full for the item complete in place and shall include all excavation, disposal of excavation, materials, furnishing of the sealant, placing of the sealant, and for all equipment, tools, labor, and incidentals necessary to complete the work.

3. ASPHALT SURFACING.

The accepted volume of asphalt surfacing placed as directed will be paid for at the contract unit price bid per gallon {liter} which shall be payment in full for the bituminous material complete in place and includes furnishing the bituminous material, preparing the surface, transporting and heating of the material as required, placing the material in the areas designated, and for all equipment, tools, labor, and incidentals necessary to complete the work.

4. PNEUMATIC CONCRETE BLANKET.

The accepted area treated under this item will be paid for at the contract unit price bid per square yard {square meter} which shall be payment in full for the pneumatic concrete blanket complete in place and includes preparation of the surface to be treated, furnishing all materials, installation of wire reinforcement, its accessories and anchor bolts, placement of the pneumatic concrete, and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

217-A Rock Bolting, 1" {25 mm} Slotted - per linear foot {meter}
217-B Rock Bolting, 5/8" {16 mm} Headed - per linear foot {meter}
217-C Rock Bolting, 3/4" {19 mm} Headed - per linear foot {meter}
217-D Rock Bolting, 7/8" {22 mm} Headed - per linear foot {meter}
217-E Seam Sealant - per cubic yard {cubic meter}
217-F Asphalt Surfacing - per gallon {liter}
217-G Pneumatic Concrete Blanket, ___ inches {mm} thick - per square yard {square meter}

SECTION 219
LANDSLIDE CORRECTIONS

219.01 Description.

This Section shall cover the work of correcting a landslide in an existing roadway slope within the designated areas shown on the plans or directed by the Engineer, all in accordance with the details shown on the plans or noted in this provision.

219.02 Materials.

Materials furnished for use shall conform to the appropriate requirements of the Standard Specifications for the type work performed or noted herein.

(a) GEOTEXTILE FILTER.

A geotextile to be used as a special underdrain shall meet the requirements of plan details, AASHTO M 288 for Subsurface Drainage Geotextile, Class 2, and Section 810 of these specifications. The geotextile shall be selected from List II-3, of the Department's manual titled "Materials, Sources, and Devices With Special Acceptance Requirements". Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

(b) HORIZONTAL DRAIN PIPE.

The drainage pipe shall be PVC, Schedule 80, Type I or II, or Schedule 120, 1.5 inch {38 mm} I.D. pipe conforming to the requirements of U.S. Commercial Standard CS-207-60 or ASTM D 1785 - modified to include the following:

The pipe shall be furnished in lengths suitable for use with the drilling equipment approved for use.

The ends of the pipe shall be machined to provide a smooth wall slip coupling when joined using appropriate solvent welding material thus precluding the use of conventional slip couplings. Fittings necessary for the outfall connections outside the drilling limits shall be rigid PVC, Schedule 80, Type I or II, or Schedule 120 fittings having a burst strength equal to or greater than the pipe noted herein. All pipe and fitting connections shall utilize solvent weld joints.

Slotted pipe shall have two rows of slots circumferentially cut 120 degrees apart. The average configuration shall be 46 slots per row, per foot {300 mm} with a maximum 0.010 inch {0.25 mm} slot opening when used in a silty or clay soil or 42 slots per row, per foot {300 mm} with a maximum 0.050 inch {1.3 mm} slot opening when used in a granular material. The configuration and the slot opening size shall be as designated on the plans and/or in the proposal or as directed by the Engineer.

Perforated pipe shall have three rows of 3/8 inch {9 mm} diameter holes, two rows which shall be 180 degrees apart with the third row located half way between the 180 degree holes. The holes shall be spaced approximately 3 inches {75 mm} apart with the center row staggered in relation to the side holes.

219.03 Construction Requirements.

(a) GENERAL.

In general, the work necessary to correct a landslide is dependent upon the in situ conditions and extent of damage existing at each site and will vary according to the details shown on the plans.

Basic procedures may require any combination of the following work items:

1. Excavation for the removal of loose or unwanted material. Normally, Unclassified Excavation as provided in Section 210 will apply unless otherwise noted by plan details.
2. Construction of paved flumes, installation of underdrain systems (Standard Underdrainage as provided in Section 606 or Special Underdrainage System as noted herein or detailed in the plans), or other methods of removing surface or underground water from the area.
3. Construction of retainage structures (Standard Retaining Wall, Mechanically Stabilized Earth Wall, or Rock Buttress) as noted by plan details to stop slippage of slope material.
4. Restoration of back slope or front slope to a designated slope angle utilizing removed material, ordinary or special borrow material as designated by the plans. This work requires the preparation of the surface by rolling or otherwise compacting the area as directed to receive the backfill material. The backfill material shall be placed in the same manner as prescribed in Subarticle 210.03(d) for embankment.
5. Restoration of the erosion control over the repaired area as prescribed by the appropriate erosion control items provided in the contract.

(b) EXCAVATION.

The area designated for treatment shall be excavated to the depth indicated by the plans or directed to remove loose or otherwise unacceptable material. Removed material designated for re-use shall be stockpiled on approved areas; material not designated for re-use shall be disposed of as required in Article 210.05. Unless stockpile areas are designated on plan details, the Contractor shall provide, at his expense, satisfactory storage areas outside of the right of way limits.

(c) DRAINAGE SYSTEMS.

1. Surface drainage systems, when required, will be classified, paid for, and constructed under the appropriate item for such provided in the contract (reference Sections 610, 614, 615, 616, and 654).

2. Underdrainage systems, when required, will be one of the following classifications as indicated by the plan details.

a. Standard underdrain - constructed and paid for under the provisions of Section 606.

b. Special underdrains - constructed in accordance with the details provided in the plans for size, shape, and content.

c. Special Filter Blanket - constructed in accordance with the details provided in the plans, specifications, or as directed by the Engineer for size, shape, content, and type. If an aggregate blanket is required, the type and size of aggregate shall be as designated on the plans. If a geotextile filter is required, the type of geotextile (woven or non-woven) shall be designated on the plans and/or in the proposal.

The geotextile filter shall be placed in the manner and at the locations shown in the plans or as directed by the Engineer. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any geotextile damaged during its installation or during placement of backfill material shall be replaced by the Contractor at no additional cost to the State. The work shall be scheduled so that 14 days does not expire between placement of the geotextile and the covering of the geotextile with backfill. Backfill aggregate shall not be dropped on the geotextile from a height greater than 1 foot {300 mm}. Greater drop heights will be permitted if the Contractor provides a cushioning layer of sand on top of the geotextile before dumping of any stone. The combination of drop height for stone and sand cushion layer thickness to be approved must be demonstrated to not puncture or damage the geotextile. No measurement or separate payment shall be made for a sand cushion layer placed for the purpose of allowing an increased drop height of stone. Any damage to the geotextile during placement of aggregate shall be corrected prior to proceeding with the work.

d. Horizontal Drains - constructed in accordance with the following details at locations, etc. shown on the plans or directed.

(1) Horizontal drains shall cover the work of drilling appropriate size horizontal holes (angle and slope designated on plans) into backslope or frontslope and the installation of a designated size of perforated or slotted PVC drainage pipe to facilitate drainage of ground water.

(2) The installation procedure requires the holes be drilled with rotary drilling equipment capable of providing 3 inch {75 mm} to six inch {150 mm} diameter holes up to 600 feet {180 m} in length to the designated lines and grades through soil and rock formations.

The drilling equipment shall allow the installation operation to be accomplished by inserting the plastic drain inside the drill hole the full length of the drill hole.

The installation operation of the drain pipe shall be done in such a manner that the drain pipe will be cemented together where necessary to form a continuous tube and will not be telescoped or damaged to the extent that its drainage efficiency will be impaired when completed.

The entrance end of the pipe shall be plugged with a rounded or pointed extension. The space between the drilled hole and the pipe shall be tightly plugged with earth for a length of at least 2 feet {600 mm} at the outlet end of the hole.

Water used for drilling and water developed during drilling operations shall be disposed of by the Contractor in such a manner that no damage will result to the work.

Unslotted PVC pipe approximately 10 feet {3 m} in length, shall be provided at the mouth of the drain to collector structure.

(d) SLOPE RETAINING STRUCTURES.

1. Retaining walls (cast-in-place or precast), if required, shall be constructed, measured, and paid for as provided in the appropriate Section of the Specifications.

2. Rock buttress, if required, shall be constructed, etc., in accordance with the following requirements:

General.

The construction, in general, consists of the excavation of a trench, preparation of a bedding to receive a rock buttress and the construction of a rock buttress to the line, grades, and slopes detailed on the plans.

Excavation of Trench.

The excavation necessary to prepare the trench to the line, grades, slopes, and section shown on the plans or directed shall be classified and paid for under the Item of Unclassified Excavation or as provided on the plans.

Preparation of Trench Bed.

The preparation of the trench bed shall be as detailed on the plans. Special bedding, if required, will be noted on the plans. Materials used in the special bedding shall conform to the specified sections of the Standard Specifications and will be paid for under the appropriate pay item for the materials used.

Rock Buttress.

The rock buttress material, unless otherwise noted on the plans, shall be hard durable stone obtained by normal quarrying operations, and will be limited to sandstone, limestone, dolomite, or granite free of dirt and debris meeting the approval of the Engineer. The rock buttress shall be placed, in the prepared trench to the slopes indicated on the plans or directed, in approximately 2 foot {600 mm} thick layers. Material used shall be approximate in size to that of a Class 2 to Class 3 Riprap. Boulders larger than 2 foot {600 mm} may be used provided they are spaced so as to permit filling and densification of the intervening space in the 2 foot {600 mm} layers. The rock shall be selected in a manner that will provide a choking material for filling voids. Densification of the rock backfill will be required; however, no density test will be required on the rock backfill.

Furnishing of the rock for the construction of the buttress shall be the responsibility of the Contractor. If permission is given to use any material outside regular excavation limits within the right of way, it will be paid for only once under the appropriate pay item provided by this Section.

(e) CONSTRUCTION REQUIREMENTS FOR GEOTEXTILES.

Exposure of geotextiles to the elements between lay down and cover shall be a maximum of 14 days to minimize damage potential.

The geotextile shall be placed and anchored on a smooth graded surface approved by the Engineer. The geotextile shall be placed in such a manner that placement of the overlying materials will not excessively stretch or tear the fabric. Anchoring of the terminal ends of the geotextiles shall be accomplished through the use of key trenches or aprons at the crest and toe of the back slope of the buttress or as specified on the plans.

Successive geotextile sheets shall be overlapped in such a manner that the upslope sheet is placed over the downslope sheet or upstream over downstream. In underwater applications, the geotextile and required thickness of backfill material shall be placed the same day. The backfill placement shall begin at the toe and proceed up the slope.

Riprap and heavy stone filling shall not be dropped onto the geotextile from the height of more than 1 foot {300 mm}. Smaller sizes of stone filling shall not be dropped onto the geotextile from a height exceeding 3 feet {1 m}. Any geotextile damaged during placement shall be replaced as directed by the Engineer at no additional cost to the State.

The geotextile shall be joined by either sewing or overlapping as outlined in Article 608.05 of these specifications. All seams shall be subject to the approval of the Engineer. Overlapped seams shall have a minimum overlap of 12 inches {300 mm} except where placed under water where the overlap shall be a minimum of 3 feet {1 m}.

A geotextile patch placed over a damaged area shall be extended 3 feet {1 m} beyond the perimeter of the tear or damage.

(f) RESTORATION OF SLIDE SLOPE.

Restoration of slide slope (front or back) shall consist of preparing the area to receive the replacement material by the shaping and compaction of the area as prescribed in Subarticle 210.03(d) for embankments. The material in place shall be compacted as noted in the plan details or directed by the Engineer.

The backfill material may be the material previously removed, ordinary borrow, or special backfill material of the type designated in the plans or proposal. Said backfill shall be placed in layers and compacted as prescribed in Section 210 or noted by plan details.

Erosion control items provided in the plans shall be used to re-establish the ground cover damaged or destroyed by the landslide or the restoration work.

219.04 Method of Measurement.

(a) GENERAL ITEM.

Construction items not specifically provided in this Section will be classified, measured, and paid for under the respective pay items for such work provided in the contract.

(b) ROCK BUTTRESS FOR LANDSLIDE CORRECTION.

The Item of Rock Buttress for Landslide Correction, when provided in the plans or proposal, will be the weight {mass} of rock used in construction of the buttress, measured on approved scales.

Measurement of any special bedding, if required, will be as specified for the respective pay item used for bedding.

(c) SPECIAL UNDERDRAIN.

The Item of Special Underdrain, when provided in the contract, will be measured in linear feet {meters} of each special type detailed in the plans, along the center of each line or lateral, center to center of junctions and/or fittings.

(d) SPECIAL FILTER BLANKET.

The Item of Special Filter Blanket, when provided in the contract, will be measured in square yards {square meters} to the nearest 0.1 square yard {0.1 m^2}, complete in place, for the material placed and accepted.

(e) HORIZONTAL DRAINS.

Horizontal drains will be measured by the linear foot {meter} of drain pipe installed in the holes drilled, including the extension necessary to discharge into the collector structure.

(f) SPECIAL BACKFILL FOR SLIDE CORRECTION.

1. When the item of special backfill for slide correction per ton {metric ton} is provided in the contract, the material ordered and accepted will be measured in tons {metric tons} on approved scales.

2. When the item of special backfill for slide correction per cubic yard in place {cubic meter} is provided in the contract, the accepted volume of backfill will be measured in cubic yards {cubic meters} complete in place by the cross section and average end area method. Cross sections shall be taken of the material in its original position, whether from a borrow pit, stockpile, or other approved source, before placing of the backfill and re-cross sectioned after placing the backfill. The volume computed between these cross sections shall be the volume of backfill.

219.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. When the Item of Rock Buttress for Landslide Correction is provided in the plans or proposal, the accepted weight {mass}, measured as noted above, will be paid for at the contract unit price bid. Said contract unit price bid shall be payment in full for furnishing and/or producing material, royalties, loading, hauling, placing, consolidating, shaping, and for all equipment, tools, labor, and incidentals necessary to complete the work.

2. The accepted Item of Special Underdrain, measured as noted above, will be paid for at the contract unit price bid per linear foot {meter}, which shall be full compensation for the underdrain complete in place. Said unit price includes excavation of the trench, backfill and compaction thereof, furnishing and installation of any pipe, fittings, geotextile filter, or filler necessary thereto, furnishing and placing of a connection to an outfall pipe or collector structure, the disposal of excess material, and for all tools, equipment, labor, and incidentals necessary to complete this item of work.

3. The accepted Item of Special Filter Blanket, measured as noted above, will be paid for at the contract unit price bid per square yard {square meter}, which shall be full compensation for the item complete in place and includes the furnishing of all materials, preparation of the area to receive the filter blanket, installation of the blanket and for all equipment, tools, labor, and incidentals necessary to complete this item of work.

4. The accepted Item of Horizontal Drain, measured as noted above, will be paid for at the contract unit price per linear foot {meter}, which shall be full compensation for furnishing and installation of the drains complete in place and connected to the collector structure. Said unit price

includes full compensation for furnishing all materials, services, equipment, tools, labor, and incidentals necessary to complete this item of work.

5. The Items of Special Backfill for Landslide Correction, ordered, accepted, and measured as noted above, will be paid for at the appropriate unit price bid per ton {metric ton} or cubic yard {cubic meter}, complete in place, which shall be full compensation for the furnishing of the type material designated for preparation of the area to be treated, loading, hauling, placement, compaction, and dressing of the area to the designated slope and includes all equipment, tools, labor, and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

219-A Rock Buttress for Landslide Correction - per ton {metric ton}
219-B Special Underdrain ___ inch {mm} Diameter - per linear foot {meter}
219-C Special Filter Blanket __*_ (__**_) - per square yard {square meter}
219-D Horizontal Drain ___ inch {mm} Diameter - per linear foot {meter}
219-E Special Backfill for Landslide Correction - per ton {metric ton}
219-F Special Backfill for Landslide Correction - per cubic yard {cubic meter}

* Specify either Aggregate or Fabric.
** If Fabric, specify either Woven or Non-Woven.

SECTION 224
TREATMENT OF LIME SINKS

224.01 Description.

The work under this Section shall cover the treatment required to correct conditions occurring when lime sinks are found within or adjacent to construction limits of the work. The application and extent of the treatment will be in accordance with plan details or as directed.

224.02 Materials.

Material furnished for use under this Section shall be of the quality and character noted on the plans or ordered by the Engineer, suitable for the purpose intended, and consistent with the requirements for such materials as may be noted in other parts of these Specifications.

224.03 Construction Requirements.

(a) GENERAL.

Choice of equipment to perform the work required under this Section shall in general be that of the Contractor provided such will produce the desired results within the limits directed by the Engineer.

(b) SEQUENCE OF WORK.

To properly evaluate the limits of the corrective treatment required to effectively bridge a lime sink, the work shall be performed in the following sequence:

Exploration of the lime sink area to locate the sink hole will be as directed by the Engineer; the size of the exploratory excavation shall be kept to a minimum.

The sink hole, once located, shall be enlarged to the size and depth as directed by the Engineer to expose the solution cavity.

After exposing the solution cavity, it shall be plugged with a rock boulder or a plug of suitable material capable of sealing the cavity, yet maintaining proper ground water drainage.

After installation of the plug, a strata of selected material that will permit proper ground water drainage shall be placed to a depth of approximately one-half the excavated hole depth, but not in excess of 7 feet {2 m}. The material used for this "Special Backfill" shall be of the type shown on the plans or directed. This special backfill material shall be placed in approximately equal uniform layers, not to exceed 2 feet {600 mm} in thickness, for the depth specified or directed. No compaction or density tests will be required.

The remainder of the backfill for the lime sink excavation shall then be constructed of Unclassified Excavation, Borrow, or other designated material in accordance with the requirements for Embankments as required in Section 210.

In the event a sink hole occurs in the immediate vicinity of the finished subgrade elevation, the use of concrete seal may be directed. In such case the same process noted before shall

be used up to the bottom elevation designated for the concrete seal. The concrete shall be Class B, Type 3, concrete of the thickness shown on the plans or as directed. Steel reinforcement, if required, will be as provided by the plans or as directed.

224.04 Method of Measurement.

(a) LIME SINK EXCAVATION.

Measurement for this item will be in cubic yards {cubic meters} computed from field measurements of the material actually removed as directed.

(b) SPECIAL BACKFILL FOR LIME SINK.

Special backfill material, furnished as directed, shall be measured in cubic yards {cubic meters}, loose measurement, or per ton {metric ton} in the transporting vehicle. No separate measurement of the boulder or plug used to seal the solution cavity will be made.

(c) CONCRETE SEAL.

When the use of a concrete seal is ordered, measurement will be made in cubic yards {cubic meters} computed from field measurement of concrete actually placed. All reinforcement required will be measured in accordance with Section 502, Steel Reinforcement.

224.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. The accepted volume of Lime Sink Excavation, measured as provided above, will be paid for at the contract unit price bid which shall be payment in full for the removal and disposal of the excavated material in a manner satisfactory to the Engineer, and for all equipment, tools, labor, and incidentals necessary to complete the work in accordance with the plans and this Specification.

2. The accepted volume of Special Backfill material, measured as noted above in accordance with the method provided in the contract (cubic yard {cubic meter} or ton {metric ton}), will be paid for at the contract unit price bid which shall be payment in full for the item complete in place and shall include all costs incidental to procurement, excavating, hauling, dumping, spreading, and formation of the embankment and for all equipment, tools, labor, and incidentals necessary to complete the work in accordance with the plans and these Specifications. No separate payment will be made for the boulder or plug used to seal the cavity.

3. The accepted volume of concrete for the seal, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the preparation of the concrete bed, furnishing of all materials, mixing, hauling and placing, and for all labor, tools, equipment, and incidentals necessary to complete the item. Steel reinforcement will be paid for under Item 502, Steel Reinforcement.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

224-A Lime Sink Excavation - per cubic yard {cubic meter}
224-B Special Backfill for Lime Sink, Type Material - per cubic yard {cubic meter}
224-C Special Backfill for Lime Sink, Type Material - per ton {metric ton}
224-D Concrete Seal for Lime Sink - per cubic yard {cubic meter}

SECTION 230
ROADBED PROCESSING

230.01 Description.

This Section shall cover the operations required to provide a satisfactory roadbed for receiving a base or pavement structure layer. Roadbeds will be of two types: (1) Improved Roadbeds when designated on the plans or (2) Modified Roadbed whenever Improved Roadbed is not specified on the plans. This Section covers the additional work above that required for regular earthwork construction specified under Section 210.

Improved Roadbed. Improved roadbed shall require the top layer, or layers, of the graded earth of both cuts and fills, with the upper surface at subgrade elevation, to be constructed of selected material from Unclassified Excavation or Borrow. Each layer of the plan designated thickness shall be processed and compacted as specified in Article 230.03.

Modified Roadbed. Modified roadbed shall require that the existing top layer of the graded earth of both cuts and fills below subgrade elevation be processed and compacted as specified in Article 230.03. This procedure is to establish a proper subgrade before constructing an overlying layer.

230.02 Materials.

(a) Improved Roadbed materials from Unclassified Excavation shall be the best material available as determined by the Engineer.

(b) Improved Roadbed material from Borrow shall meet the requirements of Subarticle 210.02(c).

230.03 Construction Requirements.

(a) GENERAL.

Choice of equipment to perform the work required under this Section shall, in general, be that of the Contractor, provided such produces the desired results.

Construction of the roadbed shall be conducted so that earth or other material does not prevent immediate drainage of water to the side ditches.

(b) IMPROVED ROADBED.

1. PREPARATION OF ROADBED.

Both cuts and fills shall be graded to the elevation designated on the plans, below subgrade elevation in accordance with the requirements of Section 210, and to the Typical Section shown on the plans or directed. No selected roadbed material shall be placed until the graded earth surface is satisfactory to grade, cross section, and density in accordance with Section 210. If a contract requires an improved roadbed to be placed on an earth surface constructed under a previous contract, the surface shall be repaired to the extent directed. Additional material required will be paid for under the proper classification of the material directed to be used.

2. PLACEMENT AND PROCESSING OF SELECTED ROADBED MATERIAL.

After preparation as noted above, the roadbed shall be brought up to subgrade elevation in maximum 6 inch {150 mm} layers using the designated selected materials. Each of these layers, except those specified in this Subarticle, shall be processed, utilizing the item Roadbed Processing, by thoroughly pulverizing, blending, and mixing until uniform in texture and appearance, insofar as practical, as determined by the Engineer. Each layer shall be compacted to the density noted in Subarticle 230.03(d) for improved roadbed layers. The section and density shall be maintained until placement of the next overlying improved roadbed, subbase, base, or other layer.

3. SPECIAL CONDITIONS.

In grading contracts which do not provide a subbase, base, or other overlying layer, the upper improved roadbed layer will not be processed as outlined above for Roadbed Processing, but shall be brought to the required elevation, typical section, and density, that specified in Subarticle 230.03(d). The required section shall be maintained until final acceptance; however, maintenance of the density will not be required.

(c) MODIFIED ROADBED.

1. PREPARATION OF ROADBED.

The graded earth shall have been constructed to subgrade elevation in accordance with Section 210 or may, by previous contract, have been constructed as an improved roadbed. No roadbed shall be processed, as outlined in this Subarticle, until the graded earth surface is satisfactory to elevation and typical section. If a contract requires roadbed processing on an earth surface constructed under a previous contract, the surface shall be repaired to the extent directed. Additional material required will be paid for under the proper classification of the material directed to be used.

2. PROCESSING OF THE ROADBED MATERIAL.

After preparation as noted above, the top six inch {150 mm}, minimum, layer, except for those layers specified in this Subarticle, of the entire width of both cuts and fills shall be processed, utilizing the item Roadbed Processing, by thoroughly pulverizing, blending, and mixing until uniform in texture and appearance, insofar as practical, as determined by the Engineer. Each layer shall be compacted to the density noted in Subarticle 230.03(d) for modified roadbed. The section and density shall be maintained until placement of the next overlying subbase, base, or other layer.

3. SPECIAL CONDITIONS.

The work described for a modified roadbed is for the establishment of a proper subgrade before constructing an overlying subbase, base, or pavement layer or temporary surfacing. In grading

contracts which do not provide for one of the above, the upper 6 inch {150 mm} layer of subgrade will not be processed as outlined above for Roadbed Processing, but shall be brought to the required elevation, typical section, and density, that specified in Section 210. The required section shall be maintained until final acceptance; however, maintenance of the density will not be required.

In addition to the above, Roadbed Processing will not be required for those roadbeds which are to be stabilized as specified in Section 231 or Section 232.

(d) DENSITY REQUIREMENTS.

Density for the layers of both improved and modified roadbed shall be as specified in Section 306 for each type layer.

(e) SURFACE REQUIREMENTS.

The graded earth surface and the finished subgrade surface, after being properly compacted, shall be checked by the use of blue-tops, strings, and template and all portions not within the following tolerances shall be corrected: Variations from the designated grade up to plus 1/2 inch {13 mm} or minus 1 inch {25 mm} will be allowed provided the variation does not increase or decrease more than 1/2 inch {13 mm} in 100 feet {40 m}; however, at bridge structures a plus tolerance will require additional fine grading to prepare a suitable grade tie. The finished surface shall not vary at any point more than 1/2 inch {13 mm} in any 25 foot {7.5 m} section from a taut string applied parallel to the surface and the roadbed centerline, or more than 1/2 inch {13 mm} from a template placed at right angles to the roadbed centerline. The template shall be of a rigid frame, adjustable metal type, accurately set, and at least as long as the width of roadbed being checked up to 30 feet {9 m}. Additional widths may be checked by the use of string and level. The Contractor shall furnish template, string, and necessary personnel to handle same under the direction of the Engineer. No subbase or other layer shall be placed on the roadbed until it meets specified requirements for alignment, grades, cross section, and density.

Where a Permeable Asphalt Treated Base (PATB) layer is to be placed (Pay Item 327-E), the finished subgrade elevations shall not vary from design by more than 0.03 feet {10mm} based on rod and level survey readings taken at a minimum of five locations across each lane (edge, outer wheel path, midlane, inner wheel path, and inside edge of lane) at longitudinal intervals not greater than 50 feet {15 m}. Surface irregularities shall not exceed 1/4 inch {7 mm} between two points longitudinally or transversely using a 10-foot {3 m} straightedge.

(f) PROTECTION AND MAINTENANCE OF ROADBED.

The Contractor shall be responsible for the protection and maintenance of any existing roadbed or any roadbed constructed during the contract. The roadbed shall be maintained free from ruts and other depressions, in a smooth and compacted condition, and true to lines and grades. Any of the Contractor's hauling and other equipment used in such a way as to cause excessive rutting or raveling of the roadbed material shall either be removed from the work or suitable runways shall be provided to prevent rutting.

No payment will be made for the protection and maintenance of the roadbed, such being considered incidental to the work. However, if a contract requires an improved roadbed to be placed on an earth surface constructed under a previous contract, the surface shall be repaired to the extent directed under the requirements of Section 210.

230.04 Method of Measurement.

Measurement and payment for the materials used in the construction of improved roadbed and modified roadbed will be at the contract unit price for unclassified or Borrow Excavation as provided in the contract.

Measurement for the Item of Roadbed Processing (which is the additional processing over and above that normally required by Section 210) will be in 100 foot {100 m} roadbed stations for each layer processed.

The length of roadbed stationing will be in 100 foot {100 m} stations and fractions thereof to the nearest foot {meter} of any main roadbed in accordance with the following: on each roadbed separately for divided highways having more than one roadbed; on each half of a roadbed of a four lane facility constructed with a positive divider between opposing traffic; on ramps; on frontage, connecting, and crossing roads; and on widening work each roadbed as defined above whether widening is on one side or both sides. No measurement will be made for increased widths, lanes, turn-outs, spurs, or crossovers when shown on the plans or for variations in widths due to changes in slopes. For additional areas over those shown on the plans, measurement will be allowed in the ratio of the

increase in width to the standard width shown on the plans. The total measurement shall be the sum of the lengths measured along the center of the main roadbed or along each separate roadbed of divided highways, plus the measured ramps from where the ramp centerline crosses the edge of shoulders, plus (if any) the lengths of cross roads, connecting roads, and frontage roads. The length of modified roadbed or improved roadbed constructed under a previous contract and actually reprocessed will be measured for payment.

No separate measurement will be made for reshaping of a roadbed constructed under a previous contract, such being considered incidental to the work covered by this Section; however, any additional material required to restore the roadbed to typical section will be measured and paid for under the appropriate item of material ordered used.

230.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Each separate layer of roadbed processed and accepted, and measured as noted above, will be paid for at the unit price bid for 100 foot {100 m} roadbed stations. Said unit price bid shall be full compensation for the mixing, remixing, watering, and re-processing necessary to obtain and maintain the required grade, section, and density as noted herein in this Section and includes all equipment, tools, labor, and incidentals necessary to complete the work as described herein.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

230-A Roadbed Processing - per Roadbed Station

SECTION 231
STABILIZED ROADBED

231.01 Description.

This Section shall cover the work of preparing a roadbed for receiving a base and pavement structure by stabilizing it with an approved local or commercial material. The work shall consist of scarifying the roadbed, incorporating the stabilizing material into the roadbed, and compacting the roadbed to the proper grade, section, and density.

231.02 Materials.

The stabilizing material to be incorporated shall be an approved local or commercial material of the type provided by the plans or proposal,

231.03 Construction Requirements.

(a) GENERAL.

Choice of equipment to perform the work under this Section shall, in general, be that of the Contractor provided such produces the desired results noted herein and does not damage or injure any completed work or facility designated to be incorporated into the work.

(b) PREPARATION OF THE ROADBED.

The roadbed shall have been prepared in accordance with the provisions of Section 210. The designated sections of the roadbed of the width specified on the plans of both cuts and fills shall then be scarified or otherwise loosened for the depth specified by the plans or as directed. Certain equipment capable of mixing the stabilizing material and the material in place without pre-working the in-place material may permit combining this step with the requirements of Subarticle (c) below.

(c) PLACEMENT AND PROCESSING OF STABILIZING MATERIAL.

The approved stabilizing material shall be spread uniformly over the roadbed, at the rate specified on the plans or as directed, by approved spreading equipment.

The stabilizing material shall then be mixed with the subgrade material until uniform in color and texture as directed and compacted to the required grade, section, and density.

(d) DENSITY AND SURFACE REQUIREMENT.

Density and surface requirements shall be the same as specified in Subarticle 230.03(d) and (e), respectively.

(e) PROTECTION AND MAINTENANCE OF ROADBED.

Protection and maintenance of roadbed shall be the same as specified in Subarticle 230.03(f).

231.04 Method of Measurement.

All accepted stabilizing material ordered and accepted will be measured in cubic yards {cubic meters}, loose measurement, or per ton {metric ton}.

231.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted volume of Roadbed Stabilizing Material, measured as noted above in accordance with the method provided in the contract (cubic yard {cubic meter} or ton {metric ton}), will be paid for at the contract unit price bid which shall be full compensation for the item complete in place on the roadbed. Said unit price shall include all cost of procurement, hauling, spreading, scarifying, mixing, and processing as required to incorporate the stabilizing material to the specified depth, to obtain and maintain the required grade, section, and density of the roadbed until covered by an overlying layer of ordered material and includes all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

231-A Roadbed Stabilizing Material, Type Material - per cubic yard {cubic meter}
231-B Roadbed Stabilizing Material, Type Material - per ton {metric ton}

SECTION 232
LIME STABILIZED ROADBED

232.01 Description.

This Section shall cover the work of preparing a roadbed for an overlying base and paving structure by stabilizing it with a lime treatment.

The work shall consist of scarifying the roadbed, incorporation of lime, and the necessary processing thereof in accordance with one of the following methods to the proper grade, section, and density.

Class 1 Lime Stabilization shall consist of spreading and incorporating the specified percentage of lime in two increments in the following sequence: spreading the first increment, initial mixing, mellowing, spreading the second increment, final mixing, compacting, and finishing in accordance with these specifications. Mellowing is defined as the process of softening to a loamy consistency.

Class 2 Lime Stabilization shall consist of spreading the specified percentage of lime, initial mixing, mellowing, final mixing, compacting, and finishing in accordance with these specifications.

Class 3 Lime Stabilization shall consist of spreading the specified percentage of lime, mixing, compacting, and finishing in accordance with these specifications.

232.02 Materials.

All material furnished for use shall comply with the requirements of the appropriate Sections of Division 800, Materials, and the following:

The soil used in the stabilization shall consist of existing roadbed material or material added as directed. Particles of aggregate larger than those passing the 3 inch {75 mm} sieve, and deleterious substances such as roots, stumps, grass turfs, and other vegetable matter shall be removed from the soil.

Article 807.03 - Water
Section 817 - Lime

232.03 Construction Requirements.

(a) GENERAL.

The basic requirement for work under this Section is to obtain a completed layer or layers of roadbed material containing a uniform lime mixture, with a smooth, closely knit surface, free from cracks, loose or segregated areas, and constructed to the proper depth, width, and surface requirement as specified.

Quantities and percentages of lime shown on the plans and proposal are based on preliminary soil investigation and dry laboratory sample tests. The actual application rate will be established from dry density tests made just prior to beginning stabilization work. The initial tests are based on Hydrated lime. If Quicklime is used and placed directly to the roadbed in pebble form, the percentage

will be adjusted by the Engineer based on a factor of 0.833 times the hydrated lime percentage required. While either hydrated lime or quicklime may be used on different segments of the project, a second application of lime must be of the same type used in the first application.

It is necessary to the quality of lime treated materials that all such materials be kept moist at all times. It shall be the Contractor's responsibility to provide sufficient equipment and keep all partially constructed or completed lime stabilized layers sufficiently and continuously moist until a succeeding layer has been placed thereon or until final acceptance of the project.

(b) EQUIPMENT.

Choice of equipment to perform the work required under this Section shall, in general, be that of the Contractor provided such produces the desired results.

(c) PREPARATION OF THE ROADBED.

The roadbed shall have been prepared in accordance with the provisions of Section 210. The roadbed shall be scarified to the depth required for the stabilization prior to the lime application. The depth of scarification shall be carefully controlled so that the surface of the roadbed below the scarified material shall remain undisturbed and conform to the established cross-section. The scarified material shall be partially pulverized and all existing unsuitable material and material retained on a 3 inch {75 mm} sieve shall be removed.

(d) APPLICATION OF LIME.

The rate of application of lime shall be as specified by the Engineer. No lime shall be applied between October 1 and April 1 without written authorization of the Construction Engineer.

Application of the lime shall be accomplished by either an approved "dry application" or "slurry application" method except that the "dry application" method will not be allowed in urban or other built-up areas.

The following guide lines will govern the acceptability of the method to be used:

"Dry Application" - Lime applied by this method shall be spread uniformly and shall be sprinkled with water sufficient to prevent loss of lime by wind. Spreading of the lime when wind and weather conditions are unfavorable will not be permitted nor will spreading of the lime by motor patrol be acceptable.

"Slurry Application" - Lime applied by this method shall be mixed with water in approved agitating equipment and applied to the roadbed as a thin water suspension of slurry. The distributing equipment shall be equipped to provide continuous agitation from the mixing site until applied on the roadbed. The proportion of lime shall be such that the "Dry Solids Content" shall be at least 30 percent by weight {mass}.

NOTE: When quicklime is used, it shall be turned under by an approved means prior to application of water so as to reduce the harmful exposure to the heat of hydration by the quicklime.

The distribution of lime at the rate specified shall be attained by successive passes over a measured section until the specified percentage of lime has been spread. After each successive pass, the material shall be incorporated into the soil with the mixing equipment. Additional water, if necessary, shall be added and mixed into the mass to hasten mellowing.

Payment will not be made for any lime that has been spread and exposed before mixing for a period of six hours or more. Such areas shall be treated again with the full required rate of application. Additional lime shall be added at the Contractor's expense to any section on which excessive loss has occurred due to washing or blowing prior to mixing.

The quantity of lime applied on any section shall be spread uniformly and shall not vary more than plus or minus five percent of the quantity ordered for that section. No payment will be made for lime application exceeding the five percent plus tolerance. When the quantity applied is deficient by more than the allowable minus tolerance, additional lime shall be applied prior to mixing.

(e) MIXING.

1. INITIAL MIXING.

The lime and water shall be incorporated uniformly into the soil. The mixing and watering operation shall be continued until a homogeneous mixture that will pass a 3 inch {75 mm} sieve is obtained. After satisfactory mixing is obtained, the layer shall be reshaped to approximate line, grade and section and sealed with a light roller, if mellowing is required.

For Class 1 and 2 stabilization, the mixture shall be left to mellow for a minimum period of three days but not to exceed 21 days. During this period the entire surface of the stabilized layer shall be kept moist by sprinkling and at no time allowed to become dry or dusty.

For Class 3 stabilization, the moisture content during the mixing operation shall not vary more than two percent, plus or minus, from the laboratory specified optimum moisture. After mixing this material shall be compacted and finished as specified in Subarticles (f) and (g) below.

2. FINAL MIXING.

After the required mellowing period (Class 1 and 2), the layer shall be scarified and in the case of a Class 1 treatment, the second application of lime added. The layer shall then be remixed as prescribed in the initial mixing operations adding water. Mixing shall be continued until 100 percent of material by dry weight {mass}, exclusive of gravel and stone, will pass a 2 inch {50 mm} sieve and 60 percent will pass a Number 4 {4.75 mm} sieve. The percent moisture shall not vary more than two percent, plus or minus, from the laboratory specified optimum moisture during this mixing operation. If mixing cannot be completed in the same day begun, the surface of the layer shall be sealed by rolling with a rubber-tired roller before suspending that day's operation and the processing continued the following day, weather conditions permitting.

(f) COMPACTION.

Compaction of the mixture shall begin immediately after the required mixing operation noted above has been completed.

Compaction operations shall be completed within 72 hours after it was begun and so conducted as to provide uniform compaction from bottom to top of the layer. The mixture shall be aerated or watered as necessary to obtain the specified moisture content within two percent, plus or minus, of the laboratory specified optimum moisture. If compaction cannot be completed in the same day started, the surface shall be sealed by rolling with a rubber-tired roller before suspending that day's operation and the compaction continued the following day.

Throughout the entire compaction operation, depressions, defective areas, or soft spots which develop shall be corrected immediately by scarifying the area, adding lime when required, or removing the material and reshaping and compacting in accordance with these specifications at the expense of the Contractor.

Density requirements will be as specified in Section 306. Standard weights {masses} will be established on the project using material from the completed mixture, as directed by the Bureau of Materials and Tests Engineer. The standard weight {mass} sample will be obtained and the standard weight {mass} established the same working day as the compaction tests are run.

If compaction cannot be obtained within the 72 hour limit noted herein in this Subarticle, the section involved shall be reprocessed adding additional lime in the increment directed by the Engineer and the compaction operation restarted, all of which shall be at the sole expense of the Contractor.

(g) FINISH AND TESTING.

The surface of the layer shall be smooth and conform to the lines, grades, and cross sections shown on the plans or established by the Engineer. Surface requirements shall be as specified in Subarticle 230.03(e).

The thickness of the lime stabilized layer will be determined from measurements taken at intervals not to exceed 200 feet {60 m}. The thickness of the entire layer(s) shall not vary more than 1 inch {25 mm} plus or minus from that shown on the plans. Any section deficient by more than 1 inch {25 mm} shall be reconstructed immediately in accordance with these specifications. Any section exceeding the 1 inch {25 mm} tolerance shall have additional lime added to correct the deficiency and shall be remixed to the specified depth and width in accordance with these specifications. In each case, such reconstruction and additional lime added shall be at the sole expense of the Contractor.

(h) PROTECTION, CURING AND MAINTENANCE.

Upon completion of the compaction and finishing of each layer, no vehicles or equipment other than watering equipment shall be permitted on the finished layer for a period of seven days unless otherwise authorized. During this curing period, the surface of the layer shall be lightly watered at frequent intervals to prevent drying.

The Contractor may, on a layer to be covered by a conventional base or subbase layer, substitute at his expense an acceptable prime coat in lieu of watering during the curing period noted above.

Regardless of the method of curing used, the Contractor shall be responsible for the protection and maintenance of the treated layer until it is covered by another layer or the completion of the project. Any damage to the treated layer due to other phases of construction or any cracking or other defects that may occur due to any cause or reason before being covered by the next layer shall be repaired without additional compensation.

232.04 Method of Measurement.

The actual area of the roadbed stabilized as ordered, for each specified compacted depth, completed to the thickness and cross-section shown on the plans or directed, will be measured in square yards {square meters}. All calculations of areas measured for payment shall be based on measurements made to the nearest 0.1 yard {0.1 meter} with areas calculated to the nearest square yard {square meter}. The length will be measured along the surface of the completed roadbed at its center point. The width will be the top surface width of the completed roadbed specified on the plans or directed, measured perpendicular to the center line of roadbed. Additional areas required for cross overs, turnouts, etc., shall be measured by length and width along the surface of area processed.

Lime actually incorporated in the work will be measured by the ton {metric ton}. In cases where Pure Quicklime (CaO) is slaked on the jobsite to produce a lime slurry, the pay quantity for lime will be measured in tons {metric tons} of hydrated lime as calculated using the certified lime purity for each truckload as follows:

TOTAL TONS {METRIC TONS} HYDRATED LIME PRODUCED = (A x B x 1.32) + A (1.0 - B)

Where: A = tons {metric tons} of Quicklime delivered
B = certified percent purity

Note: 1.32 = ratio of Molecular weights {masses} for Hydrated Lime (74) and Pure Quicklime (56)

232.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The ordered and accepted area of lime stabilization, measured as noted above, will be paid for at the contract unit price bid per square yard {square meter} of the class and depth specified. Said unit price bid shall be full compensation for all scarifying, pulverizing, mixing, shaping, watering, compacting, and application of lime and for all equipment, tools, labor, and incidentals necessary to complete and maintain the work.

The accepted quantity of lime actually incorporated in the work except as noted herein, measured as provided above, will be paid for at the contract unit price per ton {metric ton} for lime, which price shall be payment in full for furnishing, transporting, storing, handling, preparation of slurry, and spreading; and for all equipment, tools, labor, and incidentals needed for completion of the work.

Any additional soil material required to bring the roadbed to plan grade and section, and any unsuitable material excavated, will be measured and paid for under the appropriate item of Unclassified Excavation or Borrow. No direct payment will be made for blading, shaping, compacting, and like operations.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

232-A Lime Stabilization, Class ____ , ___ inches {mm} Thick
- per square yard {square meter}

232-B Lime - per ton {metric ton}

SECTION 235
DETOUR BRIDGES

235.01 Description.

The work under this Section shall cover the work of furnishing all materials, construction, maintenance, and removal (unless otherwise directed) of any temporary detour bridge structure at the approximate location shown on the plans or directed.

235.02 Materials.

All timber used shall be a minimum of dense No. 1 structure grade pine or equivalent grade of other wood.

Steel or other types of bridging material may be used; however, the grade of material used must be approved by the Bridge Engineer.

Other materials shall conform to the requirements noted elsewhere in these Specifications for the type material used.

235.03 Construction Requirements.

(a) GENERAL.

The alignment, length of bridge, grade, and typical cross-section will be shown on the plans.

All construction shall be consistent with the requirements for the type work involved as noted in other portions of these Specifications.

(b) BRIDGE REQUIREMENTS.

If the detour bridge design is not shown on the plans, then, before construction of a detour bridge may be begun, the Contractor shall submit to the State Construction Engineer a minimum of six prints of detailed drawings for the structure he proposes to furnish in accordance with 105.02. Prior to submittal, all drawings shall be checked, stamped approved, and signed by a Registered Professional Engineer registered in the State of Alabama and not employed by the Alabama Department of Transportation. The structure shall be designed to carry HS20 loading giving consideration to all vertical and lateral loads to be applied to the structure in accordance with the current edition of the AASHTO Standard Specifications for Highway Bridges using the Service Load Design Method. The Contractor, at his discretion, may exceed these requirements to reduce his maintenance or replacement expense.

No work shall be performed on the structure until after distribution of the plans has been made to the Division, District, and Project Engineers. The Contractor will be required to comply with the details of the plans as approved.

The Contractor shall take full responsibility for the proper structural design, construction, and maintenance of the facility.

The Registered Professional Engineer who signed the detour bridge submittal shall verify that the detour bridge as constructed meets all design criteria prior to any load being placed thereon. A signed statement from the Registered Professional Engineer covering the verification shall be furnished to the Project Engineer by the Contractor.

235.04 Method of Measurement.

No direct measurement or payment will be made for a detour bridge unless it is listed in the pay items of the contract. The detour bridges listed in the proposal will be identified by the station number of its location and measured as a Lump Sum Unit.

235.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Detour bridges for which an item is provided in the proposal will be paid for at the contract lump sum price bid. Said lump sum shall be payment in full for furnishing all materials, equipment, and labor necessary for the construction, maintenance, and removal (if required) of the detour bridge required.

No direct payment will be made for detours which the Contractor builds for his own convenience.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

235-A Detour Bridge at Station _____ - per lump sum

DIVISION 300
BASES

SECTION 301
SOIL, SOIL AGGREGATE, AND AGGREGATE, BASE AND SUBBASES

301.01 Description.

(a) GENERAL.

This section shall cover the work of furnishing all materials and the construction of Soil, Soil Aggregate, and Aggregate, base and subbase courses, complete in place on the roadbed.

Typical cross section, thickness, number, and material classification of the course will be shown in the plans or proposal.

(b) CLASSIFICATION.

The base or subbase materials are established by general classifications such as "Selected Materials", "Granular Soils", "Soil Aggregate", "Processed Reef Shell", and "Aggregates", and consist of natural soil, natural soil and natural aggregate combinations, or manufactured (commercial) aggregates, either used separately or blended in any combination with or without a stabilizing agent. Additional classification of the material by "Type" according to the required gradation and composition of the material in the completed base or subbase course have been tabulated in Sections 820, Selected Materials For Bases; 821, Granular Soil Materials; 822, Drainage Plane Materials; 823, Soil Aggregate Materials; 824, Processed Reef Shell Base Materials; and 825, Crushed Aggregate Base Materials.

The bases and subbases will be further established by the method of mixing, (Road, Yard, or Plant) as described in Article 301.03. The general classification, type, and method of mixing will be shown in the proposal. Special details will be shown on the plans.

301.02 Materials.

All materials furnished for use shall comply with the requirements of the applicable sections of Division 800, Materials, except as modified by the plans or proposal.

Attention is directed to:

Section 807	Water
Section 815	Cement
Section 817	Lime for Roadbed & Base Stabilization
Section 820	Selected Materials for Bases
Section 821	Granular Soil Materials
Section 822	Drainage Plane Materials
Section 823	Soil Aggregate Materials
Section 824	Processed Reef Shell Base Materials
Section 825	Crushed Aggregate Base Materials

Preliminary tests of optional sources shown on the plans indicate that the materials from these sources will meet plan requirements, either in their natural composition or by blending with additional material. However, whether sources are shown on the plans or not, the Contractor shall supply whatever components are needed, in whatever proportions are necessary, to meet specified requirements of the plans and specifications for the item complete in place.

The processed materials, in addition to complying with the requirements noted above, must be capable of being compacted to the density requirements noted in this Section. Any material furnished, regardless of compliance with all other requirements, which cannot be compacted to the densities specified shall be either removed and replaced with more suitable material, or corrected.

Testing of material will be as provided in Article 301.05.

301.03 Construction Requirements.

(a) GENERAL.

The roadbed must be in an approved condition before placement of any base or subbase will be permitted. Approval shall be based on satisfactory completion of the roadbed in accordance with

the requirements of Sections 210 and 230 and, if required by the plans or proposal, the additional modification of the roadbed in accordance with the provisions of either Section 231 or 232.

The roadbed shall be checked carefully for elevations established by the Engineer and shall be true to alignment and grade within the limits specified in Subarticle 230.03(e). Control elevation stakes will be set as provided in Article 105.08.

On a contract for base and pavement only, the roadbed, in addition to the check for continuity of grades, shall be checked for density as required by the process used in construction of the subgrade (Section 230, 231 or 232). Loss of density shall require reprocessing of the top layer (6 inches {150 mm}) of the subgrade in accordance with Section 230 by the method prescribed by the plans for the roadbed treatment. Low areas shall be corrected by the addition of material and reprocessing under the method prescribed for the roadbed treatment; minor high spots shall be eliminated during the dressing of the processed roadbed. Material ordered used for the correction of low areas in the subgrade shall be measured and paid for under the appropriate classification of the material ordered used. If no item for an acceptable type material is provided in the contract, such shall be furnished under the provisions of Article 104.03.

A base of up to 6 inch {150 mm} plan designated compacted thickness may be constructed in one layer. Unless otherwise shown on the plans, a base of over 6 inch {150 mm} thickness shall be constructed in approximately equal layers each of not over 6 inch {150 mm} compacted thickness.

Protection of base layers during construction shall be the Contractor's responsibility.

(b) EQUIPMENT.

In general, it shall be the Contractor's responsibility to select and furnish the proper size and amount of equipment that will produce and deliver to the roadbed, mix, spread, shape, and compact the base material.

When cement or lime additives are required, all equipment necessary for the proper prosecution of the work shall be assembled on the site, approved and in good working order before permission to start processing the layer will be given.

All equipment approved for use will be on a trial basis, and if after a short test section the equipment should prove unsatisfactory, it shall be removed, replaced, or supplemented as deemed necessary to accomplish the desired work.

(c) MIXING.

1. GENERAL.

There are three methods of mixing base and subbase materials; they are road mixing, yard mixing, and plant mixing. Yard and plant mixing are considered as premixing. The Contractor may substitute yard or plant mixing in lieu of road mixing, or plant mixing in lieu of yard mixing, if so requested in writing.

All mixing shall be performed in such a manner that all materials or component parts are thoroughly blended and mixed to a uniform gradation and color, with equipment and operation thereof producing consistently satisfactory results. Mixing water shall be added in a manner that will provide uniform blending with the material being mixed.

Soft or unsatisfactory spots shall be removed and/or repaired as directed by the Engineer at no expense to the Department.

2. ROAD MIXING.

a. General.

Roadmixing shall be performed by a motor grader supplemented, if necessary, by other approved mixing equipment that will produce consistently satisfactory results.

Base materials may be dumped directly on the subgrade, subbase, or underlying layer. The Contractor is encouraged, but not required, to use adjustable aggregate spreaders to place and spread commercial or crushed aggregates.

The dumping operation shall be limited to the amount of materials which can be mixed by the end of the next day. This material shall be shaped and compacted no later than the day after mixing. In no instance shall the shaping and compacting be later than the second day after the dumping operation. No deviation from the above will be allowed without written permission of the Engineer.

The bottom layer shall be mixed without disturbing more than 1 inch {25 mm} of the roadbed or underlying layer. Mixing of subsequent layers shall include scratching lightly of the surface of the underlying layer for bonding effect.

Mixing shall be sufficiently performed to distribute all component parts of the layer uniformly throughout the mass producing a material of uniform color and gradation throughout the depth, width, and length, insofar as practical as determined by the Engineer, of the layer. Mixing shall include, but not be limited to, the windrowing and blading of the material as necessary to obtain the required consistency. Water shall be applied as necessary during the mixing operation to provide, at the time of compacting, a uniform moisture content within two percentage points of optimum as established by the required laboratory test. The material shall be aerated as often as necessary to correct excess moisture conditions by scarifying, plowing, harrowing, blading, or by using special, suitable equipment.

b. Stabilization Using Additives.

(1) General.

It is necessary to the quality of the stabilization operation that careful control of the volumes of the base material, the additive, and moisture be exercised and that equipment furnished be capable of producing the desired results within the time frame noted herein of the type treatment involved; otherwise, the resultant product will be unsatisfactory. It shall be the Contractor's responsibility to provide suitable equipment, adequately sized and in sufficient numbers to process the materials as required.

Each layer of base or subbase with an additive shall be processed through a test section utilizing equipment and methods noted for the type treatment involved. This test section shall be used to establish acceptability of the Contractor's equipment and processing technique along with determining the correct volume of material(s) necessary to obtain the required depth shown on the plans or ordered in writing. The length of the test section shall be determined by the Engineer to best fit the required type of processing specified by the plans or proposal, but shall not exceed one-half mile {800 m} nor be less than 500 feet {150 m}. The material shall be placed and spread, mixed if not premixed, and processed through the entire operation normally required for the type of layer involved. The layer shall then be checked for proper additive content, density, and depth, and any deficiencies corrected as provided in Article 301.05. Satisfactory completion and acceptance of the test section will be required before the remaining work on the layer being tested is permitted. The data thus obtained from the test section shall be applied to the placement procedure of the remainder of the layer involved.

(2) Placing and Mixing.

All materials, except the additive, shall be placed as noted in Subitem a. above.

Placement of the additive will be allowed only after the initial mixing and blending described in Subitem a. above has been accomplished.

Upon completion of the above operation, the additive shall be spread uniformly over the area to be treated using approved methods and equipment. The additive shall then be incorporated with the material to be treated in such a manner as to provide uniform distribution of the additive throughout the designated width and depth of treatment.

Control of moisture shall be so exercised that the optimum moisture content (± 2%) is present during the initial mixing of the materials to be treated and the additive.

The use of lime and cement additives require special handling in accordance with the following:

Lime Treatment.

Lime treatment shall not be performed between October 1 and April 1 without written permission of the Engineer. Lime shall be spread only on that area which can be processed in the same working day. Any lime that has been spread and exposed to the air before mixing for a period of six hours or more, or any section of the work on which excessive loss of lime has occurred due to washing or blowing will not be accepted for payment. Such areas shall be treated again with the full required rate of application before acceptance.

After preparation of the material to be treated has been accomplished, the application of the lime shall be accomplished by either the "dry application" or the "slurry application" method described in Subarticle 232.03(d) except that the "dry application" method shall not be used where the resultant dust from the dry method would affect the visibility of the traveling public or affect adjacent property owners.

The actual rate of application of the lime will be set by the Engineer based on the standard density of the material to be treated as determined by AASHTO T 180.

The quantity of lime applied on any section shall be spread uniformly and shall not vary more than plus or minus five percent of the quantity ordered for that section. No payment will be made for lime application exceeding the five percent plus tolerance. When the quantity applied is deficient by more than the allowable minus tolerance, additional lime shall be applied and the deficient section reconstructed in accordance with these specifications for the full depth and width at no extra compensation.

The mixing of the lime with the base materials shall be accomplished utilizing traveling mixers capable of handling the required depth of material (loose), the lime, and the water necessary to provide the designated optimum moisture content. The blended material shall then be processed in the same manner noted in Item 301.03(d)3 for lime treated bases.

Deficiencies in the thickness of the lime stabilized layer in excess of those specified in Subarticle 301.05(d) shall be reconstructed immediately adding additional lime if deemed necessary by the Engineer. Any additional lime and such reconstruction shall be at the sole expense of the Contractor.

Cement Treatment.

Cement treatment shall not be performed when the ambient ground temperature in the shade is below 40 °F {4 °C}. Should the air temperature drop below 35 °F {2 °C} after incorporation of the cement, protection shall be provided to prevent damage of the processed layer. Cement shall only be spread on the area that can be processed in the same working day. Any cement that has been spread and exposed to the air before mixing in excess of six hours or more, or any section on which excessive loss of cement has occurred due to wind or rain, will not be accepted for payment. Such areas shall be reconstructed with the required rate of treatment before acceptance at the sole expense of the Contractor.

After the placement and processing of the base material to be treated, the cement shall be spread utilizing equipment specially designed for the purpose. The actual rate of application of the cement will be set by the Engineer based on the standard density of the material to be treated as determined by AASHTO T 180. The quantity of cement shall be spread uniformly over the area to be treated and shall not vary more than five percent from the specified rate. Care shall be exerted to prevent loss of cement due to wind or other unfavorable conditions.

The mixing of the cement with the base material shall be restricted to traveling mixers capable of handling the required depth of material (loose), the cement, and the water necessary to provide the designated optimum moisture content. When the mixer will handle only a part of the roadbed width, the successive increments shall be of such length that the full width of material may be promptly mixed, compacted, and finished with not more than 30 minutes between mixing adjacent widths (lanes). The base and cement mix shall then be processed in the same manner noted in Item 301.03(d)2 for the cement treated bases.

Should the thickness of treatment be found to be outside the tolerance noted in Subarticle 301.05(d) within two hours after completion of compaction and shaping, the Engineer may allow the reprocessing of the section provided additional cement is added in an amount to be designated by the Engineer without additional cost to the Department or handled as noted in Item 301.05(d)3.

3. YARD MIXING.

Unless otherwise provided on the plans, the mixing yard shall be furnished by the Contractor.

Yard mixing shall be accomplished by spreading each component in a layer of uniform width and thickness before placing the next component; then thoroughly mixing the materials by means of a motor grader supplemented, if necessary, by other approved mixing equipment that will produce consistently satisfactory results. The mixing shall be sufficient to combine all components into a mixture of uniform color and gradation adding water as necessary to obtain a uniform moisture content within two percentage points of optimum as established by the required laboratory test. The mixture shall then be loaded into transporting vehicles by means that will prevent segregation of materials.

If calcium chloride or another similar additive is specified as a component of the mix, the additive shall be spread in the amount specified in the proper mixing sequence and mixing continued until the additive has been thoroughly mixed uniformly into the mixture.

4. PLANT MIXING.

a. General.

All of the following construction procedures are required for the base and subbase materials to be classified as Plant Mixed materials: mixing material in a plant or pugmill; dumping material directly into a truck; hauling material to the project site; and dumping material directly into a spreader that will spread the material into uniform layers of the required cross sections and thicknesses.

Material that is dumped, stockpiled, and/or rehandled prior to spreading will be classified as Road Mixed or Yard Mixed material.

b. Mixing Plant Requirements.

The mixing plant requirements are as follows; however, any other mixing plant equipment developed that will produce equally satisfactory results will be acceptable for use with the approval of the Engineer.

(1) The plant shall be an approved contra-rotating twin-shaft pug-mill type central mixing plant of proven performance and adequate capacity. The plant shall be equipped to proportion accurately by volume or weight {mass}.

If proportioned by volume, component materials shall be fed onto a primary belt by a separate secondary belt for each component. Accurate proportioning shall be secured by positive control of secondary belt speed or by adjustable locking gates feeding onto the belt, The mixed materials shall be discharged through a surge hopper of at least 1 cubic yard {1 m^3} capacity. The mixer also shall have an approved, accurate, mechanically-fed device for adding cement or other additive at a specified rate when such components are required.

If proportioned by weight {mass}, equipment used to determine the weight {mass} of aggregates shall meet the requirements of Article 109.01. Weight {Mass} type mixers shall be equipped with a locking batch timer, adjusted for a minimum 30 second net mixing time.

(2) The controls that operate the mixing plant shall be positioned so that the operator will have unobstructed vision of all phases of the operations that affect the proportioning of materials. The plant shall be equipped with an approved device for signaling the control operator to stop the plant when any malfunction occurs in the feed-in system.

(3) The mixer shall be equipped with an accurate adjustable water meter device for controlling moisture content.

(4) Storage bins shall be equipped with overflow pipes or chutes, and shall be so partitioned that there can be no spill-over into adjacent bins. Storage bins for calcium chloride, lime, or cement shall be water tight.

c. Mixing Plant Operation.

(1) During the mixing operation the aggregate shall be introduced into the mixer in a way that will insure the proportion of each type of material to be used will be in the final mixture.

(2) Water shall be added to the mix in an amount that will produce a uniform moisture content, based on dry weight {mass} of the mixture, within two percentage points of optimum as established by the required laboratory test.

(3) When required, cement shall be added to the other components of the mix in the proportions as directed, except that the Engineer may vary the amount of cement by as much as 20 percent, plus or minus. After the required amount of cement has been set by the Engineer, the rate shall not vary more than 5 pounds {2 kg}.

When required, lime shall be added to the other components of the mix in the proportions as directed. The quantity and percentage of lime shown on the plans or proposal are based on preliminary investigations and dry laboratory samples. The actual rate or amount to be added will be determined from density tests made just prior to beginning mixing operations. After the required amount of lime has been set by the Engineer, the rate shall not vary more than five percent.

(4) When directed to be used, calcium chloride shall be added during the mixing operation by an approved metering device, or by separate scales as required for cement, at the rate of approximately 10 pounds {5 kg} per loose cubic yard {cubic meter} of mixture, based upon flake form. If other forms of calcium chloride are used, proportionate adjustment of rate of use and payment will be made. The amount of calcium chloride may be reduced or eliminated entirely as directed by the Engineer when weather conditions do not justify its use. No calcium chloride shall be added when cement is used.

(5) If other additives are specified, they shall be added as directed.

(6) The mixing plant shall not be operated at a speed or capacity that exceeds the manufacturer's rated capacity, established before mixing begins.

(7) After the plant has been set and calibrated, the Contractor shall give the Engineer sufficient notice in advance of starting operations, and shall make available sufficient skilled operators for checking the calibrations before actual start of operations. Materials and personnel used in checking the calibration shall be furnished without additional compensation.

(d) PLACING OF BASE MATERIALS.

1. GENERAL.

The operational procedure must be such that placement and processing of a layer will not damage the underlying layer or layers. Any material to be paid for by the cubic yard {cubic meter} shall be hauled in dump trucks whose volume may be readily determined. Premixed base and subbase materials shall be placed and spread by spreading equipment that will produce uniform layers of the required cross sections and thickness.

2. CEMENT TREATED BASES.

Cement treated bases and subbases shall be delivered and spread within 45 minutes after mixing. Mixtures containing cement that have not been shaped (except for final finishing) and compacted within three hours after mixing will be rejected and shall be removed promptly from the roadway and replaced at the Contractor's expense. For each base layer, the surface and thickness testing required in Article 301.05 shall be performed immediately upon compaction of the layer, and any variations from requirements shall be corrected immediately as specified in Article 301.05. All such base layers shall be kept moist enough for proper curing until covered by the next layer or the prime. The top layer shall be primed as soon as the compacting, shaping, thickness, and surface requirements have been met and in no case later than the next day after the surface is approved by the Engineer, unless weather conditions prevent. Prime shall be applied in accordance with Section 401, except that Item 401.03(b)2 will not apply.

Base material containing cement shall not be placed when the ground temperature in the shade is below 40 °F {4 °C}.

3. LIME TREATED BASES.

Lime treated bases and subbases shall be delivered, spread, shaped, and compacted in the same day mixing occurs. Materials not compacted in the same day it is placed shall be reprocessed as directed at no additional cost to the State. Each base layer shall be tested for surface and thickness immediately after compaction in accordance with the provisions of Article 301.05 and any variations corrected as noted therein. The base layers shall be kept moist until covered by the next layer. Any cracking or other defects that may occur due to any cause or reason in any layer prior to being covered by the next plan layer shall be corrected immediately at no extra compensation.

Base materials containing lime shall not be placed where the ground temperature in the shade is below 40 °F {4 °C} unless authorized by the Engineer.

(e) WATERING AND COMPACTION.

Each layer of base and subbase shall be compacted to density as specified in Section 306. Where base and shoulder layers are constructed separately, the Contractor shall select and employ whatever method or procedure is necessary to produce required density at the edges of the base layers and to prevent lateral movement of the base material during compaction. Compaction tests will be made on each base layer, and each layer shall be brought to required density before the next layer is placed. Additional watering in connection with compaction will be required to obtain required density at a uniform moisture content within two percentage points of optimum as determined by the required laboratory test, except that the moisture content for crushed aggregate base layers shall be a minimum of five percent or as directed.

301.04 Shoulder Construction Requirements.

(a) GENERAL.

Shoulder construction requirements will be the same as provided for in Article 301.03 except as noted in this Article. Shoulders will be of two general types; standard or special design. Shoulder construction shall be so conducted that the base, shoulder, and adjacent side ditch will drain freely at all times. The shoulder slopes and ditches shall be dressed to reasonably close conformity to the designated lines, grades, and cross section.

(b) STANDARD SHOULDERS.

This type shoulder, where shown on the plans, shall be constructed by extending each subbase and base layer the full width from front slope to front slope in one operation. Materials and construction details for layers placed in the shoulder area will be the same as for base layers.

(c) SPECIAL DESIGN SHOULDERS.

This type shoulder will consist of one or more layers of specified materials placed separately from the roadway base layers. This type shoulder may also include a drainage plane layer or a bituminous pavement or both. The composition and gradation of the materials and the width, thickness, and number of layers shall be as specified on the plans.

The sequence of the construction for the layers placed in the shoulder area will be at the option of the Contractor provided such will accomplish the desired results and is kept abreast of roadway base construction.

The drainage plane layer and the bituminous base and/or pavement shall be constructed in compliance with Section 315 and the appropriate Sections for the bituminous base or pavement.

The layers placed in the shoulder area shall be constructed in compliance with specifications for base layers of the same materials.

In spreading the next overlying layer of shoulder material on a drainage plane layer, special precaution shall be taken to prevent displacement of, or mixing with, the drainage plane material. This layer shall be placed by a spreader that will not touch or otherwise disturb the drainage plane layer. In order to accomplish the above, multiple passes will be permitted on wide shoulders. Placement of this layer shall be so controlled that not more than 2000 feet {600 m} of drainage plane material will remain uncovered at any time. Use of any equipment that might mix the shoulder material into the underlying drainage plane layer will not be permitted.

Layers placed in the shoulder area shall be compacted to the density specified in Section 306.

301.05 Sampling and Testing.

(a) GENERAL.

All sampling and testing, except in-place density, will be performed on the complete in-place base or subbase layers after final mixing and spreading on the roadway has been completed except as noted in Subarticle 301.05(c) for cement treated base material. In-place density will be performed on the layers after final shaping and compacting has been completed.

Any necessary sample holes, etc., required to satisfactorily establish the acceptability of any base layer shall be repaired by the Contractor immediately with like material. The cost of such repairs is considered to be incidental to the work and shall be performed without additional compensation.

(b) SURFACE REQUIREMENTS.

The finished surface of each subbase or base layer shall not vary more than 1/2 of an inch {13 mm} in any 25 foot {8 meter} section from a taut string applied parallel to the surface and roadbed centerline at the following locations: 1 foot {300 mm} inside the edges of subbase or base, at the centerline, and at other points as designated. The finished surface shall not vary more than 3/8 of an inch {10 mm} from the required section measured with a template placed at right angles to the roadbed centerline. The template shall be of a rigid frame adjustable metal type, accurately set, and at least as long as the width of base layer being checked up to 24 feet {7.2 m}. Additional widths may be checked by the use of string and Engineer's level. The Contractor shall furnish template, string, and necessary personnel to handle same under the direction of the Engineer.

Where a Permeable Asphalt Treated Base (PATB) layer is to be placed (Pay Item 327-E), the finished base layer elevations shall not vary from design by more than 0.03 feet {10 mm} based on rod and level survey readings taken at a minimum of five locations across each lane (edge, outer wheel path, midlane, inner wheel path, and inside edge of lane) at longitudinal intervals not greater than 50 feet {15 m}. Surface irregularities shall not exceed 1/4 inch {7 mm} between two points longitudinally or transversely using a 10-foot {3 m} straightedge.

(c) GRADATION AND DENSITY.

Testing for compliance will be made as specified in Subarticle 301.05(a) except that a layer with a cement additive will require the pretesting of the blended components prior to the addition of the cement additive on the primary belt at the mixing plant.

The gradation of each layer will be checked at intervals as currently scheduled by the Department to determine compliance with the material specifications. Material falling outside of the specified bands of the general composition table shall be evaluated in accordance with the following:

for each failing test, the price reduction will be five percent plus one percent for each percent for which the material failed to meet the required specifications. This applies to each sieve, percent clay, liquid limit (LL), or plasticity index (PI) requirement. These percentages are cumulative and apply to all material represented by that sample. If the resulting reduced unit price is less than 80% of the original unit price, the contractor will be given the option of modifying the in place material or removing and replacing the material. In either case, the gradation of the material will be re-tested for compliance with the material specifications.

The density of each layer will be checked at intervals as currently scheduled by the Department to verify compliance with specification requirements. Density requirements are specified in Section 306.

(d) THICKNESS.

The thickness of each layer will be checked at intervals as currently scheduled by the Department and at closer intervals if necessary to determine the limits of any section found to be outside of the tolerance limits.

1. For a layer placed under a "square yard " {"square meter"} item, the compacted thickness of the layer shall not be more than 1/2 of an inch {13 mm} less nor 1 inch {25 mm} more than the thickness specified on the plans or directed. A thickness greater than the 1 inch {25 mm} tolerance may be accepted if uniform over a sufficient length to not materially affect the riding surface or reduce any required clearances and is within surface smoothness tolerances specified in Subarticle 301.05(b).

2. For a layer placed under a "cubic yard" {"cubic meter"} item, the compacted thickness of the layer shall not exceed eight percent of each layer, plus or minus, of the designated thickness. Excess thickness above the eight percent noted above may be permitted to remain in place provided the riding surface is not affected and any required clearances are maintained, The excess material above the eight percent tolerance allowed will be deducted from the pay quantities.

3. If the base layer contains cement, areas below required thickness or elevation shall be corrected by increasing the thickness of the next layer; or for the top layer, the surface may be brought to proper elevation and thickness with layers of bituminous plant mix of appropriate gradation where the pavement is to be a bituminous type. These leveling layers shall be placed ahead of a plant mix pavement layer or after a liquid surface treatment layer, if any. These layers shall be placed without additional compensation, or the Contractor may at his option remove and replace the deficient areas at his own expense. Low areas in the subgrade under concrete pavement shall be corrected as specified under Subarticle 450.03(c).

(e) WIDTH.

The widths shown on the plans, or directed, shall be the widths used for determining the area for pay purposes of square yard {square meter} layers. Widths in excess of the designated width may be acceptable if not detrimental to the appearance or design of the project; however, no deviation in excess of 0.3 feet {90 mm} less than the designated dimension for each side of a roadway will be acceptable.

301.06 Maintenance of the Work.

Each base layer shall be maintained as provided herein without extra compensation until it is covered by a succeeding layer or acceptance of the contract. The surface shall be kept free of ruts, ridges, holes, and substantially true to profile, grade, and cross-section. Each base layer must have the required density and moisture at the time it is covered by another layer. However, maintenance requirements for moisture will be waived for Crushed Aggregate Base after the layer has been properly compacted with proper moisture content. No layer of base shall be covered by another layer or primed until it has been approved by the Engineer.

Special attention is directed to the fact that lime or cement treated bases require special care to insure proper curing. Daily watering, rolling, or maintenance of curing material is considered an integral part of the work until the treated layer is covered by another layer or completion of the contract.

The Engineer may re-test a primed base layer where he suspects that it does not have the required density and moisture. All areas found deficient shall be corrected by the Contractor, at his expense, prior to the placement of the next overlying layer.

It shall be the Contractor's responsibility to protect the base from damage and to protect the prime from being picked up or damaged by traffic and to replace promptly any base or prime so damaged.

301.07 Method of Measurement.

(a) BASE MATERIALS.

Measurement of base materials will be made in accordance with the particular item provided in the contract in accordance with the following:

1. SQUARE YARDS {SQUARE METERS}.

Measurement by the square yard {square meter} will be made of a completed accepted layer of base constructed to the thickness and cross section shown on the plans or directed. All calculations of areas for payment shall be based on computations made to the nearest 0.1 of a square yard {0.1 square meter}. The length will be measured along the surface of the layer at the centerline of the roadbed to the nearest 0.1 of a foot {0.1 m}. For transitions in thickness, the thickness will be measured to the midpoint of the transition. The width will be the top surface width of the layer as specified on the plans or directed. Each layer of crossovers, turnouts, and the like will be measured in square yards {square meters} by lengths and widths along the top surface of the layer involved. No measurement will be made for the necessary bevel or wedge of material shown on the plans along the edge of each layer.

Where the Engineer directs in writing that the thickness of a layer be changed from that specified on the plans, the accepted layer shall have an adjusted unit price derived by arriving at an increase or decrease to the contract unit price bid in direct proportion to the increased or decreased thickness of the adjusted layer. No payment shall be made for a layer completely eliminated.

2. CUBIC YARDS {CUBIC METERS}.

Measurement by the cubic yard {cubic meter} will be the loose volume of the material measured in the hauling vehicle at the point of use.

3. TONS {METRIC TONS}.

Measurement by the ton {metric ton} will be the quantity of material placed in a completed accepted layer of base constructed to the thickness and cross section shown on the plans or directed and measured in accordance with the provisions of Subarticle 109.01(h).

(b) CEMENT.

Measurement of cement will be by the ton {metric ton} for cement actually used in the work as directed, except cement used to repair or replace defective work.

(c) LIME.

Measurement of lime will be by the ton {metric ton} for lime actually used in the work as directed, except for lime used to repair or replace defective work.

301.08 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. The contract unit price bid shall be full compensation for furnishing or producing all component material, except cement and lime, in whatever proportions necessary to produce and place the base material, in accordance with the requirements specified, complete in place on the roadbed. It includes all costs for procurement, operations, compaction, watering, equipment, tools, labor, and incidentals necessary to complete the work. Cement and lime used as directed, in completed and accepted layers, will be the only other item for which separate payment will be made under this Section.

2. Payment for cement and lime, measured as noted above, will be at the contract unit price per ton {metric ton}. This payment shall be payment in full for furnishing and incorporating the cement and lime into the base material.

(b) PRICE ADJUSTMENTS.

When layers failing to meet the gradation band requirements are permitted to remain in place as specified in Subarticle 301.05(c), unit price adjustments will be made as specified therein.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

301-A __*__ __t__ Course, Type __tt__, __**__, __ttt__ Mixed, ____ inches {mm}
Compacted Thickness - per square yard {square meter}

301-B __*__ __t__ Course, Type __tt__, __**__, __ttt__ Mixed, - per cubic yard {cubic meter}

301-C Cement - per ton {metric ton}

301-D Lime - per ton {metric ton}

301-E __*__ __t__ Course, Type __tt__, __**__, __ttt__ Mixed, - per ton {metric ton}

- * Base Classification (Selected Materials, etc., Granular Soil, Soil Aggregate, Processed Reef Shell, Crushed Aggregate)
- t Base or Subbase
- tt Type
- ** Insert "with cement or lime additive," if required
- ttt Road, Yard, or Plant

SECTION 305
SOIL AND AGGREGATE MATERIALS FOR MISCELLANEOUS USE

305.01 Description.

This Section shall cover the work of furnishing and incorporating a soil or aggregate material of the type specified into the work at the locations shown on the plans or designated by the Engineer.

The type material may be a local material, such as borrow or selected soil, or commercial material, such as crushed aggregate, or any combination thereof to produce a material consistent with the requirements of the type material specified.

The intent of this Section is to provide a material for use in localized areas for patching, leveling, or minor widening work.

Layers of material of a nominal depth and width should be placed under the appropriate Section of the Standard Specifications.

305.02 Materials.

All materials furnished for use shall comply with the requirements of the appropriate sections of the Standard Specifications, except as modified by the plans or proposal. Special attention is directed to Sections 210 and 820 through 825.

305.03 Construction Requirements.

(a) GENERAL.

The work of placing the material in this Section includes surface preparation including the scarification of the existing material, the addition of the material, and the processing of the new material with the existing material to form an installation meeting plan requirements.

(b) SURFACE PREPARATION.

Surface preparation shall include any work necessary to clean the surface of the area on which the new material is to be placed, along with scarifying the surface of the existing material to promote an acceptable bond of the new and old material.

(c) PLACING OF THE MATERIAL.

The material shall be placed, spread, and incorporated into the work at the locations shown on the plans or directed. The new material shall be mixed with the old material to the extent necessary to provide for an acceptable bond between the new and old material.

Strict moisture and density controls will not be required; however, the material shall be mixed and compacted to the satisfaction of the Engineer.

305.04 Method of Measurement.

The quantity of material placed will be measured in cubic yards {cubic meters} in accordance with the provisions of Subarticle 109.01(i) or per ton {metric ton} measured in accordance with the provisions of Subarticle 109.01(h).

305.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Aggregate material ordered and accepted, measured as noted above, will be paid for at the contract unit price bid for each type material which shall be full compensation for the material complete in place and includes all costs incident to furnishing and producing the material, all hauling, surface preparation, spreading, mixing, watering, compacting, and shaping and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

305-A ___*, ___**, for Miscellaneous Use - per cubic yard {cubic meter}
305-B ___*, ___**, for Miscellaneous Use - per ton {metric ton}

* Kind of material:

Borrow, Section 210
Selected Materials, Section 820
Granular Soil, Section 821
Drainage Plane, Section 822
Soil Aggregate, Section 823
Processed Reef Shell, Section 824
Crushed Aggregate, Section 825

** Type of material, if specified

SECTION 306
DENSITY REQUIREMENTS FOR COMPACTION

306.01 Description.

This Section shall establish the density requirements for earth work, subbase, base, shoulders, surface, and pavement layers. Compensation for the work required to obtain the densities set forth hereinafter shall be absorbed in the respective items that material involved is furnished.

This Section shall also cover the work of furnishing a Portable Moisture-Density Testing Device or Thin Layer Density Testing Device when a pay item for such is provided by the plans or proposal; otherwise, the Department will, at its option, furnish a testing device or use the alternate methods provided in Article 306.03. Contractor furnished testing devices are covered by six categories as follows:

Pay Item 306-A - The furnishing of an acceptable new or used Nuclear Moisture-Density Testing Device for use by the Engineer during the life of the project with the title remaining with the Contractor.

Pay Item 306-B - The furnishing of an acceptable new Nuclear Moisture-Density Testing Device for use during the work, the maintenance of the unit during the work and, at the close of the project, the reconditioning, verification, and, if necessary, recalibration of the unit and the transfer of title of the unit to the Department.

Pay Item 306-C - The furnishing of an acceptable new or used Nuclear Thin Layer Density Testing Device for use during the life of the project with the title remaining with the Contractor.

Pay Item 306-D - The furnishing of an acceptable new Nuclear Thin Layer Density Testing Device for use during the work, the maintenance of the unit during the work and, at the close of the project, the reconditioning, verification, and, if necessary, recalibration of the unit and the transfer of title of the unit to the Department.

Pay Item 306-E - The transfer of ownership or disposal of a Department owned Nuclear Testing Device by the Contractor and the furnishing of an acceptable new Nuclear Moisture-Density Testing Device for use during the work, the maintenance of the unit during the work and, at the close of the project, the reconditioning, verification, and, if necessary, recalibration of the unit and the transfer of title of the unit to the Department. The Department owned device designated for replacement shall be picked up at the Central Laboratory. The Department will package and have the device ready for transport. Transfer of all devices will be in accordance with Health Department regulations and under no circumstances will a nuclear device be transferred to an unlicensed agent or company.

Pay Item 306-F - The transfer of ownership or disposal of a Department owned Nuclear Testing Device by the Contractor and the furnishing of an acceptable new Nuclear Thin Layer Density Testing Device for use during the work, the maintenance of the unit during the work and, at the close of the project, the reconditioning, verification, and, if necessary, recalibration of the unit and the transfer of title of the unit to the Department. The Department-owned device designated for replacement shall be picked up at the Central Laboratory. The Department will package and have the device ready for transport. Transfer of all devices will be in accordance with Health Department regulations and under no circumstances will a nuclear device be transferred to an unlicensed agent or company.

306.02 Materials.

Materials involved shall comply with the appropriate Section under which the work is to be performed.

The portable nuclear surface moisture-density device furnished for use, including Contractor's gages submitted for quality control purposes, shall meet the requirements of the current Alabama Department Of Transportation Technical Specification M&T 14 and be approved for use. The thin layer density testing device furnished for use, including Contractor's gages submitted for quality control purposes, shall meet the requirements of the current ALDOT Technical Specification M&T 33 and be approved for use. Each device shall have a certificate from the manufacturer, or its authorized service center, certifying the unit's condition and serviceability. Contractors submitting new or used moisture density and/or asphalt thin layer density testing devices for quality control purposes shall have the calibration of the device checked/verified annually.

The Department has established List II-21, Nuclear Gages. This list is in the Department's manual, "MATERIAL, SOURCES AND DEVICES WITH SPECIAL ACCEPTANCE REQUIREMENTS." Only gages on this list shall be furnished for use. Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

The Contractor shall provide a service warranty from the unit's manufacturer or one of his authorized service centers for parts and services necessary for continuous serviceability of the unit for the period of the construction contract of the project that will not be voided by certain designated State Department Of Transportation employees removing, repairing, or exchanging modules. In addition provision shall be made for periodic checks of the instrument by the manufacturer's service organization to prevent malfunctioning and to insure the unit is in first class working order at all times.

Special note is made of the Alabama State Department of Public Health requirement of a license for owning radioactive materials. A device will not be returned to the Contractor until he obtains such license.

While no standby equipment will be required, excessive delay in having a malfunctioning unit repaired or the continued malfunctioning of a unit shall be cause for the Engineer to order the unit replaced and/or the work halted and/or deduct from the Contractor's estimate a prorated portion of the unit price bid for the days the unit is not usable. During periods of repair and servicing, the Department may, at its option, furnish a device or use the alternate methods provided in Article 306.03.

306.03 Construction Requirements.

(a) GENERAL.

1. The control density testing procedures are based on the Department's standard methods as noted in this Article.

Basically, in-place densities shall be in accordance with ALDOT-222 or ALDOT-350 Test Procedure. In the event a test unit malfunctions, the Engineer may direct the use of one of the appropriate alternate methods until the test unit can be repaired or another unit brought in. Should the Engineer determine the use of the ALDOT-222 or ALDOT-350 Test Method to be impractical, he may direct the use of an alternate method.

Alternate in-place density methods are as follows:

Embankment	AASHTO T 191
Modified or Improved Roadbed	AASHTO T 191
Roadbed or Lime Stabilization	AASHTO T 191
Soil & Aggregate Base & Subbase	AASHTO T 191
Bituminous Bases and Pavements	AASHTO T 166

The use of the control strip method, ALDOT-225 for soils and aggregate subbases and bases and ALDOT-224 for Bituminous bases and pavements, will not be permitted unless such is designated in the plans, proposal, or directed in writing by the Materials and Tests Engineer. When the use of this method is designated, it shall be in accordance with the provisions of Item 2 below, and be under the direct supervision of the Materials and Tests Engineer.

All tests shall be made periodically as considered necessary and as currently scheduled by the Department's Testing Manual.

2. The use of the control strip method of testing will require the construction of control strips for subbase and base layers in accordance with the following requirements.

A control strip shall be constructed to determine a target density and, if applicable, target optimum moisture content. Each control strip, constructed to acceptable density and surface tolerances, shall remain in place and become a section of the completed roadway. Unacceptable control strips shall be corrected or removed and replaced at the Contractor's expense.

Each control strip shall be approximately 500 feet {150 m} long and full width and depth of the layer involved. A control strip shall be constructed at the beginning of work for each layer of subbase or base. A separate control strip shall be constructed for each layer of shoulder subbase or base constructed separately from the traveled way.

The equipment used in the construction of the control strip shall be approved by the Engineer. Compaction of the control strip shall begin immediately after a layer of material has been placed and shall be continuous and uniform over the entire surface. Compaction shall be continued until no discernible increase in density can be obtained by additional compactive effort. The average density of the control strip shall be the target density for the remainder of the course it represents.

A new control strip may be ordered by the Engineer or requested by the Contractor when:

(1) A change in the type or source of material is made.

(2) A change in the thickness of the layer to be placed is made.

(3) There is reason to believe that a control strip density is not representative of the material being placed.

The cost of the construction of the control strip is considered incidental to the testing method and shall be without extra compensation.

(b) DENSITY FOR EMBANKMENT LAYERS.

CONTROL TEST.

AASHTO T 99 Method A, C, or D.

Method A will be used when material has 10 percent or less aggregate retained on the Number 4 {4.75 mm} sieve with the retaining aggregate discarded.

Method C will be used when the material has more than 10 percent aggregate retained on the Number 4 {4.75 mm} sieve, and less than 20 percent retained on the 3/4 inch {19.0 mm} sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

Method D will be used when the material has more than 20 percent retained on the 3/4 inch {19.0 mm} sieve and the test performed in accordance with Note 7 of the AASHTO Procedure.

IN-PLACE DENSITY REQUIREMENTS - 95% for Method A or C, or 98% for Method D.

Embankment layers that are composed predominantly of rock (approximately 70%) shall be rolled until firm, but no in-place density test will be required.

MOISTURE CONTENT.

Strict moisture controls will not be required. However, compaction in a semi-dry condition will not be permitted.

(c) DENSITY FOR MODIFIED AND IMPROVED ROADBED LAYERS.

CONTROL TEST.

AASHTO T 99 Method A, C or D.

Method A will be used when material has 10 percent or less retained on the Number 4 {4.75 mm} sieve with the retained aggregate discarded.

Method C will be used when the material has more than 10 percent aggregate retained on the Number 4 {4.75 mm} sieve and less than 20 percent retained on the 3/4 inch {19.0 mm} sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

Method D will be used when the material has more than 20 percent retained on the 3/4 inch {19.0 mm} sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

IN-PLACE DENSITY REQUIREMENTS - 100%

MOISTURE CONTENT.

Moisture content at time of in-place density test shall be within ± 2% of the moisture content established during the control density test.

(d) DENSITY FOR ROADBED OR LIME STABILIZATION.

CONTROL TEST.

AASHTO T 99 Method A, C or D for materials without chemical additives.

Method A will be used when the material has 10 percent or less aggregate retained on the Number 4 {4.75 mm} sieve with the retained aggregate discarded.

Method C will be used when the material has more than 10 percent aggregate retained on the Number 4 {4.75 mm} sieve and less than 20 percent retained on the 3/4 inch {19.0 mm} sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

Method D will be used when the material has more than 20 percent retained on the 3/4 inch {19.0 mm} sieve and the test performed in accordance with Note 7 of the AASHTO procedure.

ALDOT-223 for chemically stabilized roadbeds.

IN-PLACE DENSITY REQUIREMENTS - 100%

MOISTURE CONTENT.

Moisture content at the time of the in-place density test shall be to the satisfaction of the Engineer, but in no case will be more than ± 5% of the established optimum moisture, unless authorized in writing by the Materials and Tests Engineer.

(e) DENSITY FOR SUBBASE AND BASE LAYERS.

CONTROL TEST.

AASHTO T 180, Method A, C, or D for material containing natural soil binders without chemical additives.

Method A will be used when the material has 10 percent or less aggregate retained on the Number 4 {4.75 mm} sieve with the retained aggregate discarded.

Method C will be used when the material has more than 10 percent aggregate retained on the Number 4 {4.75 mm} sieve and less than 20 percent retained on the 3/4 inch {19.0 mm} sieve and the test performed in accordance with Note 8 of the AASHTO procedure.

Method D will be used when the material has more than 20 percent retained on the 3/4 inch {19.0 mm} sieve and the test performed in accordance with Note 8 of the AASHTO procedure.

ALDOT-223 for materials containing natural soil binders with Portland Cement, calcium chloride, or other chemical additives, excluding bituminous materials.

ALDOT-140 for materials composed of all crushed aggregates with or without chemical additives, excluding bituminous materials.

AASHTO T 209, unless otherwise specified by the plans, shall be used for bituminous mixtures.

ALDOT-224 for Bituminous mixtures by the control strip method.

ALDOT-225 for all soil or aggregate base layers, with or without chemical additives, excluding bituminous materials by the control strip method.

IN-PLACE DENSITY REQUIREMENTS. (See Table I)

TABLE I								
In-Place Density Test Method	CONTROL TEST METHOD PERCENT REQUIRED IN-PLACE							
	Standard Methods							
	AASHTO T 180			ALDOT-223		LVD	Maximum Theoretical	Control Strip Method
	A	C	D	A	B	ALDOT 140	AASHTO T 209	ALDOT 225
Sand Method ALDOT-221	95	100	100	98	100	100		100
AASHTO T 166							94 ± 2	-
Nuclear Gage ALDOT-222 **	95	100	100	98	100	100	94 ± 2	100
ALDOT-350 *							94 ± 2	-

* For bituminous layers having a designated rate of placement of 300 pounds per square yard {165 kg/m²} or less.

** For bituminous layers having a designated rate of placement of greater than 300 pounds per square yard {165 kg/m²}.

MOISTURE CONTENT.

Moisture content at the time of in-place density test shall be within ± 2% of the moisture content established during the control density test except for bituminous mixtures.

(f) BLANK.

(g) DENSITY FOR BITUMINOUS PAVEMENT LAYERS.

CONTROL TEST.

Bituminous pavement layers shall be compacted to the applicable requirements shown in Tables II and III with AASHTO T 209 method unless otherwise specified by the plans.

Bituminous pavement layers of 99 pounds or less per square yard {54 kg or less per square meter} (124 or less pounds per square yard {67 kg or less per square meter} if on a bituminous surface treatment), plan designated weight {mass}, shall be thoroughly compacted to the satisfaction of the Engineer, but there will be no specified density requirements. A density test will not be considered valid under any circumstance where the thickness of the layer being tested is less than 7/8 of an inch {23 mm}.

IN-PLACE DENSITY REQUIREMENTS. (See Table II or Table III)

TABLE II	
BINDER LAYER	
In-Place Density Test Method	CONTROL TEST METHOD PERCENT REQUIRED IN-PLACE
	Standard Method
	AASHTO T 209
AASHTO T 166	94 ± 2
ALDOT-222 **	94 ± 2
ALDOT-350 *	94 ± 2

TABLE III	
WEARING LAYER	
In-Place Density Test Method	CONTROL TEST METHOD PERCENT REQUIRED IN-PLACE
	Standard Method
	AASHTO T 209
AASHTO T 166	94 ± 2
ALDOT-350 *	94 ± 2

* For layers having a designated rate of placement of from 100 to 300 pounds per square yard {55 to 165 kg/m²}.

** For layers having a designated rate of placement of greater than 300 pounds per square yard {165 kg/m²}.

(h) NUCLEAR TESTING DEVICE.

The operation of the nuclear testing device shall be in conformity with Alabama Department Of Transportation Radiological Operation Manual on Nuclear Moisture and Density Meters.

306.04 Method of Measurement.

Measurement for the Item of Nuclear Testing Device will be made on a unit basis for the number of devices ordered and accepted for use.

306.05 Basis of Payment.

(a) GENERAL.

No separate payment will be made for the density requirements noted in this Section, such being considered incidental to the requirements of the placement of the material involved.

The actual number of Nuclear Testing Devices, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the furnishing of the testing unit with all accessories and services noted in this Section and its use throughout the life of the project. Said unit price shall be for the device's exclusive use on the project throughout the life of the contract or until such time as the Engineer deems there will be no further need of the unit, at which time the device will either be transferred to the Department, if Pay Item 306-B, 306-D, 306-E, or 306-F, or the Contractor will be notified by certified letter to pick up his testing unit. The Contractor will have 30 calendar days from the date of the notification to present a valid license for owning radioactive material from the Alabama State Department of Public Health and claim his property. Failure of the Contractor to present the proper license and claim said property within the 30 days shall be prima facie evidence that he has relinquished all claims to the property and the Department will claim title to the unit.

In addition to the above, for Pay Item 306-E or 306-F, payment shall also be full compensation for transferring ownership or disposal of a Department owned Nuclear Testing Device.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

306-A Portable Nuclear Moisture-Density Testing Device - per each
306-B State Retained Portable Nuclear Moisture-Density Testing Device - per each
306-C Nuclear Thin Layer Density Testing Device - per each
306-D State Retained Nuclear Thin Layer Density Testing Device - per each
306-E State Retained Portable Nuclear Moisture-Density Testing Device (Includes Disposal Of Existing Device) - per each
306-F State Retained Nuclear Thin Layer Density Testing Device (Includes Disposal Of Existing Device) - per each

SECTION 315
DRAINAGE PLANE LAYER

315.01 Description.

This Section shall cover the work of constructing a drainage plane layer composed of an approved free-draining material.

This layer normally is used to facilitate drainage from the pavement structure layer through the shoulders; however, it may be used at other locations when shown on the plans or directed.

315.02 Materials.

Materials for use shall meet the appropriate requirements of Division 800, Materials, with specific reference to Section 822.

315.03 Construction Requirements.

The drainage layer shall be constructed in reasonably close conformity to the cross sections and dimensions shown on the plans and in the sequence noted in Subarticle 301.04(c). The thickness shown on the plans will be loose measurement before covering with another layer.

The drainage plane materials shall be spread by approved equipment capable of providing a single layer of uniform thickness, uncompacted, and continuous from the inner base layer edge through the shoulder line. The equipment must be capable of spreading this layer without damaging or disturbing the underlying and contiguous layers. Multiple passes may be permitted on wide shoulders.

There will be no density requirement for this layer. Care shall be taken to insure firm contact between drainage layer and the contiguous base layers.

Any disturbance to or loss of drainage plane material while uncovered shall be corrected prior to placing the overlying layer.

315.04 Method of Measurement.

Measurement of Drainage Plane Material will be in accordance with Article 301.07.

315.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Drainage Plane Material, measured as noted above, will be paid for at the contract unit price bid for the item of work involved in accordance with Article 301.08.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

315-A Drainage Plane Material, ___ inches {mm} Thick - per square yard {square meter}

SECTION 327
PLANT MIX BITUMINOUS BASE

327.01 Description.

The work under this Section shall consist of constructing a base layer composed of an aggregate and bituminous material hot mixed in a central plant and hot laid on a prepared surface in accordance with these specifications and in close conformity with the lines, grades, typical section, mix, and average weight per square yard shown on the plans or directed.

The work under this Section shall also include the construction of a Permeable Asphalt Treated Base (PATB) layer to serve as a drainage layer in the pavement structure.

Unless otherwise provided herein or by Special Provision, the work under this Section shall comply with the requirements for Hot Mixed Asphalt Pavements, Section 410.

327.02 Materials.

(a) MIX 1 AND MIX 2.

All materials furnished for use shall conform to the requirements of Section 410 and the following:

GENERAL.

The minimum VMA for mixes in this Section is 13.0. The job mix shall be designed by the Marshall Method to produce a minimum of 1200 pounds {5.5 kN} stability at 50 blows, unless otherwise specified on the plans or proposal.

AGGREGATES.

Fine aggregate shall meet the requirements of Article 802.04.

Coarse aggregate shall be gravel, processed reef shell, crushed slag, crushed stone, or a combination thereof meeting the requirements of Section 801, and as specified below.

The coarse and fine aggregates shall be combined in a total blend that will produce an acceptable job mix within the gradation limits shown below.

The plans and proposal will designate the mix to be used.

GENERAL COMPOSITION			
SIEVE (Square Mesh Type)	PERCENT PASSING BY WEIGHT		
	Mix 1	Mix 2 *	PATB
2 inch {50 mm} Sieve		100	
1.5 inch {37.5 mm} Sieve	100	82 - 97	100
1 inch {25.0 mm} Sieve	95 - 100		95 - 100
3/4 inch {19.0 mm} Sieve	80 - 95	55 - 85	
1/2 inch {12.5 mm} Sieve	64 - 84		25 - 60
3/8 inch {9.5 mm}Sieve	56 - 74	40 - 65	
No. 4 {4.75 mm} Sieve	40 - 56	30 - 52	0 - 10
No. 8 {2.36 mm} Sieve	28 - 42	22 - 42	0 - 5
No. 16 {1.18 mm} Sieve	20 - 34		
No. 30 {600 μm}Sieve	13 - 26		
No. 50 {300 μm} Sieve	8 - 20	5 - 22	
No. 100 {150 μm} Sieve	4 - 14	1 - 18	
No. 200 {74 μm} Sieve	2 - 6	0 - 8	0 - 2
* Mix 2 is intended to be used as a narrow width buildup in widening projects. All design criteria on Mix 2 is waived due to the size of the coarse aggregate. The M & T Engineer will determine the liquid asphalt binder content and gradation within the general composition of the mix.			

Liquid Asphalt Binder.

Unless the grade of liquid asphalt binder is specified on the plans or in the proposal, the Contractor shall use PG 67-22 liquid asphalt binder. The proportion of liquid asphalt binder to total sample by weight shall be 3.5 percent to 7.0 percent for Mix 1 and 3.0 percent to 6.0 percent for Mix 2. The exact proportion shall be fixed by the job-mix formula.

(b) PERMEABLE ASPHALT TREATED BASE MIX (PATB).

1. GENERAL.

All materials furnished for use shall conform to the requirements of Section 410 and the following:

The PATB shall be open graded, hot laid, central plant mixed, asphalt base material with no requirement for density, air voids, VMA, or stability. All other requirements outlined in Section 410 shall apply except pay factors for liquid asphalt binder content.

ALDOT No. 57 size crushed stone meeting the requirements of Section 801 shall be used. This material shall meet the gradation requirements as outlined in the above table.

During the drying process, the aggregate shall not be heated to a temperature greater than 280 °F{138 °C}.

The liquid asphalt binder and the dried aggregate shall be mixed in such a manner that the finished mixture shall not exceed 250 °F {121 °C}.

Laying temperature for the mixture shall be as directed by the Engineer.

The use of recycled asphalt pavement (RAP) will not be allowed in the PATB but will be allowed in other pavement layers.

The mix shall be designed with a target liquid asphalt binder content of 2 to 2.5 percent.

The PATB shall be tested for vapor/moisture susceptibility by ALDOT-255 and shall be redesigned if the mixture exhibits stripping potential. Additives or modifiers may be used to reduce stripping of liquid asphalt binder.

The liquid asphalt binder used in the PATB layer shall meet the requirements of Section 804 and be the same grade and type as that used in the overlying layer.

The geotextile filter shall comply with the requirements of Section 604, Geotextiles In Permeable Asphalt Treated Base Application.

2. SAMPLING AND TESTING FREQUENCY.

Sampling and testing of AC Content, Mixture Gradation, and Aggregate placed in a stockpile shall be as follows:

SAMPLING AND TESTING REQUIREMENTS						
Control Parameter	Sample Size	Sampling Methods	Sampling Location	Testing Methods	ALDOT Testing Frequency	Contractor Testing Frequency
1.Asphalt Content	25 lb. {12 kg}	AASHTO T 168 & ALDOT-210	Loaded Truck	ALDOT-319	1 per day	1 / 600 tons {1 / 600 metric tons}
2. Mixture Gradation	25 lb. {12 kg}	AASHTO T 168 & ALDOT-210	Loaded Truck	ALDOT-371	1 per day	1 / 600 tons {1 / 600 metric tons}
3. Stockpile Gradations	10 lb. (5 kg)	AASHTO T 2	Stockpile	AASHTO T 11 & T 27		1 / 1000 tons {1 / 1000 metric tons}
Notes: 1. Maximum Specific Gravity, Air Void Content, VMA, Marshall Stability & Flow, and Retained Tensile Strength shall be waived. 2. Each Asphalt Content test result shall be within ±0.45 of that shown on the job-mix formula.						

327.03 Construction Requirements.

(a) MIX 1 AND MIX 2.

The construction requirements for the base layer shall be the same as prescribed for hot mix asphalt pavement surfaces, Section 410, except as follows:

The edges shall be trimmed immediately after final rolling, using an accurately aligned string or wire to a tolerance of 2 inches {50 mm}outside the theoretical edge of the layer and to a slope not flatter than 1:1.

Any edge distorted by rolling shall be promptly corrected.

(b) PERMEABLE ASPHALT TREATED BASE MIX (PATB).

The construction requirements for the permeable asphalt treated base layer shall be the same as prescribed for hot mix asphalt pavement surfaces, Section 410, except as follows:

A static steel wheel roller shall be used to compact the permeable base applying 0.5 to 1.0 tons per foot of roller width {1.5 to 3.0 metric tons per meter of roller width}. The roller shall make one to three passes, as directed by the Engineer, when the temperature of the mixture reaches approximately 150 °F {66 °C}.

No portion of the PATB layer shall be exposed to the elements between laydown and cover for more than five calendar days.

When required, the geotextile filter shall be furnished and installed to comply with the requirements of Section 604 or as shown on the plans or directed by the Engineer.

If rutting of PATB occurs when placing the next layer due to grade of roadway, temperature of the PATB, etc., the Engineer may require ethe use of a tracked paver.

No traffic shall be allowed to operate or park on the travel lane or outside shoulder portion of the permeable base. Limited operation of equipment, e.g. delivery vehicles may be permitted on the inside edge.

327.04 Method of Measurement.

Measurement of the work included under this Section will be as provided in Article 410.08.

327.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Payment for the work included under this Section will be as provided in Article 410.09.

For Pay Item 327-E, payment for furnishing and installing a required geotextile filter will not be included in this item of work. The payment for furnishing and installing a required geotextile filter will be included in Pay Item 604-A, Separative Geotextile.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

327-A Plant Mix Bituminous Base, Mix ____ - per ton {metric ton}
327-B Plant Mix Bituminous Base, Patching, Mix ____ - per ton {metric ton}
327-C Plant Mix Bituminous Base, Leveling, Mix ____ - per ton {metric ton}
327-D Plant Mix Bituminous Base, Widening, Mix _____ - per ton {metric ton}
327-E Permeable Asphalt Treated Base - per ton {metric ton}

DIVISION 400
SURFACING AND PAVEMENTS

SECTION 401
BITUMINOUS SURFACE TREATMENTS

401.01 Description.

(a) GENERAL.

The work covered by this Section consists of basic bituminous treatments such as prime coat, asphalt flush coats, liquid seals, and bituminous surface treatments.

This Section also covers the work of applying a bituminous surface treatment containing a polymer additive. Polymer additives shall be included in emulsified asphalts used in placing chip seals on roadways or shoulders where the surface treatment will be subjected to traffic.

Each bituminous treatment shall consist of one or more hot applications of bituminous material and, except for prime coats, includes a specified cover aggregate which shall be spread after each bituminous application.

The work also includes the cleaning of the existing surfaces as well as furnishing and applying all materials, and necessary incidental work thereto, all in accordance with plan details and these Specifications.

(b) BITUMINOUS TREATMENT TABLE.

The following table shows the amount of bituminous material and the size and amount of cover aggregate required for the various types of bituminous treatments. The types are designated in the table by letters of the alphabet such as A, B, C, D, etc. The proposal will designate in the pay item description which of the various types are to be used. The kind of bitumen may also be specified or, if none is specified, the Contractor may select one of the kinds, if not in conflict with other provisions of these Specifications, permitted by the table. All other requirements of the tabular line opposite the type designation shall apply.

(Example: A bituminous treatment Type AKG, specifies a prime coat with the quantities specified on line "A", covered by a single surface treatment with the quantities specified on line "K", covered in turn by a seal treatment with the quantities shown on line "G".)

Bituminous materials shall be placed within the tolerance specified by the table for the type treatment involved, unless otherwise ordered by the Engineer in writing. Any variation outside of the designated limits shall be cause for ordering the treatment to be removed and replaced or corrected as directed by the Engineer, all without additional cost to the Department.

The rate of aggregate coverage shown by the table is the approximate rate found to produce an acceptable coverage when properly applied. Regardless of the rate shown, the Contractor shall provide aggregate in sufficient quantities and so spread the aggregate that the bitumen is uniformly and evenly covered.

The Engineer will notify the Contractor in writing should it become advisable to change the amounts of any material from the limits specified in the table. In such event an adjustment in the contract unit price will be made as specified in Subarticle 401.06(a).

BITUMINOUS TREATMENT TABLE SUBARTICLE 401.01(b)					
Designated Letter	Type Treatment	Aggregates ****		Gallons {Liters} of Bituminous Material per square yard {m^2} of Treatment **	
		Size	cu. ft./ sq. yd. {m^3/m^2}	Liquid Asphalt Binder	Emulsified Petroleum Resin, Cutback or Emulsified Asphalt
A	Prime Coat				0.22 – 0.25* {1.00 - 1.13}*
B	Flush Coat "B"	Sand	0.15 {0.0051}		0.16 – 0.19 {0.72 - 0.86}
C	Flush Coat "C"	9	0.20 {0.0068}		0.16 – 0.19 {0.72 - 0.86}
D	Liquid Seal "D"	78 or 89	0.25 {0.0085}	0.18 – 0.21 {0.81-0.95}	0.20 – 0.23 {0.90 - 1.04}
E	Liquid Seal "E"	78	0.25 {0.0085}	0.22 – 0.25 {1.00-1.13}	0.25 – 0.28 {1.13 - 1.27}
F	Liquid Seal "F"	78	0.27 {0.0091}	0.26 – 0.29 {1.18-1.31}	0.31 – 0.34 {1.40 - 1.54}
G	Liquid Seal "G"	7 or 78	0.27 {0.0091}	0.31 – 0.34 {1.40-1.54}	0.35 – 0.38 {1.58 - 1.72}
H	Liquid Seal "H"	6	0.40 {0.0135}	0.31 – 0.34 {1.40-1.54}	0.35 – 0.38 {1.58 - 1.72}
J	Surface Treatment "J"	6	0.42 {0.0142}	0.33 – 0.36 {1.49-1.63}	0.38 – 0.41 {1.72 - 1.86}
K	Surface Treatment "K"	5	0.50 {0.0169}	0.35 – 0.38 {1.58-1.72}	0.40 – 0.43 {1.81 - 1.95}
L ***	Surface Treatment "L"				
	1st Application	4	0.9 {0.0305}	0.35 – 0.38 {1.58-1.72}	0.40 – 0.43 {1.81 - 1.95}
	Dry Choke	78	0.20 {0.0068}		
	2nd Application	78	0.25 {0.0085}	0.55 – 0.58 {2.49-2.63}	0.62 – 0.65 {2.81 - 2.94}

* On cement treated layer, reduce prime bituminous amounts 20 percent.
** For shoulders, different amounts of aggregate and bitumen may be shown on plans or in the proposal.
*** Aggregate for this treatment shall be crushed aggregate.
**** Approximate rate of application for uniform coverage. Minor adjustments to these rates may be ordered by the Engineer to fit the physical properties of aggregates furnished for use.

Multipurpose and Cationic Emulsified Asphalts shall be in the same quantities as shown above for Emulsified Asphalt. Conversion of aggregate volume to weight {mass}, when required, shall be in accordance with AASHTO T 19.

The application rates of Bituminous Materials shown above are based on the material being at 60 °F {16 °C}.

401.02 Materials.

All materials shall comply with the requirements of Division 800, Materials, except as noted herein. Special reference is made to the following:

(a) BITUMINOUS MATERIALS, SECTION 804.

The grade of bituminous material shall be within the following limits unless the kind and grade are specified on the plans or in the proposal.

1. PRIME:

Emulsified Asphalt	AE-P
Cutback Asphalt	MC 30 or MC 70 for tight bases;
	MC 250, RC 70 or RC 250 for open bases.
Emulsified Petroleum Resin	EPR *

* This material shall not be used as a prime on processed reef shell base courses, crushed aggregate base courses, or rubblized concrete. This material shall not be left exposed for more than four days before placing a base layer of asphalt over it. This material shall also be supplied from the producer in the form in which it shall be placed. Material in a concentrated form that requires dilution after delivery will not be allowed.

2. ASPHALT FLUSH COAT:

Emulsified Asphalt	CRS 2

3. LIQUID SEALS AND SURFACE TREATMENTS:

Liquid Asphalt Binder	PG 58-22
Cutback Asphalt	RC 250, RC 800, RC 3000, MC 800, MC 3000
Emulsified Asphalt	CRS 2, CRS 2h

4. SURFACE TREATMENT WITH POLYMER ADDITIVE:

Liquid Asphalt Binder	PG 64-22 *
Emulsified Asphalt	CRS 2, CRS 2h

* This liquid binder shall be manufactured from PG 58-22 with polymer additive to achieve the PG 64-22 grade.

Where the plans require the placement of a bituminous plant mix overlay over a bituminous surface treatment or liquid seal, the overlying layer shall not be placed until the asphalt in the bituminous surface treatment or liquid seal has cured to the satisfaction of the Engineer. Curing time is dependent upon several factors including temperature, humidity, and wind velocity. When emulsified asphalt is used, curing begins with a distinct change in color, from brown to black, and proceeds until the asphalt satisfactorily retains the aggregate.

Traffic stripe on each layer shall be provided and paid for in accordance with Section 701.

(b) AGGREGATE.

Coarse aggregates for bituminous surface treatments shall be crushed aggregate meeting the requirements of Section 801. The kind of aggregate materials used shall be at the Contractor's option within the following limits:

1. The use of carbonate stone such as limestone, dolomite, or aggregate tending to polish under traffic shall be restricted as follows, based on the average daily traffic (ADT) count in both directions:

≤ 500 vehicles per day - No restrictions apply.

> 500 but ≤ 1,000 vehicles per day - Carbonate stone shall not be used in the final application. Aggregates for the final application (wearing layer) shall be limited to siliceous aggregates such as granite, blast furnace slag or lightweight aggregates (expanded clays or shales produced by the Rotary Kiln Method).

> 1,000 vehicles per day - Carbonate stone shall not be used in any application.

The above will not apply to shoulder surfacing or detours, or to bituminous surface treatments which are to be covered over with a bituminous plant mix layer.

2. Crushed gravel may be used for all applications which are to be covered with a bituminous plant mix layer, for all applications on roads having an average daily traffic count (ADT) of less than 1500 vehicles, and for all applications of shoulder surface treatment work.

(c) POLYMER ADDITIVE.

The polymer additive shall meet the requirements of Section 811. The polymer additive may be co-milled into the emulsified asphalt at the manufacturer's facility by pre-mixing the polymer into the liquid asphalt binder before the material is emulsified. This method of adding the polymer shall be at the rate of 3%, by volume, of the asphalt emulsion. Latex rubber additive may also be added to the emulsified asphalt in the distributor at the rate of 3%, by volume, of the asphalt emulsion. The distributor pump shall recirculate the material for a minimum of 15 minutes after adding the latex rubber. Any change to the above must be approved in writing by the Engineer. The temperature of the

emulsified asphalt shall be between 140 °F {60 °C} and 180 °F {85 °C} at the time of introduction of the latex rubber.

401.03 Construction Requirements.

(a) EQUIPMENT.

In general, it shall be the Contractor's responsibility to select the proper sizes and amount of equipment to provide the desired results, but the following basic items shall be provided. In addition, all equipment necessary for the proper prosecution of the work shall be assembled on the site and must be approved and in good working order before permission to start any treatment will be given.

All equipment approved for use shall be on a trial basis, and should after a short test section the equipment prove unsatisfactory, it shall be removed, replaced, or supplemented as deemed necessary to accomplish the desired results.

1. CLEANING EQUIPMENT.

Cleaning equipment shall be capable of cleaning the surface thoroughly without cutting, tearing, or otherwise damaging the surface.

2. PRESSURE DISTRIBUTOR.

A pressure distributor shall be required and shall be so designed and operated that it will distribute the contents, at a pressure between 30 psi {200 kPa} to 75 psi {500 kPa}, in a uniform spray for the full width of the treatment area without atomization, at the rate and within the limits specified. Heating equipment shall be provided. Distributors shall be capable of circulating or agitating the bitumen throughout the heating process providing a uniform temperature, with the ranges specified herein, and suitable means shall be provided for determining such temperatures. Suitable measuring equipment for accurately measuring the volume of the contents shall be provided. The distributor shall be equipped with a spray bar of adjustable height, hand hose, and nozzle.

Heating equipment will not be required for the application of Emulsified Petroleum Resin prime.

3. AGGREGATE SPREADER.

A self-propelled aggregate spreader with mechanically actuated spreading attachments and adjustable widths of satisfactory design and performance will be required; however, when the area to be processed is of such size or shape that to require the use of a mechanical spreader would be impractical, the Engineer may permit the aggregate to be spread manually.

4. ROLLERS.

A self-propelled steel wheel roller having a weight {mass} between 5 tons {4 metric tons} and 8 tons {7 metric tons} shall be required immediately behind the aggregate spreader followed by a self-propelled pneumatic tired roller. Only one coverage shall be made with the steel wheel roller.

(b) TEMPERATURE AND WEATHER LIMITATIONS FOR PLACEMENT OF SURFACE TREATMENTS.

All bituminous treatments shall be applied in strict conformity with the following:

1. SEASONAL

No Bituminous Surface Treatment, which will be exposed to traffic, including shoulder paving, shall be placed between the dates of October 1 and May 1 in North Alabama and between the dates of November 1 and April 1 in South Alabama regardless of weather conditions. For the purpose of identification, South Alabama shall be referred to for projects lying partly or wholly in the area of the State lying south of latitude 33°N and with North Alabama encompassing the remaining or northern portion of the State. This seasonal limitation will not apply to Prime Coat.

2. WEATHER.

Bituminous material shall not be placed on a wet surface or when the air temperature is below 60 °F {15 °C} or when, in the opinion of the Engineer, weather conditions are otherwise unfavorable. No Bituminous material shall be placed when the temperature is expected to fall below freezing during the night regardless of the daytime temperature.

3. MOISTURE IN AGGREGATE.

Aggregates spread when the temperature is 70 °F {20 °C} and above may be surface damp but not wet. Aggregates spread when the temperature is below 70 °F {20 °C} shall be surface dry. Aggregates found by the Engineer to contain excessive moisture or free water at the time of use shall be rejected.

The above limitations shall not be waived unless approved in writing by the Engineer.

(c) PREPARATION OF EXISTING SURFACE.

Loose material, dust, dirt, caked clay, or any foreign material shall be removed. Cleaning shall be continued until the surface is clean or, in case of application on a soil or aggregate surface, all the loose dirt is removed and the surfaces of the larger size aggregate in the road surface are exposed but not dislodged. All cleaning of the area to be treated shall be completed before any bituminous material is applied.

(d) APPLICATION OF BITUMINOUS MATERIAL.

1. GENERAL.

No bituminous material or treatment shall be applied until the base or underlying surface has been approved.

2. PREPARATION OF BITUMINOUS MATERIAL.

Bituminous materials used for each treatment shall be heated as previously noted. The material shall be maintained within the specific temperature range during application. Any material which has not been maintained within the specified range shall be rejected. The following temperature (°F {°C}) ranges shall apply:

TYPE OF BITUMEN	PRIME	HOT APPLICATION
Liquid Asphalt Binder		275 °F - 350 °F {135 °C - 175 °C}
Cutback Asphalt		
RC-70, MC-30, MC-70, MC-250	100 °F - 150 °F {35 °C - 65 °C}	
RC-250		125 °F - 180 °F {50 °C - 80 °C}
RC-800, MC-800		170 °F - 240 °F {75 °C - 115 °C}
RC-3000, MC-3000		215 °F - 270 °F {100 °C - 130 °C}
Emulsified Petroleum Resin	Ambient Temperature	
Emulsified Asphalt	120 °F - 170 °F {50 °C - 75 °C}	120 °F - 170 °F {50 °C - 75 °C}
Emulsified Asphalt With Polymer Additive	- - - - - -	140 °F - 180 °F {60 °C - 80 °C}

It is recommended that, in general, liquid asphalt binders be used June through September and either emulsified asphalt or cutback be used the remainder of the season.

Emulsified Petroleum Resin prime will not be required to be heated and shall be applied at ambient temperature. No Emulsified Petroleum Resin prime shall be placed when the ambient temperature is below freezing.

3. APPLICATION OF BITUMEN.

The bitumen shall be applied uniformly over the area to be treated. Where the treatment width is 26 feet {8 m} or less, the entire width shall be treated in one application, unless otherwise directed. Where only a partial width is treated in one application, extreme care shall be used to insure a slight overlap of adjacent treatments, but not in excess of 4 inches {100 mm}.

The spray bar shall be adjusted to the proper height for exact single or double overlap of spray area without partial overlap. Uniformity of discharge shall be checked before beginning application and at other times as directed. Streaked areas and any other areas lacking uniform distribution shall immediately be made uniform. In all cases the distributor shall be stopped before the application begins to run light (just before the distributor tank is completely empty). A method of making joints shall be used that will insure that in beginning and ending the distribution of each load, a proper junction is made with the preceding and succeeding work without excessive bituminous material at the joints.

In applying bituminous materials, the Contractor shall use effective means to protect structures, walls, curbs, etc. from discoloration or spattering.

4. SPECIAL DETAILS.

Before applying a prime coat, the surface shall be prepared as provided in Subarticle 401.03(c) above and, if necessary, it shall be sprinkled with water.

After the prime coat has been applied, the contractor shall keep all traffic off the road until, in the opinion of the Engineer, the prime coat is dry and cured. When directed, the Contractor shall, without extra compensation, spread the minimum necessary amount of approved clean, coarse sand over the bituminous prime to prevent its breaking up under traffic or to speed up curing.

No overlying surface shall be placed until the prime coat has been approved by the Engineer.

The Contractor shall, without extra compensation, maintain the prime treatment and the surface of the base intact until it is covered by an application of a surfacing material. Maintenance shall include satisfactory repair to all holes, ravels, depressions, and areas deficient in prime so that the prime surface shall be smooth and of uniform texture before placing of an overlying surface.

(e) SPREADING AND EMBEDDING AGGREGATE.

The size and amount of aggregate used shall be in accordance with provisions of Subarticle 401.01(b) for the type treatment required by the plans or proposal.

Spreading of aggregate shall follow application of bituminous material as closely as practicable using mechanical aggregate spreaders; inaccessible areas shall be covered as directed. Sufficient aggregate to cover each distributor load, in loaded trucks along with an adequate crew of workmen equipped with brooms standing by, shall be at the site before bituminous application begins.

Spreading of the aggregate shall begin and continue immediately behind the application of the bituminous material. However, if excessive rolling of the aggregate occurs during spreading, the Engineer may allow the chip spreader to delay slightly in order to hold aggregate rolling to a minimum.

Rolling shall begin immediately behind the spreading operation. Sufficient rollers shall be furnished to insure that the initial pass of the roller is made within five minutes of the spreading of the aggregate. Rolling shall be continuous, providing coverage of the entire area of treatment to insure thorough embedment of the aggregate.

Unless a sufficient number of rollers are in operation to complete the above requirement, the next load of bituminous material shall not be applied until the rolling of the previous application is completed.

When the Engineer determines the aggregate has been thoroughly embedded, rolling shall cease and the Contractor shall, without delay, remove all excess aggregate from the treatment area.

(f) SPECIAL CONSTRUCTION REQUIREMENTS FOR PLACING OF BITUMINOUS TREATMENT "L".

When placing surface treatment "L", special emphasis will be placed on not allowing either public or construction traffic over the work while placing of the treatment; if this cannot be avoided, it shall be well controlled and kept to a minimum.

The sequence of placement of the material shall be as follows:

1st Step - Cleaning of surface and applying the first application of bitumen at the rate shown in Subarticle 401.01(b).

2nd Step - Placement of cover aggregate so as to have a uniform cover in contact with the asphalt. The surface should then be rolled with a light roller to key the aggregate with the asphalt.

3rd Step - Place dry choke aggregate and continue rolling and brooming until voids are filled.

4th Step - Apply 2nd application of hot bitumen at rate shown in Subarticle 401.01(b).

5th Step - Apply 2nd application of aggregate and continue brooming and rolling until the voids are filled and the aggregate is keyed to the asphalt.

401.04 Maintenance and Protection of Surface and Traffic.

Maintenance shall include immediate repair of any failures or defects that occur, repeated as often as is necessary to keep the surface continuously intact and acceptable. Maintenance shall be performed without direct compensation.

Unless otherwise specified on the plans or in the proposal, the Contractor shall handle traffic through the work and over the surface except while bituminous material is actually being applied and covered with aggregate. It shall be his responsibility to take whatever steps are necessary or directed to protect both the work and the traveling public.

401.05 Method of Measurement.

Measurement will be made of the number of square yards {square meters} of accepted bituminous treatment, complete in place.

The length shall be the actual length measured along the surface of the treatment. The width shall be the designated width of completed surface. Where the pay item specifies a prime coat plus an

overlying treatment, the measurement will not include the additional width of the prime coat. Where the pay item specifies a prime coat only, the width will be the specified width of the prime coat.

401.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Payment for accepted bituminous surface treatment, or bituminous surface treatment with polymer additive, Pay Item No. 401-B, measured as provided above, will be paid for at the contract unit price per square yard {square meter} complete in place for the type of bituminous treatment specified in the proposal by the type designation letter or letters; except that adjustments in the contract unit price shall be made as follows: When changes in amounts of treatment materials are ordered as provided in Article 401.01, the contract unit price will be adjusted upward or downward accordingly. Adjustment will be based on the increase or decrease in amounts per square yard {square meter}, at the verified cost, f.o.b. delivery point plus 2 cents per gallon {0.5 cent per liter} for the bitumen, and the verified cost per square yard {cubic meter} for the aggregate delivered to the spreader. The contract unit price or adjusted contract unit price for the accepted area complete in place shall be payment in full for furnishing all material, placement of materials, maintenance thereof and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

401-A Bituminous Treatment Type designation letter/letters, Type of bitumen, if specified - per square yard {square meter}

401-B Bituminous Treatment Type designation letter/letters, Type of bitumen, if specified (With Polymer Additive) – per square yard {square meter}

SECTION 402
SLURRY SEAL COAT

402.01 Description.

This Section shall cover the work of constructing a surface course approximately 1/8 to 3/8 of an inch {3 to 10 mm} in thickness placed on existing paved surfaces in accordance with these specifications and within reasonably close conformity to the lines, grades, and widths shown on the drawings and as specified.

402.02 Materials.

(a) ASPHALT EMULSION.

CQS-1h or CQS-1hp shall meet the requirements of Section 804.

(b) AGGREGATE.

Aggregate shall meet the appropriate requirements of Section 801 and 802 with lightweight aggregate and manufactured sand made from limestone added to the list of approved stones.

(c) FILLER.

Filler, if required, shall meet the requirements of Section 805.

(d) WATER.

The water shall be potable and free from harmful soluble salt.

(e) COMPOSITION OF MIXTURES.

The aggregate, asphalt emulsion, water and, if required, filler meeting the requirements herein specified, shall conform to the composition by weight {mass} percentages as specified by the Engineer, but within the limits of Table A of this Section.

Type I. This aggregate blend is used to seal cracks and fill voids. It should be used on areas where a minimum wearing surface and a maximum seal is desired. This fine gradation requires an application rate of 4 to 10 pounds {2 to 5 kg} of dry aggregate per square yard {square meter}.

Type II. This aggregate blend is used to give crown corrections and a moderate wearing surface. This surface course shall be used in areas that require this size of aggregate to fill in voids and leave a substantial wearing surface. This gradation requires an application rate of 10 to 20 pounds {5 to 10 kg} of dry aggregate per square yard {square meter} resulting in a surface thickness of approximately 1/8 to 3/8 of an inch {3 to 10 mm}.

The slurry seal shall meet the requirements of Subarticle 410.02(b) where applicable.

TABLE A Composition by Weight {Mass} Percentages (Based on Square Opening Laboratory Sieves) Combined Aggregate Gradations		
Passing Sieve	Type I	Type II
3/8" {9.5 mm}		100
No. 4 {4.75 mm}	100	90 -100
No. 8 {2.36 mm}	95 -100	70 - 95
No. 16 {4.18 mm}	50 - 90	45 - 70
No. 50 {300 µm}	20 - 42	15 - 35
No. 200 {75 µm}	7 - 20	5 - 15
Asphalt residue, Percent by Weight {Mass}:	7.0 - 16.0	6.0 - 15.0

402.03 Construction Requirements.

(a) WEATHER LIMITATIONS.

The weather limitations as specified in Item 410.03(b)1 shall apply except that slurry seal shall not be placed when the air temperature is 50 °F {10 °C} or lower; nor when the temperature of the pavement on which it is to be placed is 50 °F {10 °C} or lower.

(b) EQUIPMENT REQUIREMENTS.

The slurry seal mixing equipment shall be an approved self-propelled, continuous-flow apparatus consisting of a composite of all the required units herein described. The apparatus shall be capable of proportioning, combining, and mixing accurately the specified components into a homogeneous mixture with an asphalt film of sufficient thickness to furnish the desired binding properties.

This apparatus shall contain bins, tanks, and receptacles of sufficient size and volume, proportioning feeders, liquid measuring meters or devices, mechanical mixer, and distributor for placing the finished mixture. All units shall be integrated, mechanized, and synchronized to deliver the component to the mixer simultaneously and in time adjusted sequence.

(c) MIXER.

The mixer shall be of the spiraled, multi-blade type or other type as approved by the Engineer. The mixing chamber shall have a stated capacity which shall not be exceeded and it shall be mechanically equipped to regulate the mixing time up to but not to exceed four minutes. It shall be equipped to pre-wet the aggregate prior to aggregate contact with the asphalt emulsion. It shall have a gate for controlling the discharge of the mixture into the distributor spreader.

(d) SPREADING EQUIPMENT.

A mechanically operated type squeegee distributor shall be integrally assembled with the slurry mixer. The strike-off shall be lined with a flexible material to prevent loss of the slurry mixture during spreading. The strike-off shall have vertical adjustment available for changing grade and crown to assure uniform spreading of the mixture. The apparatus shall be equipped with a pressure system and a fog type spray bar adequate for placing a complete fog coat of water with a maximum application of 0.05 gallons per square yard {0.25 L/m²} over the pavement surface immediately preceding the spreading of the mixture.

Hand squeegees, shovels, surface cleaning machines, and hand equipment as necessary, shall be provided to perform the work.

(e) CONDITIONING OF EXISTING SURFACE.

Conditioning of the existing surface shall be in accordance with Subarticle 410.03(c).

(f) PLACEMENT.

The temperature of the components of the completed mixture shall be so controlled that the application temperature of the slurry seal shall be within the range designated by the Engineer but not less than 50 °F {10 °C} nor more than 125 °F {50 °C} .

(g) JOINTS.

1. TRANSVERSE JOINTS.

Transverse joints shall be constructed by either overlapping the previously cured slurry with 10 to 15 feet {3 to 4 m} of fresh slurry or by lightly wetting the area that the spreader box will touch while the slurry is still in a completely uncured, semi-fluid condition.

2. LONGITUDINAL JOINTS.

Longitudinal joints shall be constructed when the slurry is completely uncured or when it is totally cured. Should the slurry be completely cured, the cured slurry at the joint area shall be wetted by the spray bar. Should the slurry be completely uncured, the slurry shall not be wetted. A burlap drag, or other suitable device, that will cause the fresh slurry coming from the spreader box to distribute itself evenly over the joint, shall be pulled along the joint seam.

(h) CURING.

Treated areas shall be allowed to cure until such time as the Engineer or inspector-in-charge shall permit their opening to traffic. All traffic shall be diverted up to a maximum of 24 hours to permit undisturbed curing of the slurry or until such time as curing has taken place and rolling has been completed.

(i) ROLLING.

Any rolling required for the slurry seal shall be done with a pneumatic roller. The roller shall be capable of exerting a contact pressure during rolling of 350 to 450 kPa. Rolling shall consist of not less than four complete coverages over the specified areas.

(j) TACK COAT.

When specified, a tack coat shall be placed in accordance with Section 405.

402.04 Method of Measurement.

The amount of slurry seal coat, applied as directed and accepted, will be measured in square yards {square meters}. The length will be the actual length measured along the surface. The width will be the actual width sealed as shown on the plans or directed.

402.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of square yards {square meters}, measured as provided above, will be paid for at the contract unit price for the item of Slurry Seal Coat of the type specified on the plans, complete in place, which price shall be payment in full for furnishing all materials and constructing the Slurry Seal Coat, and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

402-A Slurry Seal Coat, Type __* - per square yard {square meter}

* Indicate I or II

SECTION 405
TACK COAT

405.01 Description.

The work under this Section shall cover the furnishing and placing of a bituminous tack coat on an existing surface which is to be covered by a bituminous plant mix material in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or directed by the Engineer.

The work shall include the cleaning of the existing surface prior to application of the tack coat.

The area of treatment and the rate of application of a tack coat shall be based on the plans and specifications after evaluating the actual surface condition on which the plant mix overlay is to be placed.

405.02 Materials.

Bituminous material for tack coat shall be Emulsified Asphalt, Grade CRS-2, CRS-2h, CSS-1, CSS-1h, CQS-1h, or CQS-1hp, or one of the Performance Graded Asphalt Binders shown in Article 804.07. If Emulsified Asphalt is used, the emulsion shall not be diluted prior to application.

Unless shown otherwise on the plans, the contractor shall have the option of using any of the above listed bituminous materials, subject to other limitations of these specifications. In making his selection of materials, the contractor shall take into consideration seasonal, weather, temperature, and other placement conditions, while keeping in mind that SS stands for slow setting, RS stands for rapid setting, and QS stands for quick setting, the faster setting or breaking emulsion. Also, low temperatures and humid or damp conditions will retard the breaking or setting of all emulsions.

All materials shall meet the requirements of Section 804.

405.03 Construction Requirements.

(a) EQUIPMENT.

In general it shall be the Contractor's responsibility to select the proper size and amount of equipment to provide the desired results. Equipment furnished shall meet the requirements of Subarticle 401.03(a).

(b) SEASONAL, NIGHTTIME, WEATHER, AND TEMPERATURE LIMITATIONS.

The bituminous tack material shall be applied in conformity with the following:

1. SEASONAL – Grade CSS-1, and CSS-1h- Emulsified Asphalts shall not be placed between the dates of October 1 and May 1 in North Alabama and between the dates of November 1 and April 1 in South Alabama regardless of weather conditions. For the purpose of identification, South Alabama shall be referred to for projects lying partly or wholly in the area of the State lying south of latitude 33°N and with North Alabama encompassing the remaining or northern portion of the State. These seasonal limitations shall not apply to the placement of other bituminous materials for tack allowed by Article 405.02.

2. NIGHTTIME – Grade CSS-1 and CSS-1h Emulsified Asphalts shall not be used for tack during nighttime paving operations.

3. WEATHER - Tack material shall not be applied on a wet surface or when in the Engineer's opinion weather conditions are not suitable.

4. TEMPERATURE - Temperature requirements for placement of tack coat material shall be the same as specified in Subarticle 410.03(b) for plant mixed pavements.

(c) PREPARATION OF EXISTING SURFACE.

Loose material, dust, dirt, and all foreign matter shall be removed from the surface to be treated. Approval of the surface before application of the tack material is required.

(d) APPLICATION.

Tack coat material shall be applied in an amount from 0.05 gallons per square yard {0.25 L/m^2} up to a maximum of 0.10 gallons per square yard {0.5 L/m^2} for emulsified asphalt and from 0.03 gallons per square yard {0.13 L/m^2} up to a maximum of 0.07 gallons per square yard {0.3 L/m^2} for asphalt binder. When tacking new, freshly laid pavement, the Engineer may approve reducing the above minimum requirements.

Unless approved otherwise by the Engineer, the application temperature shall be 120^0F – 170^0F {50^0C – 75^0C} for Emulsified Asphalts and 275^0F – 350^0F {135^0C – 175^0C} for Performance Graded Asphalt Binders.

An asphalt distributor shall be provided for use on all accessible areas; inaccessible areas such as around manholes, etc. may be coated by other approved methods.

When applying tack coat, it shall be applied to all contact surfaces of curbs, gutters, manholes, and adjacent pavement edges, whenever and to the extent directed. Adjacent surfaces, such as gutters and the like, that are not to be in contact with the mix, shall be adequately protected from the spray, by means of heavy paper securely fastened in place or other satisfactory means. Any such surface soiled by tack coat material shall be cleaned and restored to its previous condition without additional compensation.

Tack coat material shall be spread only far enough in advance to permit the construction to progress consistently, uniformly, and continuously after the curing period and shall not be applied so far in advance that the viscous quality will be reduced by traffic prior to construction thereon. Tack coat that loses its viscous quality before being covered shall be renewed and any which has been damaged shall be replaced without extra compensation.

405.04 Method of Measurement.

The amount of bituminous material used as directed for tack coat will be measured in gallons {liters}, as specified in Article 109.02.

405.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The amount of bituminous material used as directed for tack coat, measured as noted above, will be paid for at the contract unit price bid per gallon {liter} which shall be full compensation for furnishing the bituminous material, hauling, heating, application, curing, and maintaining and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

405-A Tack Coat - per gallon {liter}

SECTION 408
PLANING (MILLING) OF EXISTING PAVEMENT

408.01 Description.

This Section shall cover the work of removing, by planing (milling), existing asphalt pavement. The work specified in this Section includes the transporting, stockpiling, or otherwise disposing of the removed pavement material. The removed material shall become the property of the Contractor unless otherwise noted on the plans.

If the reclaimed material is suitable for use in a recycled asphalt plant mix, and the Contractor elects to use the material in such fashion, then the height of the stockpiles at the asphalt plant should be limited to prevent moisture buildup or reconsolidation of the material.

408.02 Equipment.

The equipment for this operation shall be a machine capable of maintaining a depth of cut and cross slope which shall achieve the results specified herein. The determination of the minimum number of planing machines required and the minimum horizontal planing width of each machine shall be the responsibility of the Contractor, unless otherwise specified on the plans. The machine shall be equipped with automatic grade controls which operate by sensing from one or more skis, wheels, or other type of mechanism moving along the pavement surface and, if required, shall produce a skid resistant surface texture. The sensing device shall be of sufficient design to significantly improve the longitudinal profile of the pavement surface.

The machine shall be equipped with a means to effectively limit the amount of dust escaping from the removal operations.

If the machine is equipped with preheating devices, special attention is directed to the fact that local environmental and other regulations governing the operation of this type of equipment may vary considerably from place to place. It shall be the Contractor's responsibility to familiarize himself and comply with all such local regulations, as well as State and Federal rules, and to obtain all necessary permits.

408.03 Construction Requirements.

The existing pavement shall be removed to varying depths in a manner which will restore the pavement surface to a uniform longitudinal profile and cross section as specified on the plans or as directed by the Engineer.

The required planing depth at the centerline and at the edge of pavement may vary to obtain the required cross slope. The approximate depths of required planing are shown on the plans for the appropriate typical sections. In areas where the existing roadway does not have the required crown and/or superelevation rate, the planing depths shall vary to provide the desired cross slope and profile.

When provided on the plans, areas where planing will not, by itself, sufficiently correct an existing pavement, the Contractor shall use a bituminous concrete leveling layer along with the planing to produce the required crown and/or superelevation rate. This leveling layer will be paid for under the appropriate pay item for leveling.

The longitudinal profile of the planed surface shall be established by a sensing device on the side of the cut nearest the centerline of the road. The cross slope of the planed surface shall be established by a second sensing device near the outside edge of the cut or by an automatic cross slope control mechanism. The Engineer may waive the requirement for automatic grade or cross slope controls where the situation warrants such action.

The Contractor may elect to make multiple cuts to achieve the required pavement configuration or depth of cut.

The planing machine shall be operated to effectively minimize the amount of dust being emitted from the machine. Prewetting of the pavement may be required.

On resurfacing projects, the planing operations shall be limited to an area where the planed area will be covered with a bituminous surface treatment or paving, whichever applicable, within 24 hours after planing has begun, unless otherwise noted on the plans.

Prior to resurfacing or opening a planed area to traffic, where permitted, the planed surface shall be thoroughly swept with a power broom or other approved equipment to remove, to the greatest extent practicable, fine material and dust particles. This operation shall be conducted in a manner so as to minimize the potential for creation of a traffic hazard and to minimize air pollution.

Material removed by the planing machine, and material swept from the pavement, shall be disposed of in locations approved by the Engineer.

408.04 Finished Surface.

If the planed surface is to be the final surface of the pavement, it shall have either continuous or intermittent striations or any other pre-approved pattern which will provide an acceptable level of skid resistance. If pavement is to be constructed over the planed surface, it shall have a texture which will provide good bonding.

The finished surface shall have a reasonably uniform texture and shall meet the surface requirements specified in Subarticle 410.05(a).

Areas varying from a true surface in excess of the above stated tolerance may be accepted without correction if the Engineer determines that they were caused by a pre-existing condition which could not have reasonably been corrected by the planing operation. Any unsuitable texture or profile, as determined by the Engineer, shall be corrected by the Contractor at no additional compensation.

The Engineer may require planing of any area where a surface delamination causes a non-uniform texture to occur.

408.05 Method of Measurement.

The planing of pavement ordered and accepted will be measured in square yards {square meters} computed from surface measurements taken to the nearest 0.1 of a foot {0.1 m} on the planed pavement.

In areas where a non-uniform layer of thickness is planed off, the approximate layer thickness will be computed by averaging the depth of cut at opposite lane edges for each travelway at longitudinal measurement intervals of approximately 300 feet {100 m} or as directed by the Engineer. This average depth will be used to establish the item number under which payment will be made.

408.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The planing of pavement ordered and accepted, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the planing of the pavement, the transporting and stockpiling of the removed surplus material, the removal of grinding residue and the satisfactory disposal thereof, and the cleaning of the pavement and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

408-A Planing Existing Pavement (Approximately ___*___ inches {mm} thru ___**___inches {mm} thick) - per square yard {square meter}

* Lower limit of approximate thickness to be removed.

** Upper limit of approximate thickness to be removed.

SECTION 410
HOT MIX ASPHALT PAVEMENTS

410.01 Description.

The work under this Section covers the general requirements that are applicable to all types of hot mix asphalt pavements of the plant mix type. Deviations from these general requirements will be

indicated in the specific requirements for various types of mixes noted in the following sections of these Specifications.

This work shall consist of one or more courses of hot mix asphalt plant mix constructed in accordance with these specifications and the specific requirements of the type of mixture required and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

This work shall also include the preparation of the underlying surface on which the plant mix is to be placed, including patching and/or leveling as shown on the plans or directed.

In addition, this work shall also include the placing of widening at locations shown on the plans and/or directed by the Engineer. In general, widening shall consist of (1) narrow width build-ups, three feet or less {one meter or less}, required for widening existing pavement, (2) paving for turn-outs beyond three feet {one meter} from the edge of pavement, (3) pavement crossovers, and (4) turning lanes of less than 200 feet {60 m} for crossovers. Paving used on turn-outs for intersecting paved roads and shoulder paving will not be considered as widening unless shown on the plans.

410.02 Materials.

(a) GENERAL.

All materials furnished for use shall conform to the appropriate provisions of Section 327 (327-E, Permeable Asphalt Treated Base only), 420, 423, 424, or 429.

All mixes shall be tested during design to determine if an anti-stripping agent is needed. During design and production, Section 429 mixes shall have a tensile strength ratio (TSR) of at least 0.75 and Section 424 mixes shall have a TSR of at least 0.80 when tested in accordance with AASHTO T 283 as modified by ALDOT-361. If any TSR value falls below the minimum specified above, plant operations shall cease until corrective measures are taken. However, if any visual stripping occurs in the design or field production, an anti-stripping agent may be required if deemed necessary by the Engineer. Should it become necessary for the Contractor to include an anti-strip agent in the mix due to the occurrence of visual stripping during field production of the mix after the design tests indicated that the same mix met the above listed TSR requirement, such work will be paid for as Extra Work as defined by Article 104.03. Additional payment for the anti-strip agent will not be made in cases where the same mix has been previously used in field production and visual stripping occurred.

The amount of anti-stripping agent, when required, shall be 0.25 to 1.0 percent by weight {mass} of the liquid asphalt binder content for liquid agents and 0.5 to 2.0 percent by weight {mass} of the total aggregate for powdered agents. Liquid anti-stripping agent shall be added to the liquid asphalt binder by approved on-line blending equipment either at the refinery or the Contractor's mixing plant within ±10% of the specified rate.

Silicone may be used in liquid asphalt binder, not to exceed 2 ounces per 5000 gallons {3 ml per 1000 L}. Other additives shall not be added to the liquid asphalt binder unless expressly authorized in writing by the Materials and Tests Engineer.

The use of any unauthorized additive will be cause for rejection of the mixture.

(b) COMPOSITION OF MIXTURES.

1. GENERAL.

The project designated rate per square yard {square meter} of the plant mix layers are designed assuming a compacted mix unit weight {mass} of not greater than 158 pounds per cubic foot {2530 kg/m^3} for dense graded mixes (light weight aggregates excepted.) Hence, a correction to the plan designated rate per square yard {square meter} will be made in accordance with the following:

If the compacted mix density as determined in the job mix formula design exceeds 158 , or is below 130, pounds per cubic foot, {2530 kg/m^3, or is below 2080 kg/m^3}, the correction will be based on the formula:

x = ab/158 {x = ab/2530}, where

x = corrected rate per square yard {square meter},

a = laboratory compacted mix unit weight in pounds per cubic foot {density in kilograms per cubic meter} as shown in the job-mix formula, and

b = project designated rate per square yard {square meter} of plant mix as shown on the job plans.

If the laboratory compacted density is between 130 pounds per cubic foot and 158 pounds per cubic foot {2080 kg/m^3 and 2530 kg/m^3}, no correction will be made to the pounds per square yard {kilograms per square meter} designated by the plans or proposal.

If the plans provide for the use of lightweight aggregate (expanded clay or shale), the pounds per square yard {kilograms per square meter} of the layer shown by the plans or proposal will not be adjusted.

If the plans provide for the use of an "Open Graded" plant mix layer, the pounds per square yard {kilograms per square meter} of the layer shown by the plans or proposal will not be adjusted.

2. JOB-MIX FORMULA.

a. General.

No work shall be started under this Section on a specific project, nor any mixture accepted therefrom, until the Contractor has submitted and received approval of his intended material sources and his job-mix formula. The submitted formula shall have been designed by a certified technician (Level III - Designer) in a laboratory that has been certified by the Department. At least two working days prior to beginning work, the Contractor shall furnish the Division a copy of the approved job mix with the project number inserted. A copy of the approved job mix shall be available at the plant any time material is being delivered to the State.

At least three weeks prior to the beginning of each HMA laydown operation, the Contractor shall submit to the Materials and Tests Engineer, for approval, a job mix formula for each mixture to be supplied from a specific plant. The submitted formula shall include any additive by type and trade name and be accompanied by samples from the material sources he proposes to use in producing the mix. The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of liquid asphalt binder to be added to the aggregate, a single percentage of any additive, and a mixing temperature range suitable for the type, grade, etc. of liquid asphalt binder to be used in the mix. Each job-mix formula shall be accompanied by a test report from an approved laboratory certifying that all current Departmental design test parameters have been met (copies of the Departmental current design test parameters may be obtained from the office of the Materials and Tests Engineer). There will be no charge for the Department's checking of the Contractor's job-mix formula.

Designs for all mixes shall be the responsibility of the Contractor.

After the job-mix formula has been approved, the Contractor shall establish and notify the Engineer of the delivery temperature of the mixture to the road.

All mixtures furnished for use on the project shall conform to the approved job-mix formulas and the established delivery temperature within the following ranges of tolerances:

See appropriate pay factor table for liquid asphalt binder content requirements.

Plus or minus seven percent for the #4 {4.75 mm} and larger sieve requirements.

Plus or minus four percent for the #8 through #100 {2.36 mm through 150 μm} sieve requirements.

Plus or minus two percent for the #200 {75 μm} sieve requirement.

Plus or minus 30 °F {17 °C} for the established delivery temperature.

The initial setting of the controls for all materials shall be those amounts shown on the job-mix formula. The above tolerances are provided for slight variations inherent in job control applications. The Contractor shall make changes as necessary in order that the mixture will run as close as practical to the job-mix formula.

The approved job-mix formula for each mixture shall be in effect until the Materials and Tests Engineer withdraws approval by written order. A change in aggregate sources will require a new job-mix formula before the new material is used. A change in liquid asphalt binder source and anti-stripping agent will be allowed without a new job-mix formula provided the design criteria is met by a one-point check of the mixture. The one-point check shall include the Air Void, VMA, Stability, Flow, and TSR (Tensile Strength Ratio) and may be determined during the production of the mix; Stability and Flow apply to Section 429 mixes only. However, no change in the grade of liquid asphalt binder will be allowed without the approval of the Materials and Tests Engineer.

The placement of the entire wearing layer shall be from the same job mix unless otherwise approved in writing by the Engineer.

b. Design.

Refer to applicable Sections (424, 429, etc.) for design criteria.

(c) RECYCLED PLANT MIX.

Unless specified otherwise in other sections of the specifications, the Contractor shall have the option to use any ratio of reclaimed material to new material subject to the other requirements of these specifications and the following table:

SECTION	TYPE MIX	% RAP	REMARKS
327	PATB	0	
420	OGFC	0	
423	SMA	15	All Layers – No Rap containing Chert Gravel
424 & 429	SP & IMP.	0	Wearing Layer, if RAP contains Chert Gravel
424 & 429	SP & IMP.	15	Other Layers, if RAP contains Chert Gravel
424 & 429	SP & IMP.	20	All Layers, if RAP does not contain Chert Gravel

Refer to applicable Sections (424, 429, etc.) regarding any other restrictions on the use of recycled plant mix.

On any project utilizing reclaimed material in the mixture, the Contractor's paving operation shall conform to one of the four following options:

1. If the reclaimed material to be used is to be removed from the project under construction, the Contractor shall mill off at least 100 feet {30 m} of the roadway in two or more areas to secure uniform samples for evaluation and design purposes. No additional samples of the reclaimed material will be required unless deemed necessary by the Engineer. If the Contractor chooses this option, he shall furnish, at his expense, appropriate traffic control items. The roadway shall be left in a condition safe to the traveling public and which will not trap water.

2. The Contractor may use a mix of 100 percent virgin aggregates until a sufficient amount of reclaimed material is milled from the project to establish a stockpile representing the reclaimed asphalt material to be used on the remainder of the project.

3. The Contractor may use reclaimed material that was previously milled from another Alabama Department of Transportation project provided the source can be identified in regard to route, mile {kilometer} post, and layers (based on thickness) milled. The reclaimed material must be traceable back to the original job-mix formula so that the source of coarse aggregate can be identified to meet the Department's approval procedure.

4. The Contractor may use reclaimed material from a stockpile of unknown origin or a blended stockpile provided it has been approved by the Department in accordance with ALDOT-372.

Any reclaimed material to be used in the recycled mix shall be stockpiled in an appropriate manner. The reclaimed material may be required to be stockpiled into two, or more, stockpiles if deemed necessary by the Engineer due to discernible differences in the composition of the material. Each RAP stockpile will be assigned an identifying number in accordance with ALDOT-372. Once a stockpile has been sampled, no other material shall be added. The Contractor will not be allowed to use any material from any stockpiles that have not been designated for a job-mix formula.

If recycled plant mix is used, the following shall apply:

One hundred percent of all reclaimed material shall pass the 2 inch {50 mm} sieve before entering the plant. On gate-calibrated plants, one hundred percent of all reclaimed material shall pass the 2 inch {50 mm} sieve before entering the cold bin.

The recycled asphalt concrete mixture shall be a homogeneous mixture of reclaimed material, new fine and/or coarse aggregate, and new hot mix asphalt material.

(d) FIBERS

1. GENERAL.

A fiber stabilizer is required for some mix types (420, 423, etc). A fiber stabilizer may be used on other mix types where draindown is a problem. When fiber is used, the dosage rate shall be a minimum of 0.30% for both cellulose and mineral fibers by weight of total mix and shall produce a maximum liquid asphalt binder draindown of 0.30% or less when tested in accordance with ALDOT-386. The sampling and testing frequency for both Contractor and Department testing during production shall be one test for each 5000 tons {metric tons} or portion thereof. Either cellulose or mineral fibers may be used. The fiber shall be listed on List II-23, Fibers for use in Hot Mix Asphalt (from the Materials, Sources, and Devices with Special Acceptance Requirements (MSDSAR) manual). If pelletized fibers are used, the fiber within the pellet shall be listed on List II-23. All fibers listed on List II-23 shall meet the requirements of either Item 2 or 3 of this Subarticle.

2. CELLULOSE FIBERS.

The maximum length of the fiber shall be 0.25 inches {6.35 mm}. A representative 3 gram sample, when heated in a crucible between 1100 and 1200 °F {595 and 650 °C} for at least 2 hours, shall show between 13% and 23% non-volatiles. A representative 5 gram sample, when stirred into 100 ml of distilled water, shall have a pH between 6.5 and 8.5 after sitting for 30 minutes. A representative 5 gram sample, when saturated with mineral spirits for 5 minutes and then sieved for 10

minutes on a No. 40 {425 μm} sieve, shall absorb between 4% and 6% its own weight of mineral spirits. A representative 10 gram sample, when weighed and placed into a 250 °F {121 °C} oven for two hours, shall lose less than 5% by weight when weighed immediately upon removal from the oven.

Sieve analysis of the cellulose fiber shall be either of the following methods:

- Using an Alpine Air Jet Sieve (Type LS), a representative 5 gram sample of the fiber is sieved for 14 minutes at a controlled vacuum of 11 psi {75.8 kPa}. The fibers remaining on the screen are weighed. The results of this analysis shall indicate that 60% to 80% of the fiber passes the No. 100 {150 μm} sieve. Or:

- Using a Mesh Screen Analysis, a representative 10 gram sample of the fiber is sieved using a shaker with two nylon brushes on each screen. The results of this analysis shall indicate that the fiber has the following amounts passing the specified screens: 75% to 95% on the No. 20 {850 μm} sieve, 55% to 75% on the No. 40 {425 μm} sieve, 20% to 40% on the No. 140 {100 μm} sieve.

3. MINERAL FIBERS.

When tested according to the Bauer-McNett fractionation, the fiber length shall have a maximum mean test value of 0.25 inches {6.35 mm}. By using a phase contrast microscope, and a representative test sample of at least 200 fibers, the fiber diameter shall have a maximum mean test value of 0.0002 inches {5.1 μm}. The shot content passing the No. 60 {285 μm} sieve shall be 85% to 95%. The shot content passing the No. 230 {65 μm} sieve shall be 60% to 80%. This is a measure of non-fibrous material determined on vibrating sieves (for further information see ASTM C 612).

4. PLACING FIBER IN MIX.

a. Manual Method.

Provided it can be demonstrated to the satisfaction of the Engineer that the proper dosage of the fibers is uniformly distributed into the mix, manual introduction of fibers is acceptable when a batch plant is used to make the mix. When the fibers are available in prepackaged (weighed) containers, proper dosage may be pre-determined per batch. A device is required to interrupt mixture production and warn the plant operator if the operator manually feeding the fiber fails to introduce it properly. Dry mixing time shall be increased at least five seconds to insure adequate blending. Wet mixing time shall be increased at least five seconds for cellulose fibers and up to five seconds for mineral fibers. Manual introduction of fibers shall not be used in drum plants.

b. Automatic Method.

Methodology and equipment for metering bulk loose and pelletized fiber into asphalt plants has been developed by the fiber suppliers; whenever the fiber supplier's recommendations are more stringent than this specification, the fiber supplier's recommendations are controlling. This specification requires specialized equipment that can accurately proportion and meter, by weight {mass}, the proper amount per batch (for batch plants) or continuously, in a steady uniform manner (for drum plants). Fiber, pelletized or loose, shall not be fed through the cold feed bins or through the rap bin.

These proportioning devices shall be interlocked with the plant system and controlled to +/-10% of the weight of the fibers required so as to maintain the correct proportions for all production rates and batch sizes. During the test strip, an equipment calibration check shall be performed to the satisfaction of the Engineer which shows the fiber is being accurately metered and uniformly distributed into the mix. These metering devices shall provide in process highflow (+ 10% or more) and lowflow (-10% or less) plant operator notification and interrupt the mix production where the fiber rate is not properly controlled. The fiber metering system shall also provide a record of feed rate (weight or mass per time) and include a section of translucent pipe for visual confirmation of consistent flow rates. Care shall be taken to insure that the fibers are not entrained in the plant's exhaust system. If there is any evidence of fiber in the bag-house or wet-washer fines, the liquid asphalt binder line and/or the fiber line shall be relocated so that the fiber is captured by liquid asphalt binder spray and incorporated into the mix. If there is any evidence of clumps of fibers or pellets at the discharge chute, the contractor shall increase the mixing time and/or intensity. This may entail extending the liquid asphalt binder and fiber feeding lines further into the drum.

(e) SAMPLING AND INSPECTION.

Aggregates will be accepted in stockpiles in accordance with the Department's Testing Manual provided there is no segregation or contamination, but production of required gradation in the mix shall be the Contractor's responsibility.

Liquid asphalt binder will be accepted on the basis of ALDOT-243.

The right is reserved to take samples, including aggregates from stockpiles, plant mix from the hot elevator, plant mix from the spreader, liquid asphalt binder from storage tanks at the plant, etc., and to make further tests as needed as a basis for continued acceptance of the materials.

Samples of the mixture in use will be taken and tested in accordance with Subarticle 106.09(b).

When directed, the Contractor shall cut samples with mechanical equipment from the compacted pavement for testing. Samples not smaller than 4 inches {100 mm} square or 4 inches {100 mm} in diameter for the full depth of the course to be tested shall be taken at the locations directed by the Engineer. Furnishing of suitable approved cutting equipment, the cutting of the samples, and the immediate repair of the sample holes with similar type of material shall be performed by the Contractor without extra compensation.

A laboratory shall be furnished for the control of each hot mix asphalt plant in accordance with the provisions of Section 601.

410.03 Construction Requirements.

(a) EQUIPMENT.

In general, choice of equipment will be left to the Contractor and it shall be his responsibility to provide proper sized and amounts of equipment that will produce, deliver to the roadbed, spread, and compact the plant mixed material in sufficient quantities for the continuous movement of the spreaders under normal operating conditions.

The mixing plant, hauling, spreading, and compaction equipment shall meet the requirements listed below; however, other equipment that will produce equally satisfactory results, such as electronically or automatically controlled devices of proven performance, will be considered for use in lieu thereof.

The Contractor shall secure approval of all equipment prior to beginning work and any equipment found unsatisfactory shall be promptly replaced or supplemented.

1. REQUIREMENTS FOR ALL PLANTS.

Mixing plants shall comply with the requirements of AASHTO M 156 as modified by ALDOT-324, Mixing Plant Requirements for Hot-Mixed, Hot-Laid Asphalt Paving Mixtures. In addition to the above, if a recycled mix is used, the mixing plant shall be modified as necessary to accommodate the use of the reclaimed material and necessary additives. Mixing plants shall be inspected at least annually to insure compliance with the requirements of AASHTO M 156 and ALDOT-324. The Contractor/Vendor will be charged a fee as specified by ALDOT-355, General Information Concerning Materials, Sources, and Devices with Special Acceptance Requirements. If the plant is relocated or substantially modified in any way within a year of the last inspection, an additional inspection and related fee will be required.

The plant shall be equipped with a dust collector constructed to waste or store and later return uniformly to the aggregate mixture all or any part of the material collected.

2. SCALES.

A digital recorder shall be installed as part of the platform truck scales. The recorder shall produce a printed digital record on a ticket of the gross and tare weights {masses} of the delivery trucks along with a time and date print for each ticket. Provisions shall be made so that scales may not be manually manipulated during the printing process, and so interlocked as to allow printing only when the scale has come to rest. The scales and recorder shall be of sufficient capacity and size to accurately determine the weight {mass} of the heaviest loaded truck or tractor trailers that are used for the delivery of the hot mix asphalt from that plant.

In lieu of plant and truck scales, the Contractor may provide either (1) an approved automatic printer system which will print the weights {masses} of the material delivered (evidenced by a weight {mass} ticket for each load), provided the system is used in conjunction with an approved automatic batching and control system, or (2) an electronic load cell weight {mass} determination system with associated computer hardware and automated printing system.

The Contractor may provide a "weigh {mass} batcher" system utilizing a weigh {mass} hopper equipped with load cells that determine the net amount of mix delivered from the weight {mass} hopper. An automated weigh {mass} printing system shall be provided to accurately print the weight {mass} of material delivered, the time, and the date for each ticket.

All scales which determine the weight {mass} of the mix for pay purposes shall meet the requirements of Subarticle 109.01(h).

3. HAULING AND REMIXING EQUIPMENT.

a. Load Limitations.

Reference is made to Article 105.12 concerning load limitations on hauling equipment.

Wherever a Material Remixing Device is used, the following restrictions shall apply:

- The device shall be empty while on a bridge.
- The device shall be moved across a bridge without any other vehicles or equipment being on the bridge.
- The device shall be moved on a bridge only within the limits of a lane and shall not be moved on the shoulder of a bridge.
- The device shall move at a speed no greater than 5 miles {8 km} per hour without acceleration or deceleration.

b. Trucks.

Trucks used for hauling hot mix asphalt mixtures shall have tight, clean, smooth metal beds that have been thinly coated with a minimum amount of approved asphalt release agent (List II-6, Hot Mix Asphalt Release Coating for Truck Beds, in the MSDSAR manual) to prevent the mixture from adhering to the beds. The use of gasoline, kerosene or other volatile material is prohibited. Each truck shall be equipped with a cover of canvas or other suitable material of such size as to protect the mixture from adverse conditions. Each truck shall have a hole in the side of the body, approximately 5/16 of an inch {8 mm} in diameter and suitably placed, to allow for temperature measurement of the asphalt mix. When the air temperature is below 60 °F {15 °C}, or hauling time exceeds 30 minutes, or threatening weather exists, no mixture shall leave the plant unless it is covered entirely and the cover securely fastened.

c. Material Remixing Device.

A material remixing device shall be used for the placement of the base (not including 327-E, Permeable Asphalt Treated Base), binder and wearing layers of pavement if a pay item for this device is shown on the Plans. If a pay item is not shown on the Plans, the Contractor may use a material remixing device without compensation.

The material remixing device shall be capable of remixing plant mix between the trucks and the finished mat. Plant mix shall be remixed in the device prior to being laid by the paver or spreader. The plant mix delivered by the material remixing device shall be a homogeneous, non-segregated mixture.

Equipment known to accomplish this remixing operation and currently approved by the ALDOT are the ROADTEC Shuttlebuggy and the BLAW-KNOX MC-330/TWIN PUG TUB.

A material transfer vehicle will not be required for temporary work of short duration, bridge replacements having less than 1000 feet {300 m} of pavement at each end of a bridge, acceleration and deceleration lanes less than 1000 feet {300 m} in length, tapered sections, width transition sections, shoulders, crossovers, ramps, side street returns and other areas designated by the Engineer.

4. HOT MIX ASPHALT PAVERS OR SPREADERS.

Hot mix asphalt pavers or spreaders shall be self-contained and of sufficient size, power, and stability to receive, distribute, and strike off the asphalt material at rates and widths consistent with the specified typical section requirements and details shown on the plans and noted in Item 410.03(f)2.

All hot mix asphalt pavers or spreaders used for mainline paving, including shoulders and interchange ramps, shall be operated with a full width vibratory, or other compactive type, screed. The augers used to move the material across the width of the screed shall extend within 1.5 feet {450 mm} of the edge of the screed. It will be permissible to use a hydraulically extendable strikeoff for paving turnouts and short sections of pavement including variable width sections and crossovers.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture, providing a finished surface of the required evenness and texture without tearing, gouging, or shoving of the mixture.

All hot mix asphalt paving machines shall be operated with automatic grade and slope controls unless otherwise directed by the Engineer. Equipment operating together shall have the same type controls. The automatic controls may operate either from control grade wires or ski; however, when a ski is used, the spreader shall have a ski of not less than 30 feet {10 m} in length. Both grade and slope controls shall be in good working order at all times. In the event of a malfunction of the

automatic control system, the spreading operation shall be discontinued after one hour until the equipment is repaired and restored to first class working order.

5. COMPACTION EQUIPMENT.

Compaction equipment shall be capable of compacting the mixture to the required density throughout the depth of the layer while it is still in a workable condition without damage to the material. The Contractor shall be responsible for the selection of the types and number of rollers to be used.

(b) WEATHER AND TEMPERATURE LIMITATIONS.

All hot mix asphalt plant mixtures shall be applied in compliance with the following:

1. WEATHER.

The mixture shall be laid only upon an approved underlying course, which is dry, and only when weather conditions are suitable. The Engineer may, however, permit work of this character to continue when overtaken by sudden rains, up to the amount which may be in transit from the plant at the time, provided the surface just ahead of the placing is swept clear of water and the mixture is within the allowable tolerances from the established delivery temperature. The layer placed under such conditions shall be at the Contractor's risk and shall be removed and replaced by him without extra compensation should it prove unsatisfactory.

2. TEMPERATURE CONTROL.

Hot mix asphalt layers of 200 pounds per square yard {110 kg/m^2} or less shall not be placed when the surface or air temperature is below 40 ºF {4 ºC}; air temperature shall be 40 ºF {4 ºC} before the spreading operation is started. Spreading operations shall be stopped when the air temperature is below 45 ºF {7 ºC} and falling. Rolling and finishing operations shall be completed during daylight hours. For hot mix asphalt layers over 200 pounds per square yard {110 kg/m^2}, the above temperature may be lowered 5 °F {2 °C}. Unless otherwise stated in the plans and specifications, polymer modified HMA layers of 200 pounds per square yard {110 kg/m^2} or less shall not be placed when the surface or air temperature is below 60 ºF {15 ºC}; for layers over 200 pounds per square yard {110 kg/m^2}, the above temperature may be lowered 10 °F {5 °C}.

(c) PREPARATION OF UNDERLYING SURFACE.

1. GENERAL.

The underlying surface must be approved before the placing of a plant mix application will be allowed. The underlying surface, whether an old surface or a new surface, shall be thoroughly cleaned of all foreign or loose material and maintained in such condition in advance of the surfacing work.

Failures in existing pavement or base shall be corrected, as noted in Item 410.03(c)2, in advance of the placement of an overlying layer.

A prime coat, when required, shall be placed in accordance with Section 401. A tack coat, when required, shall be placed in accordance with Section 405.

2. PATCHING.

When patching of an existing surface is provided by the plans, the Engineer will examine the pavement surface and designate the area to be patched. The designated areas shall be trimmed to neat vertical lines for the depth of the unstable material as directed. The loose faulty material shall be picked up and removed from the area. The newly exposed patch area shall be cleaned and treated with prime or tack material as directed before placement of patching material. The hot mix asphalt patching material shall be placed and compacted by methods approved by the Engineer until the patch area is filled to the elevation of the surrounding surface. Compaction of the patching material shall be to the degree that further consolidation of the patching material is not anticipated and is acceptable to the Engineer.

3. LEVELING.

When leveling of an existing pavement or base is provided by the plans, the surface shall be brought to proper grade and cross section with plant mix material. The surface to be treated shall be prepared as noted herein and approved before placing the new material. The plant mix material shall be spread in accordance with the provisions of Item 410.03(f)2 and, if placed in a uniform layer, compacted as noted in Subarticle 410.03(g) until the desired section is formed. If the leveling is not placed in a uniform layer, it shall be compacted to the satisfaction of the Engineer.

Leveling shall include superelevating when so directed.

The Engineer may vary the size of the coarse aggregate and the liquid asphalt binder content from that specified where field conditions justify such a change.

4. WIDENING.

When widening is provided by the plans, the widening shall be placed at the locations designated by the plans and/or directed by the Engineer. The requirements for placing of the widening shall be the same, as far as practical, as for the placing of the normal roadway. Compaction of the widening material shall be to the degree that further consolidation of the widening material is not anticipated and is acceptable to the Engineer.

(d) PREPARATION OF MIXTURES.

1. LIQUID ASPHALT BINDER.

The liquid asphalt binder material shall be heated in a manner that insures the even heating of the entire mass under efficient and positive control at all times. Any liquid asphalt binder material which, in the opinion of the Engineer, has been damaged shall be rejected.

2. AGGREGATE.

a. Aggregate Used for Batch Mixing and Continuous Mixing Operations.

All aggregates shall be dried so that the moisture content of the hot mix asphalt at the point of sampling is less than 0.2 percent by weight {mass} in accordance with ALDOT-130. The temperature of the aggregate at the dryer shall not exceed 600 ºF {315 ºC}.

When more than two ingredients enter into the composition of the mineral aggregate, they shall be combined as directed.

The aggregate, immediately after being heated, shall be screened into three or more sizes and conveyed into separate bins, ready for batching and mixing with liquid asphalt binder material. However, for mixes using aggregate of 1/2 inch {12.5 mm} maximum size, the number of bins may be reduced to two.

b. Aggregates for Dryer Drum Mixing Operations.

Maintenance of a uniform aggregate gradation is essential for a dryer drum operation; hence, caution and care shall be exercised in stockpiling of materials to avoid segregation.

3. MIXING.

a. General.

The temperature range of mixing shall not exceed the temperature shown on the approved job-mix formula.

b. Batch Mixing.

The dried mineral aggregate, and measured mineral filler when used, prepared as prescribed above, shall be combined in uniform batches by determining the weight {mass} of and conveying into the mixer the proportionate amounts of each aggregate required to meet the job-mix formula. The largest size aggregate shall be introduced first, then smaller sizes progressively, with mineral filler last, or all mineral components may be added simultaneously. The mineral components shall be thoroughly mixed. The required quantity of liquid asphalt binder material for each batch shall be measured by weight {mass} using scales or a liquid asphalt binder material metering device attached to the liquid asphalt binder material bucket.

After the mineral components have been mixed, the liquid asphalt binder material shall be added and the mixing continued for a period of at least 45 seconds, or longer if necessary to produce a homogeneous mixture. However, if a check by ASTM D 2489 (Ross Method) shows that 95% plus coating is obtained, a shorter mixing time will suffice. The Engineer may then give written permission for a change. Each batch must be kept separate throughout the weight {mass} determining and mixing operations.

The mixture shall be uniform in composition, free from lumps or balls of material containing an excess quantity of asphalt, or from pockets deficient in asphalt.

c. Continuous Mixing.

Components shall be introduced and proportioned volumetrically by continuous methods utilizing equipment specified herein for continuous plants. Amounts of aggregate and liquid asphalt binder material entering the mixer, and the rate of travel through the mixer, shall be so coordinated that a uniform mixture of specified gradation and liquid asphalt binder content will be produced.

d. Dryer-Drum Mixing.

Components shall be proportioned by weight {mass} as noted herein in Item 410.03(a)1 for this method of mixing. Amounts of aggregate and liquid asphalt binder material entering the mixer, and the rate of travel through the mixer, shall be so coordinated that a uniform mixture of specified gradation and liquid asphalt binder content will be produced. An anti-stripping agent may be required to insure adequate coating of the aggregates, if so directed by the Engineer.

4. RECYCLED MIXTURES.

a. New Aggregate Temperature.

The temperature of the new aggregate shall be super-heated to the point where, when combined with the reclaimed material, the specified discharge or delivery temperature is produced; however, in no case shall the temperature of the new aggregate exceed 600 °F {315 °C}.

b. Mixing.

The plant shall be designed and operated so that heat transfer will take place in the mixing unit without damage to, or vaporization of, the liquid asphalt binder material. For batch type plants, a minimum dry mixing cycle of 15 seconds shall be required for the new aggregate and reclaimed material before introduction of the new liquid asphalt binder material. All environmental regulations shall be met as required by Article 107.22.

(e) TRANSPORTING MIXTURE.

The mixture shall be transported in approved equipment in accordance with Item 410.03(a)3. The equipment shall be in sufficient numbers to deliver the material to the roadbed without delay in the quantity required. No loads shall be delivered too late in the day to be spread, compacted, and finished during daylight hours.

(f) PLACING THE MIXTURE.

1. RATE OF PLACEMENT.

The average rate of plant mix to be placed will be specified by the plans; however, this rate may require correction to adjust for the compacted mix unit weight {density} as determined in the job-mix formula design as outlined in Subarticle 410.02(b). The Engineer may direct in writing that the designated weight {mass} be increased or decreased in certain areas. It shall be the Contractor's responsibility to place and spread the material uniformly to such thickness as will produce the specified average rate, separately for each layer of base, binder, and surface, and to maintain a continuing check on tonnage {mass} and yardage {area} throughout the day's operation to insure uniform specified rate.

The unit for checking the average rate shall be approximately 5000 square yards {5000 m^2} to the nearest even truck load. If the last check performed in any day or any section of roadway is between 2000 and 5000 square yards {2000 and 5000 m^2}, this section shall be classified as a unit; if less than 2000 square yards {2000 m^2}, this section shall be added to the previous unit and the revised unit rechecked.

The average spread rate shall not vary from the designated rate by more than 10 percent in any unit checked. This tolerance is for providing leeway in equipment adjustment only. A consistent and uncorrected variation from the designated rate, even within the 10 percent tolerance, will not be allowed. This tolerance does not apply to patching, leveling, and widening.

If the average rate of any unit is found deficient by more than 10 percent of the specified average rate, the Engineer will determine (1) whether the Contractor shall remove and replace the deficient unit without payment for the removal or the material removed, or (2) whether the Contractor may leave the deficient unit in place and cover it with a layer of the same mix of adjusted maximum size aggregate of not less than 80 pounds per square yard {45 kg/m^2} average. In case (2), the surface layer shall not be feather-edged at the end of the overlay layer, but a sufficient amount of the surface beyond the ends of the deficient unit shall be removed, to a neat line across the pavement, to allow placing the full 80 pounds per square yard {45 kg/m^2} and make a joint that will meet the surface requirements. There will be no payment for any portion of the overlay needed to bring the total up to the designated average rate for that unit.

Unless otherwise provided in the following sections of these specifications, or shown on the plans, the average rate placed and compacted in one layer shall not exceed 350 pounds per square yard {200 kg/m^2} for base or binder layers, and 200 pounds per square yard {110 kg/m^2} for surface layers. Where the amount to be placed exceeds these limits, it shall be placed and compacted in two or more approximately equal layers or as shown on the plans.

2. SPREADING.

a. General.

Spreading of the hot mix asphalt mixture shall be performed by equipment meeting the requirements of Item 410.03(a)4, except as noted in this Item. Approved specialized equipment may be employed to spread the hot mix asphalt material where standard full scale equipment is impractical due to size and irregularity of the area to be paved.

For hot mix asphalt pavement wearing layers, spreading operations shall be so correlated with plant and hauling equipment that the spreading operation, once begun, shall proceed at a speed as uniform and continuous as practical. The continual forward movement of the spreader requires the use of hauling vehicles capable of supplying the spreader with hot mix asphalt material while the spreader is in motion. Repetitive interruptions or stopping of the spreader shall be cause for the Engineer to stop the work until the Contractor evaluates the cause of the stoppage and has provided a definite action plan for correction of the interruptions. Any interruption will require the thorough check of the area immediately under the spreader and any variances shall be corrected immediately or the material removed and replaced, as directed, without additional compensation.

Material placed in the spreader shall be immediately spread and screeded to such uniform depth that the average rate of the mixture required is secured. Alignment of the outside edges of the pavement shall be controlled by preset control lines, and shall be finished in conformity with these controls.

Any spreading operation, which cannot produce acceptable joints within the surface tolerances and density requirements, shall be cause for requiring the Contractor to modify his operations to include additional spreading equipment.

b. Spreading by Motor Grader.

For areas of a hot mix asphalt plant mix surface inaccessible to the mechanical spreader, patching of pot holes and correcting failures in existing pavement, the plant mix may be dumped in low areas in the amounts directed, windrowed, spread, and compacted to bring the elevation and section to the desired level.

If shown on the plans, the Contractor shall use a motor grader or a motor grader equipped with a dragbox to perform the spreading for the leveling operation. The motor grader shall be equipped with smooth faced tires. The dragbox, when required, shall be of sufficient size and weight {mass} to effectively shape and level the plant mix and shall be approved by the Engineer prior to use.

c. Spreading by Hand.

For areas inaccessible to mechanical spreading equipment, and when patching potholes and minor pavement failures, hand spreading of the hot mix asphalt mixture may be permitted. The mixture shall be distributed immediately into place by means of suitable tools and spread in a uniformly loose layer.

(g) COMPACTING.

As soon as the mixture has been spread and has set sufficiently to prevent undue cracking or shoving, rolling shall begin. A delay in the initial rolling will not be tolerated and the initial or breakdown rolling should in general be performed by rolling longitudinally, beginning at the sides and proceeding toward the center of the surface.

When paving abuts a previously placed lane, the longitudinal joint shall be rolled in the first pass. On superelevated curves rolling shall begin at the low side and progress toward the high side.

If any displacement occurs during rolling, it shall be corrected at once. To prevent adhesion of surface mixture to the rollers, the wheels shall be kept adequately moistened with water and a non-foaming detergent, but an excess of water will not be permitted.

Adequate precaution shall be taken to prevent dropping of gasoline or oil on the pavement. In places inaccessible to a roller, compaction shall be obtained with hand or mechanical tampers that produce adequate pressure to obtain required density.

Throughout the process of compacting, tests for surface smoothness as required by Article 410.05 and density as required by Section 306 shall be made continuously.

(h) JOINTS.

1. GENERAL.

Placing of hot mix asphalt paving layers shall be as continuous as possible. All joints shall be made in a careful manner in such a way as to provide a smooth, well-bonded, and sealed joint meeting the density and surface requirements of Articles 410.04 and 410.05. Failure to meet

requirements noted above shall be cause for ordering the removing and reconstruction of the joint without extra compensation.

The contact surface of concrete structures shall be treated with a thin coat of liquid asphalt binder material, tack material, or the liquid asphalt binder material used in the mix, prior to construction of the joint. When directed by the Engineer, the same treatment noted above shall be used on cold asphalt joints.

2. LONGITUDINAL.

Longitudinal joints in the wearing surface shall conform with the edges of proposed traffic lanes, insofar as practical. Any necessary longitudinal joints in underlying layers shall be offset so as to be at least 6 inches {150 mm} from the joint in the next overlying layer.

3. TRANSVERSE.

Transverse joints shall be carefully constructed. Rollers shall not pass over the unprotected edge of the freshly laid mixture unless laying operations are to be discontinued. To facilitate the expeditious removal of the plant mix joint when laying operations are resumed, the Contractor shall place a heavy wrapping paper on the underlying surface across the joint and place plant mix on top of the paper.

Upon resumption of the work, a neat joint shall be formed by sawing back vertically into the previously laid material to expose the full depth of the layer. The fresh mixture shall be raked and tamped to provide a well-bonded and sealed joint meeting surface and density requirements.

410.04 Density Requirements.

Density requirements shall be as specified in Table IV, Subarticle 410.08(c).

410.05 Surface and Edge Requirements.

(a) SURFACE SMOOTHNESS REQUIREMENTS.

1. GENERAL.

Surface smoothness and roadway section will be checked by the use of string, Engineer's level, and straight edge.

The Contractor shall furnish string, straightedges, and the necessary personnel to handle them under the supervision of the Engineer.

Surface smoothness tests shall be made continuously during and immediately after rolling so that irregularities may be eliminated to the extent possible by rolling while the material is still workable; otherwise, deficiencies shall be corrected as provided in Article 410.06.

2. REQUIREMENTS FOR ALL SURFACES.

The finished surface of all base, binder, and wearing surface layers shall not vary more than 1/4 of an inch {6 mm} from the required section measured at right angles to the pavement centerline. The finished surface shall not vary more than 3/8 of an inch {9 mm} in any 25 foot {8 m} section from a taut string applied parallel to the surface and roadbed centerline at the following locations: 1 foot {300 mm} inside of the edges of pavement, at the centerline, and at other points as designated. The variance from the designated grade shall not increase or decrease more than 1/2 of an inch {12 mm} in 100 feet {30 m}.

The surface shall not vary more than 1/4 of an inch {6 mm} from a 16 foot {4.8 m} straightedge placed parallel to the centerline at points directed. A 16 foot {4.8 m} rolling straightedge, equipped with marking capability, may be used in lieu of the fixed straightedge if approved by the Engineer.

(b) EDGE REQUIREMENTS.

Surface, binder, and leveling pavement edges not confined by curbing or other structures may be lightly tamped, generally with a lute and immediately behind the placement operation, to form an approximately 1:1 slope as a preventative measure against cracking and bulging during the rolling process. This procedure shall also be required on the initial edge of a longitudinal cold joint. These edges shall be neatly shaped to line behind the breakdown roller and shall be trimmed as necessary after final rolling, to an accurately lined string or wire providing a maximum tolerance of 2 inches {50 mm} outside the theoretical edge of pavement, with a maximum variation from a true line of 1/2 of an inch {12 mm} in 10 feet {3 m} and a slope not flatter than 1:1. Edges that are distorted by rolling shall be corrected promptly.

(c) RIDEABILITY REQUIREMENTS.

The rideability requirements covered in this Subarticle shall apply only when either Item 410-A, 410-B, or 410-C is included on the plans or in the proposal.

1. TESTING DEVICE.

a. Description.

The testing device shall be a longitudinal profilograph including all accessories and chart paper herein described. The chart paper containing the log of the smoothness index shall become the property of the Department at the time the measurements are taken. The following categories cover the furnishing and disposition of the profilograph:

Pay Item 410-A - The furnishing, by the Contractor, of a new profilograph, including chart paper, and its reconditioning, if deemed necessary by the Engineer, and title transfer to the Department upon completion of its use on the project.

Pay Item 410-B - The furnishing, by the Department, of a profilograph for use on the project. The Contractor shall furnish the chart paper.

Pay Item 410-C - The furnishing, by the Contractor, of a new or acceptable used profilograph, including chart paper, for use on the project with the Contractor retaining ownership of the profilograph.

b. Equipment Requirements.

The profilograph shall be a California type profilograph, completely equipped with all necessary accessories. The profilograph shall be hand-propelled and shall have multiple averaging wheels.

When the profilograph is required to be furnished by the Contractor, the Contractor shall calibrate the profilograph prior to delivery to the project and shall maintain the profilograph during the time its use is required on the project. When the profilograph is furnished by the State, the Department will calibrate and maintain the profilograph.

Chart paper for the profilograph shall be furnished in sufficient quantities for all calibration, test runs, and actual tests deemed necessary by the Engineer.

c. Equipment Delivery.

The profilograph shall be delivered to the project a minimum of two weeks before the beginning of the paving operation of the pavement layer to be tested to allow time for checking the profilograph.

2. TESTING PROCEDURE.

a. Description.

Unless shown otherwise by the plans, the following surfaces will be subject to the requirements of this Subarticle if one of the pay items listed in Subitem 410.05(c)1.a. is included in the proposal:

- Actual wearing surfaces including Polymer Modified Open Graded Friction Course (Section 420);
- The surface of the layer directly beneath the Polymer Modified Open Graded Friction Course.

The actual testing procedure shall be as outlined in ALDOT-335, a copy of which may be obtained from the office of the Materials and Tests Engineer. The Engineer reserves the right to make minor modifications to this procedure if he deems such will produce better results.

The profilograph test shall be performed as soon as practical after the pavement has been rolled and compacted sufficiently to prevent damage to the surface but no later than the next work day after placement of the pavement, unless otherwise authorized by the Engineer. The Contractor shall furnish the necessary personnel to operate the profilograph under the direction of the Engineer.

The profilograph test is considered a part of the paving operation and will be performed immediately in the proper sequence, in a satisfactory manner, even to the exclusion of other work.

b. Rideability Requirements.

The results of the profilograph tests shall be evaluated by Department personnel as outlined in ALDOT-335.

If a Profile Index of 10 inches per mile {160 mm/km} is exceeded in any test section of any daily paving operation, the paving operation will be suspended as soon as possible after results

of the unacceptable test section are obtained. The paving will not be allowed to resume until corrective action is taken by the Contractor.

When the Profile Index is 4 inches per mile {64 mm/km}, or more, per section, a unit price reduction will be assessed. When the Profile Index is below 2 inches per mile {32 mm/km} per section, a unit price increase will be added. The following schedule lists the Profile Index obtained with the corresponding price adjustment:

TABLE I	
Profile Index Inches/Mile/Section {Millimeters/Kilometer/Section}	Contract Price Adjustment Percent of Pavement Unit Bid Price
Under 2.0 {Under 32}	105 – (Profile Index/0.4) {105 – (Profile Index/6.4)}
2.0 to less than 4.0 {32 to less than 64}	100
4.0 thru 10.0 {64 thru 160}	100 - (Profile Index – 4.0)/0.3 {100 - (Profile Index – 64)/4.8}
Over 10.0 {Over 160}	Unacceptable

Any price adjustment for rideability considerations will be applied to the theoretical tonnage {metric tonnage}, calculated using the plan specified rate of placement, placed in those sections testing under 2, or 4 or more, inches/mile {32, or 64 or more, mm/km} per section.

c. On test sections where the Profile Index is less than 4 inches per mile {64 mm/km}, the longitudinal stringline and straightedge requirements of Item 410.05(a)2 may be waived by the Engineer except at transverse construction joints and tie-ins. Within 50 feet {15 m} of all transverse construction joints and tie-ins, and on all test sections where the Profile Index is 4 inches per mile or greater {64 mm/km or greater}, all requirements of Item 410.05(a)2 will apply.

410.06 Defective or Deficient Areas.

Deficiencies in surface smoothness shall be remedied to the extent practicable by rolling while the material is still workable. Otherwise the layer shall be removed and replaced as necessary to obtain required smoothness. "Skin patching" of a surface layer to correct low areas or heating and scraping to correct high areas will not be permitted. Overlays of not less than 80 pounds per square yard {45 kg/m^2} may be authorized by the Engineer for surface smoothness deficiencies provided all material in the overlay is without additional cost to the Department.

Deficiencies in thickness shall be remedied as specified in Item 410.03(f)1.

All areas containing excessive or deficient amounts of liquid asphalt binder, all areas showing unacceptable segregation of materials, and all areas unbonded after rolling shall be removed and replaced at no cost to the Department. Unacceptable segregation of a hot mix asphalt mat is defined as any area in which two six inch {150 mm} cores are taken and the average percent liquid asphalt binder content of the cores have an absolute difference greater than 0.50 percentage points of the design liquid asphalt binder content, or the combined gradation analysis of the two cores on selected sieves has an absolute difference greater than 10 percentage points from the job-mix formula. All testing shall be in accordance with ALDOT-389, "Evaluation of Segregated Areas in Hot Mix Asphalt Pavement." The location of all cores taken for segregation evaluation will be determined by the Department. All coring and traffic control required by ALDOT-389 shall be conducted/supplied by the Contractor at no cost to the Department; however, the Contractor will be reimbursed $500.00 per core when core results are within tolerances and the coring operations require additional traffic control.

At any time that segregation is determined to be unacceptable, work shall be automatically suspended if positive corrective action is not taken by the Contractor to prevent further segregation in the mat. Upon suspension, the Contractor shall place a test section not to exceed 500 tons {500 metric tons} of the affected mixture for evaluation by the Engineer. However, if after a few loads it is apparent that the corrective actions were not adequate, work shall again be suspended and the segregated areas evaluated in accordance with ALDOT-389. Likewise, if after 500 tons {500 metric tons} it is apparent that the problem has been solved, work will be allowed to continue.

When correcting subsurface mixtures (base and binder layers), the removal and replacement may be limited to the actual segregated areas or the full mat width within the limits of individual segregated areas as directed by the Engineer. Removal and replacement of hot mix asphalt wearing

surface layers shall be a minimum of the full mat width and 10 feet {3 m} in length. All surface tolerance requirements shall apply to the corrected areas for both subsurface and surface mixes.

Areas found deficient in density shall be removed and replaced or immediately re-rolled until density is acceptable.

All work specified in this Article shall be performed without additional compensation.

410.07 Maintenance and Protection.

Sections of newly finished work shall be protected from all traffic until they become properly hardened. Maintenance shall include immediate repairs of any defects that may occur on the work; such repairs shall be repeated as often as necessary to maintain the work in a continuously satisfactory condition. The Contractor shall be responsible for the protection of the work and protection of any traffic using the work. No extra compensation will be paid for maintenance and protection.

410.08 Method of Measurement.

(a) GENERAL.

The accepted quantity of hot mix asphalt plant mix used as directed will be measured in tons of 2000 pounds {metric tons} in accordance with the following:

When the laboratory compacted density as determined in the job-mix formula design exceeds 158 pounds per cubic foot {2530 kg/m^3}, the actual total tonnage {metric tonnage} of mix placed will be adjusted for pay purposes in accordance with the following formula:

$y = 158\ c / a$ { $y = 2530\ c / a$}, where

y = total tonnage {metric tonnage} of plant mix for pay purposes;

c = actual tonnage {metric tonnage} of plant mix measured and placed, except items subject to pay factor adjustment under the QC/QA provisions. On items subject to pay factor adjustment, the adjusted tonnage {metric tonnage} (after pay factor adjustment) will be used;

a = laboratory compacted mix unit weight in pounds per cubic foot {density in kilograms per cubic meter} as shown in the job-mix formula.

No adjustments to the actual total tonnage {metric tonnage} placed will be made where the laboratory compacted mix density is below 158 pounds per cubic foot {2530 kg/m^3}.

No adjustments to the actual tonnage {metric tonnage} placed will be made when the use of lightweight aggregate (expanded clay or shale) is designated.

For determining weight {mass}, each load of hot mix asphalt mixture shall have its weight {mass} determined on approved certified scales, as specified in Article 109.01, furnished by the Contractor without direct compensation.

The weight {mass} measurement shall include all components of the mixture. No deductions will be made for any of the components, including the liquid asphalt binder material, contained in the mixture.

(b) ACCEPTANCE OF THE MIXTURE.

The hot mix asphalt mixture will be evaluated at the plant, with respect to voids in lab compacted samples and liquid asphalt binder content, on a LOT to LOT basis. The material will be tested for acceptance in accordance with the provisions of Section 106 and the following requirements. However, any load or loads of mixture, which, in the opinion of the Engineer, are obviously unacceptable, will be rejected for use in the work.

The Contractor shall control all operations in the handling, preparation, and mixing of the hot mix asphalt plant mix so that the percent liquid asphalt binder and voids in laboratory compacted samples will meet the approved job-mix formula within the tolerances shown in Tables II and III for the 1.00 pay factor. In recognition of the fact that the drying and screening operations may generate additional dust over that shown in the approved mix design, the Contractor's attention is drawn to the realization that the dust must be controlled in order to control VMA and voids in the total mix.

Acceptance of the mixture will be in accordance with Subarticle 106.09(c).

LOT pay factors for asphalt content and air voids will be determined from Table II for Section 423 and 429 mixes and from Table III for a Section 424 mix after the requirements of Item 106.09(c)3 are satisfied. LOT pay factors for asphalt content will be determined from the top half of Table II for Section 327-E and 420 mixes after the requirements of Item 106.09(c)3 are satisfied. Air voids are not a pay factor for Section 327-E and 420 mixes.

Calculations for the acceptance test results for asphalt content and voids in total mix shall be carried to the thousandths (0.001) and rounded to the nearest hundredth (0.01). Calculations for averages shall be carried to the thousandths (0.001) and rounded to the nearest hundredth (0.01) in

accordance with AASHTO R 11 rules of rounding. LOT pay factors will be calculated to the nearest hundredth (0.01).

Payment for Section 423 and 429 mixes will be on the basis of Table II Acceptance Schedule for Payment. Payment for a Section 424 mix will be on the basis of Table III Acceptance Schedule for Payment. The production process will be considered out of control when any individual test result (asphalt content or air voids) from a LOT has a pay factor equal to 0.80 computed from the "1 Test" column in Table II or Table III, whichever is appropriate. When this happens, the LOT will automatically be terminated. The Contractor may terminate a LOT at any time he deems his operation out of control (any pay factor less than 1.00). The Contractor shall notify the Project Engineer immediately should he decide to terminate a LOT. If mix from the terminated LOT is contained in storage/surge bins, that mix will be considered part of the terminated LOT, if it is placed on the project. Testing for mat density will continue as scheduled until mix produced prior to plant shutdown has been placed. The pay factor for the terminated LOT will be computed in accordance with Subarticle 106.09(c) utilizing all accumulated LOT data for asphalt content, air voids, and mat density as required by Table I.

When a LOT is terminated as described above, a new LOT shall not be started until after all of the following has been accomplished: (1) the Contractor shall determine what adjustments to make in order to bring the process under control; (2) after adjustments, the Contractor shall produce sufficient mix (approximately 25 to 35 tons {25 to 35 metric tons}) as a trial batch and test for control parameters (asphalt content and air voids); (3) adjustments, trial batches, and tests shall be repeated as many times as necessary until pay factors for both asphalt content and air voids equal 1.00, minimum, at which time a new LOT may be started. Mix utilized as a trial batch shall not be used on the project.

TABLE II						
SECTION 327E MIXES (PERMEABLE ASPHALT TREATED BASE)** SECTION 420 MIXES (OPEN GRADED FRICTION COURSE)** SECTION 423 MIXES (STONE MATRIX ASPHALT) SECTION 429 MIXES (IMPROVED BITUMINOUS)						
ACCEPTANCE SCHEDULE OF PAYMENT FOR ASPHALT PLANT MIX CHARACTERISTICS						
Arithmetic Average of the Absolute Values of Deviations of the LOT Acceptance Tests From Job Mix Formula Values						
Asphalt Content						
Lot Pay Factor ->	1.02	1.00	0.98	0.95	0.90	0.80*
1 Test	0.00-0.28	0.29-0.48	0.49-0.51	0.52-0.57	0.58-0.66	Over 0.66
2 Tests	0.00-0.20	0.21-0.34	0.35-0.36	0.37-0.40	0.41-0.47	Over 0.47
3 Tests	0.00-0.16	0.17-0.28	0.29-0.29	0.30-0.33	0.34-0.38	Over 0.38
4 Tests	0.00-0.14	0.15-0.24	0.25-0.26	0.27-0.28	0.29-0.33	Over 0.33
5 Tests	0.00-0.13	0.14-0.21	0.22-0.23	0.24-0.25	0.26-0.30	Over 0.30
6 Tests	0.00-0.11	0.12-0.20	0.21-0.21	0.22-0.23	0.24-0.27	Over 0.27
7 Tests	0.00-0.11	0.12-0.18	0.19-0.19	0.20-0.22	0.23-0.25	Over 0.25
8 Tests	0.00-0.10	0.11-0.18	0.19-0.19	0.20-0.20	0.21-0.23	Over 0.23
9 Tests	0.00-0.09	0.10-0.16	0.17-0.17	0.18-0.19	0.20-0.22	Over 0.22
Voids in Total Mix (Lab. Compacted Samples)						
Lot Pay Factor ->	1.02	1.00	0.98	0.95	0.90	0.80*
1 Test	0.00-0.90	0.91-1.50	1.51-1.62	1.63-1.80	1.81-2.10	Over 2.10
2 Tests	0.00-0.64	0.65-1.06	1.07-1.15	1.16-1.27	1.28-1.48	Over 1.48
3 Tests	0.00-0.52	0.53-0.87	0.88-0.94	0.95-1.04	1.05-1.21	Over 1.21
4 Tests	0.00-0.45	0.46-0.75	0.76-0.81	0.82-0.90	0.91-1.05	Over 1.05
5 Tests	0.00-0.40	0.41-0.67	0.68-0.72	0.73-0.80	0.81-0.94	Over 0.94
6 Tests	0.00-0.37	0.38-0.61	0.62-0.66	0.67-0.73	0.74-0.86	Over 0.86
7 Tests	0.00-0.34	0.35-0.57	0.58-0.61	0.62-0.68	0.69-0.79	Over 0.79
8 Tests	0.00-0.32	0.33-0.53	0.54-0.57	0.58-0.64	0.65-0.74	Over 0.74
9 Tests	0.00-0.30	0.31-0.50	0.51-0.54	0.55-0.60	0.61-0.70	Over 0.70

* If approved by the Department, the Contractor may accept the indicated LOT partial pay. The Department may require removal and replacement. If the LOT pay factor is greater than 0.80, the Contractor has the option to remove at no cost to the Department and to replace at contract unit bid price rather than accepting the reduced LOT payment.

** The Acceptance Schedule of Payment for "Voids in Total Mix" will not apply to the 327E and 420 mixes

TABLE III						
SECTION 424 MIXES (SUPERPAVE)						
ACCEPTANCE SCHEDULE OF PAYMENT FOR ASPHALT PLANT MIX CHARACTERISTICS						
Arithmetic Average of the Absolute Values of Deviations of the LOT Acceptance Tests From Job Mix Formula Values						
Asphalt Content						
Lot Pay Factor ->	1.02	1.00	0.98	0.95	0.90	0.80*
1 Test	0.00-0.38	0.39-0.62	0.63-0.68	0.69-0.75	0.76-0.88	Over 0.88
2 Tests	0.00-0.27	0.28-0.44	0.45-0.48	0.49-0.53	0.54-0.62	Over 0.62
3 Tests	0.00-0.22	0.23-0.36	0.37-0.39	0.40-0.43	0.44-0.51	Over 0.51
4 Tests	0.00-0.19	0.20-0.31	0.32-0.34	0.35-0.38	0.39-0.44	Over 0.44
5 Tests	0.00-0.17	0.18-0.27	0.28-0.30	0.31-0.34	0.35-0.39	Over 0.39
6 Tests	0.00-0.15	0.16-0.25	0.26-0.28	0.29-0.31	0.32-0.36	Over 0.36
7 Tests	0.00-0.14	0.15-0.23	0.24-0.26	0.27-0.28	0.29-0.33	Over 0.33
8 Tests	0.00-0.13	0.14-0.22	0.23-0.24	0.25-0.26	0.27-0.31	Over 0.31
9 Tests	0.00-0.13	0.14-0.21	0.22-0.23	0.24-0.25	0.26-0.29	Over 0.29
Voids in Total Mix (Lab. Compacted Samples)						
Lot Pay Factor ->	1.02	1.00	0.98	0.95	0.90	0.80*
1 Test	0.00-1.50	1.51-2.50	2.51-2.70	2.71-3.00	3.01-3.50	Over 3.50
2 Tests	0.00-1.06	1.07-1.77	1.78-1.91	1.92-2.12	2.13-2.47	Over 2.47
3 Tests	0.00-0.87	0.88-1.44	1.45-1.56	1.57-1.73	1.74-2.02	Over 2.02
4 Tests	0.00-0.75	0.76-1.25	1.26-1.35	1.36-1.50	1.51-1.75	Over 1.75
5 Tests	0.00-0.67	0.68-1.12	1.13-1.21	1.22-1.34	1.35-1.57	Over 1.57
6 Tests	0.00-0.61	0.62-1.02	1.03-1.10	1.11-1.22	1.23-1.43	Over 1.43
7 Tests	0.00-0.57	0.58-0.94	0.95-1.02	1.03-1.13	1.14-1.32	Over 1.32
8 Tests	0.00-0.53	0.54-0.88	0.89-0.95	0.96-1.06	1.07-1.24	Over 1.24
9 Tests	0.00-0.50	0.51-0.83	0.84-0.90	0.91-1.00	1.01-1.17	Over 1.17
* If approved by the Department, the Contractor may accept the indicated LOT partial pay. The Department may require removal and replacement. If the LOT pay factor is greater than 0.80, the Contractor has the option to remove at no cost to the Department and to replace at contract unit bid price rather than accepting the reduced LOT payment.						

(c) ACCEPTANCE OF THE ROADWAY DENSITY.

For other than mainline paving (patching, widening, crossovers, and non-uniform thickness leveling), in-place density pay factors will not be applied. For mainline paving (including shoulders, ramps, acceleration/deceleration lanes, and uniform thickness leveling), in-place density pay factors will be applied as specified herein unless otherwise noted on the plans or in the specifications.

After the hot mix asphalt mixture has been placed and compacted, it shall be evaluated for density. A nuclear gage mat density determination shall be run by the Contractor on each 1000 foot {300 m} segment of roadway asphalt mixture placed. The location of each test will be designated by the Department. The Department will make a nuclear density determination on alternate 1000 foot {300 m} segments at the same location as the Contractor's test. Testing locations will be selected with the random number method outlined in ALDOT-210. For purposes of evaluation, a LOT will be as defined in Item 106.09(c)1. A SUBLOT for evaluation of density will be equal to 4000 feet {1200 m} (4 test results) or fraction of a 4000 foot {1200 m} length as applicable. For instance a 9000 foot {2700 m} LOT would be divided into two 4000 foot {1200 m} SUBLOTS and one 1000 foot {300 m} SUBLOT.

The in-place density will be expressed as a percentage of the theoretical maximum mix density with the following relationship:

$$\% \text{ TMD} = \frac{\text{In-Place Density}}{\text{Maximum Mix Density}} \times 100$$

Maximum mix density is equated to maximum mix specific gravity as measured with AASHTO T 209, Flask determination with dry back. The maximum mix specific gravity used will be the average of the values from the four most recent determinations using Contractor data.

For a 1000 foot {300 m} segment where both the Department and the Contractor test for mat density, the Department's and the Contractor's test results from tests run in the same area will be compared to each other. If there are no differences or if the differences are within the tolerances listed in Table V for mat density, no further testing will be necessary and the Contractor's test value for that 1000 foot {300 m} segment will be used in the computation of the appropriate SUBLOT pay factor.

When differences between the Department's and the Contractor's mat density test results are not within the tolerances listed in Table V, the Department and the Contractor will repeat their individual tests on the mat in the same area where the original tests were run. If the test values determined by the Department and the Contractor when compared this time are within the tolerances listed in Table V, the Contractor's new test value will be used instead of the questioned value for that 1000 foot {300 m} segment in the computation of the appropriate SUBLOT pay factor. If these test values, when compared, are still not within the tolerances listed in Table V, then a core shall be taken in the same area and the test value to be used for the 1000 foot {300 m} segment will be determined from the core density tested in accordance with AASHTO T 166. Should this situation occur, both nuclear testing devices shall be checked for proper calibration and operation in accordance with the appropriate ALDOT.

In addition, for each five 1000 foot {300 m} segments the Contractor shall obtain one core in the same location where the nuclear gage tests are performed by both the Department and the Contractor. These cores shall be turned over to the Department for testing. The testing will be performed in accordance with either AASHTO T-166 or ALDOT-403, at the Department’s option. The density indicated by both nuclear gages must be within 1.5 % of the bulk density determined by the core in accordance with AASHTO T 166. Should either or both of the gages not be within the 1.5 % tolerance, the offending gage(s) will be re-calibrated and checked for proper operation.

The appropriate pay factor for each SUBLOT shall be determined from Table IV for the appropriate number of test results. The pay factor for the LOT shall be determined by computing the weighted average of the SUBLOTS:

$$\text{LOT Pay Factor (PF)} = \frac{\text{PF SUBLOT 1 (Length SUBLOT 1) + PF SUBLOT 2 (Length SUBLOT 2) + …}}{\text{Length SUBLOT 1 + Length SUBLOT 2 + …}}$$

Calculations for the acceptance test results for in-place density shall be carried to the hundredths (0.01) and rounded to the nearest tenth (0.1). LOT and SUBLOT pay factor calculations shall be carried to the thousandths (0.001) and rounded to the nearest hundredth (0.01) in accordance with AASHTO R 11 rules of rounding.

In-place density pay factors will be applied only to layers of uniform thickness where the application rate is greater than 100 pounds per square yard {54 kg/m^3}. If a failing density test occurs on any layer determined to be less than 7/8 of an inch {23 mm} thick, the test will not be used in the pay factor determination for pay adjustment.

On projects that are financed and administered by a county, the quality assurance mat density tests may be run from cores rather than with a nuclear testing device at the option of the Department. Should the Department decide to substitute core tests for nuclear tests, the Contractor shall cut the cores in the presence of the Engineer and furnish the cores to the Engineer for testing. The cores shall be taken on alternate SUBLOTS in the same area where the Contractor's nuclear tests are run. Pay factors for mat density shall be determined as described herein.

TABLE IV ACCEPTANCE SCHEDULE OF PAYMENT FOR IN-PLACE DENSITY					
SECTION 423 MIXES (STONE MATRIX ASPHALT) AND SECTION 429 MIXES (IMPROVED BITUMINOUS)					
Characteristic	SUBLOT PAY FACTOR	Arithmetic Average of the Absolute Values of Deviations of SUBLOT Acceptance Tests From Target**			
		1 Test	2 Tests	3 Tests	4 Tests
In-Place Density	1.02	0.0-2.0	0.0-1.4	0.0-1.2	0.0-1.0
	1.00	2.1-3.4	1.5-2.4	1.3-2.0	1.1-1.7
	0.98	3.5-3.6	2.5-2.5	2.1-2.1	1.8-1.8
	0.95	3.7-4.0	2.6-2.8	2.2-2.3	1.9-2.0
	0.90	4.1-4.7	2.9-3.3	2.4-2.7	2.1-2.4
	0.80*	Over 4.7	over 3.3	over 2.7	over 2.4
SECTION 424 MIXES (SUPERPAVE)					
Characteristic	SUBLOT PAY FACTOR	Arithmetic Average of the Absolute Values of Deviations of SUBLOT Acceptance Tests From Target**			
		1 Test	2 Tests	3 Tests	4 Tests
In-Place Density	1.02	0.0-2.25	0.0-1.59	0.0-1.30	0.0-1.12
	1.00	2.26-3.75	1.60-2.65	1.31-2.17	1.13-1.88
	0.98	3.76-4.05	2.66-2.86	2.18-2.34	1.89-2.02
	0.95	4.06-4.50	2.87-3.18	2.35-2.60	2.03-2.25
	0.90	4.51-5.25	3.19-3.71	2.61-3.03	2.26-2.62
	0.80*	Over 5.25	over 3.71	over 3.03	Over 2.62

* If approved by the Department, the Contractor may accept the indicated partial SUBLOT pay. The Department may require removal and replacement. The Contractor has the option to remove at no cost to the Department and replace at contract unit bid price rather than accepting the reduced SUBLOT payment.

** Target density shall be 94.0 % of the theoretical maximum density.

TABLE V COMPARISON OF ALDOT AND CONTRACTOR TESTING	
TEST	ACCEPTABLE
ASPHALT CONTENT	± 0.30 %
AIR VOIDS	± 0.50 %
MAT DENSITY	
GAGE vs. GAGE	± 2.2 %
GAGE vs. CORES	± 1.5 %

(d) TACK COAT.

Tack coat liquid asphalt material used as directed will be measured and paid for as specified in Section 405.

(e) WASTED AND EXCESS MATERIALS APPLIED.

Deductions in measurement will be made for all material wasted or lost due to negligence of the Contractor or applied beyond the limits of the work.

(f) PROFILOGRAPH.

The number of profilographs measured for payment will be the actual number of units ordered and accepted.

(g) MATERIAL REMIXING DEVICE.

The number of material remixing devices measured for payment will be the number of units approved by the Engineer for use. These devices will be measured per each device.

410.09 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Compensation for plant mix material, measured as provided above, will be made on a tonnage {metric tonnage} basis and the contract unit price per ton {metric ton} for each individual item shall be full compensation for construction of the hot mix asphalt plant mix layer complete in place on the roadbed as indicated or directed, including all materials, procurement, handling, hauling, and processing cost, and includes all equipment, tools, labor, and incidentals required to complete the work.

Unless otherwise covered by a separate pay item, the cost of excavation for patching and widening, compacting the subgrade, backfilling, spreading, or disposing of excess excavated material, removal and disposal of old pavement, removal and resetting of roadway signs and mailboxes, and removal of pavement markers shall be subsidiary obligations of the associated plant mix pay item, and no additional payment will be made for performing the work.

No payment will be made for unacceptable material; for material needed to overlay layers deficient in thickness; for material used in replacing defective or condemned construction; for material wasted in handling, hauling, or otherwise; or for maintaining the work.

The ordered and accepted profilographs, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for furnishing the unit and includes all equipment, tools, labor, calibration, maintenance, services, supplies, chart paper, and incidentals necessary to complete these items of work.

The number of approved remixing devices, measured as noted above, will be paid for at the contract unit bid price. This price shall be full compensation for furnishing the vehicles and shall include all equipment, tools, labor, calibration, maintenance, services, operator, and all other items necessary to furnish and operate the vehicles.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

See Appropriate Section for Type of Plant Mix Involved.
410-A Profilograph, _____*_____ - per Each
410-B State Furnished Profilograph - per Each
410-C Contractor Retained Profilograph - per Each
410-H Material Remixing Device - per Each
* Specify type, "truss" or "beam", if applicable.

SECTION 420
POLYMER MODIFIED OPEN GRADED FRICTION COURSE

420.01 Description.

The work covered by this Section shall consist of constructing a hot mixed, hot laid polymer modified open graded friction course wearing layer generally placed on an existing pavement. The typical cross section and the average weight per square yard will be shown on the plans. Requirements for all hot mix asphalt pavements as specified in Section 410 are applicable to this Section, subject to any exceptions contained herein. Quality Control/Quality Assurance (QC/QA) requirements as specified in Section 106 are applicable to this Section, subject to any exceptions contained herein.

420.02 Materials.

The materials furnished for use shall comply with the requirements of Section 410 and the following:

(a) AGGREGATES.

The aggregate shall be limited to 100% crushed, virgin aggregates of the following: granite, blast furnace slag, sandstone or manufactured lightweight aggregate, all of which shall be from approved sources and meet the appropriate requirements of Sections 801 and 802. However, if additional dust (- 200 {- 75 μm} material) is needed, mineral filler (meeting the requirements of Section 805) or agricultural limestone may be used. If agricultural limestone is used, it shall meet the requirements of ASTM C 602, Standard Specification for Agricultural Liming Materials, for Class E agricultural limestone, so that a minimum of 80 percent of the material will pass the No. 8 {2.35 mm} sieve and 25 percent will pass the No. 60 {0.250 mm} sieve. In addition, a minimum of 5 percent will pass the No. 200 {75 μm} sieve. No more than 10 percent agricultural limestone shall be used.

The aggregate shall be combined into a total blend that will produce an acceptable job mix within the gradation limits shown below in Table 1. No recycled asphalt pavement shall be allowed in the mix.

The plans and proposal will designate the mix to be used.

GENERAL COMPOSITION		
SIEVE (Square Mesh Type)	PERCENT PASSING BY WEIGHT	
	Mix 1	Mix 2
3/4 inch {19.0 mm}		100
1/2 inch {12.5 mm}	100	85 - 100
3/8 inch {9.5 mm}	90 – 100	55 – 65
No. 4 {4.75 mm}	30 – 50	10 - 25
No. 8 {2.36 mm}	5 – 17	5 - 10
No. 200 {75 μm}	3 - 6	2 - 4

(b) LIQUID ASPHALT BINDER.

The liquid binder shall be a polymer modified PG 76-22 meeting the requirements of Section 804. The proportion of liquid asphalt binder to total sample by weight {mass} shall be 5.6 percent to 9.0 percent for Mix 1 and 4.7 percent to 9.0 percent for Mix 2. The exact proportion shall be fixed by the job mix formula.

(c) POLYMER.

The polymer additive shall meet the requirements of Section 811.

(d) FIBER.

A fiber stabilizer meeting the requirements of Subarticle 410.02(d) shall be incorporated into the mix. The fiber shall be introduced and blended into the mix according to the requirements of Subarticle 410.02(d).

(e) TENSILE STRENGTH RATIO (TSR) REQUIREMENTS.

During design and production, the Section 420 mixes shall have a TSR of at least 0.80 when tested in accordance with Section 7 of ALDOT-259. The testing frequency for both Contractor and Department testing during production shall be one test for each 5000 tons {4500 metric tons} or portion thereof.

420.03 Design

The Open Graded Friction Course shall be designed with a minimum air void content of 12% according to ALDOT-259, OPEN GRADED ASPHALT CONCRETE FRICTION COURSE DESIGN METHOD. The contractor shall have the responsibility for the design of Section 420 mixes.

The work will be accepted on a LOT by LOT basis in accordance with the applicable requirements. Pay factors for air voids and density shall not apply.

420.04 Construction Requirements.

(a) GENERAL.

The requirements of Articles 410.03 through 410.07 shall apply except as modified hereinafter in this Article.

(b) COMPACTION EQUIPMENT.

Item 410.03(a)5 is amended to require that steel wheel tandem (7 ton {6 metric ton} minimum size) rollers shall be furnished in sufficient numbers based on the quantity of material being placed to provide effective compaction coverage within the workable time period of the mix as designated by the Engineer.

(c) WEATHER AND TEMPERATURE LIMITATIONS.

The weather, air, and surface temperature limitations for (polymerized) HMA mixes are found in Subarticle 410.03(b).

(d) COMPACTING.

Subarticle 410.03(g) is amended to require that rolling shall be as approved by the Engineer; no density tests will be required.

420.05 Method of Measurement.

The accepted quantities of polymer modified open graded friction course will be measured as provided in Article 410.08.

420.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Polymer Modified Open Graded Friction Course, measured as noted above, will be paid for at the contract unit price bid in accordance with Article 410.09.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

420-A Polymer Modified Open Graded Friction Course, Mix * - per ton {metric ton}

* Specify "1" or "2".

SECTION 423
STONE MATRIX ASPHALT (SMA)
(FIBER STABILIZED ASPHALT CONCRETE)

423.01 Description.

The work covered by this Section shall consist of constructing a hot mix asphalt layer of fiber stabilized stone matrix asphalt pavement on a prepared surface in accordance with these specifications and in conformity with the lines, grades, typical cross section, and the placement rate shown on the plans or as directed. The plant, equipment, and construction requirements for this pavement are specified in Sections 106 and 410, subject to any exceptions herein. All 423 mixes shall be designed and produced in accordance with the requirements given in this Section and ALDOT-395, SMA Mix Design.

423.02 Materials.

(a) AGGREGATES.

1. GENERAL.

All fine and coarse aggregate furnished shall come from an approved producer who is participating in and meeting the requirements of ALDOT-249, *Procedure for Acceptance of Coarse and Fine Aggregates*. The producer's name shall be listed in the Department's *Materials, Sources, and Devices with Special Acceptance Requirements Manual*, List I-1. The Department has established a list of qualified producers of fine and coarse aggregates. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

2. COARSE AGGREGATE.

Coarse aggregate shall be aggregate retained on the No. 4 {4.75 mm} sieve. The virgin coarse aggregate shall be 100% crushed granite, limestone, sandstone, slag, or other 100% crushed manufactured stone meeting the requirements of Section 801 and Table 1.

Table 1	**Coarse Aggregate Quality Requirements**		
Test Method		Minimum	Maximum
Flat & Elongated % by Count 3:1 (max to min)	ASTM D 4791 Section 8.4	0	20
Flat & Elongated % by Count 5:1 (max to min)	ASTM D 4791 Section 8.4	0	5

Aggregate Soundness.

The percent degradation of the source aggregate by the sodium sulfate soundness test (AASHTO T 104, *Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate)* after five cycles of testing shall not exceed 10 %.

Deleterious Materials and Absorption.

The amount of deleterious substances, flat or elongated particles, and absorption in the coarse aggregate shall not exceed the following limits:

(a) Coal and Lignite (Visual)	0.25 %
(b) Clay Lumps and Friable Particles (AASHTO T 112)	0.25 %
(c) Other local deleterious substances (Shale, Mica, Marcasite, etc.) (Visual)	2.0 %
(d) Absorption (Absorption on the material passing the 3/4 inch {19.0 mm} sieve and retained on the No. 4 {4.75 mm} sieve) (AASHTO T 85 *). Applies to gravel aggregates only.	2.0 %
* Section 8.1 of AASHTO T 85 modified to require a 15 minute vacuum saturation period as per Section 6.3 of AASHTO T 209 prior to the required 15-19 hour soaking period.	

Los Angeles Abrasion Criteria.

The percent loss of the coarse aggregate by the LA Abrasion test (AASHTO T 96, *Resistance to Abrasion of Small Size Aggregate by use of the Los Angeles Machine)* shall not exceed 48 % except that, for Sandstone and Blast Furnace Slag, the LA Abrasion shall not exceed 55 %.

3. FINE AGGREGATE.

Fine aggregate shall be aggregate passing the No. 4 {4.75 mm} sieve. Gravel used to manufacture fine aggregate shall have a bulk specific gravity greater than 2.550 (AASHTO T 85). The virgin fine aggregate shall be 100% crushed granite, limestone, sandstone, slag, or other 100% crushed manufactured stone meeting the requirements of Section 802 and Table 2; the parent material shall meet the requirements of Section 801.

Table 2 Fine Aggregate Quality Requirements		
Test Method	Minimum	Maximum
Uncompacted Voids % AASHTO T 304*	45	100
Sand Equivalent % AASHTO T 176*	50	100
Liquid Limit % AASHTO T 89	0	25
Plasticity Index AASHTO T 90	Non-plastic	
*The Sand Equivalent and Uncompacted Voids may be run on the blend of the aggregates.		

The fine aggregate shall be non-plastic when tested in accordance with AASHTO T 89, as modified by ALDOT-232, and AASHTO T 90 and shall have a maximum of 1.0 percent clay lumps and friable particles as determined by AASHTO T 112. It shall consist of hard, tough grain, free of injurious amounts of clay, loam, or other deleterious substances.

4. MINERAL FILLER.

The mineral filler shall meet the requirements of Section 805.

(b) RECYCLED ASPHALT PAVEMENT (RAP).

When RAP is used as a component of SMA, the coarse and fine aggregates contained in the RAP shall meet the respective requirements as outlined in Items 423.02 (a) 2 and 3. The total amount of RAP allowed in SMA is limited to 15% by weight {mass} of aggregate. RAP containing gravel or fine aggregate manufactured from gravel with a bulk specific gravity less than 2.550 is not allowed in SMA. Otherwise, the use of RAP shall conform to the specifications of Subarticle 410.02.

(c) BLEND OF AGGREGATES.

The combined aggregates shall conform to the percent passing by volume requirements of Table 3.

Table 3 Stone Matrix Asphalt Percent Passing by Volume

Sieve Size	1.5 inch {37.5 mm} Maximum Aggregate Size		1 inch {25.0 mm} Maximum Aggregate Size		3/4 inch {19.0 mm} Maximum Aggregate Size		1/2 inch {12.5 mm} Maximum Aggregate Size	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
1.5 inch {37.5 mm}	100	100						
1 inch {25.0 mm}	90	100	100	100				
3/4 inch {19.0 mm}	30	86	90	100	100	100		
1/2 inch {12.5 mm}	26	63	50	74	90	100	100	100
3/8 inch {9.5 mm}	24	52	25	60	26	78	90	100
# 4 {4.75 mm}	20	28	20	28	20	28	26	60
# 8 {2.36 mm}	16	24	16	24	16	24	20	28
# 16 {1.18 mm}	13	21	13	21	13	21	13	21
# 30 {600 µm}	12	18	12	18	12	18	12	18
# 50 {300 µm}	12	15	12	15	12	15	12	15
# 200 {75 µm}	8	10	8	10	8	10	8	10

An example of how to blend aggregate based upon volume can be found in ALDOT-395, SMA Mix Design. The production tolerances for the above gradation bands are as specified in Item 410.02(b)2, except that the tolerance for the No. 4 {4.75 mm} sieve is +/- 4% and for the 3/8 inch {9.5 mm} sieve is +/- 6%.

Aggregates that tend to polish under traffic, such as limestone, dolomite, or marble, shall be permitted only in widening as defined by Article 410.01, shoulder paving, underlying layers, and layers that are to be covered by Polymer Modified Open Graded Friction Course (Section 420) mix in this contract, except as noted in Table 4.

Table 4. Allowable Carbonate Stone Criteria

BPN 9 Value Of Aggregate Source *	Maximum Allowable Percentage Of Carbonate Stone
≤ 25	30
26 through 28	35
29 through 31	40
32 through 34	45
≥ 35	50

* This value, BPN 9, is made using the British Pendulum Tester on aggregate source specimen polished for 9 hours on an accelerated polishing machine known as the British Wheel as per ASTM D 3319, ASTM E 303 and BMTP-382.

In no case shall the total amount of virgin carbonate stone in the combined mixture used as actual wearing surface layers exceed the percentage shown in Table 4. When parts of the carbonate stone used in the mix are from differing strata of material or coming from multiple sources that are represented by different BPN 9 values, the lowest BPN 9 value will be used.

(d) FIBER.

A fiber stabilizer meeting the requirements of Subarticle 410.02 shall be incorporated into the mix. The fiber shall be introduced and blended into the mix according to the requirements of Subarticle 410.02.

(e) LIQUID ASPHALT BINDER.

Unless otherwise shown on the plans, the liquid asphalt binder shall meet the requirements of Section 804 and shall be polymer-modified to meet a PG 76-22 as specified in Section 811. Up to 15% reclaimed asphalt pavement (RAP) may be used in the mix. The minimum liquid asphalt binder content shall be as specified in Table 6.

Table 6. Minimum Liquid Asphalt Binder Content

Maximum Aggregate Size (inches) {mm}	Minimum Liquid Asphalt Binder Content (% by weight) {% by mass}
1.5 {37.5}	5.3
1.0 {25.0}	5.5
3/4 {19.0}	5.7
1/2 {12.5}	5.9

423.03 Design.

All SMA mixes shall be designed according to ALDOT-395, SMA Mix Design. SMA mixes shall be designed using a 50 blow Marshall design. At the design number of blows, the SMA shall have a minimum VMA of 17, a VCA_{MIX} less than the VCA_{DRC} (calculating Voids in the Coarse Aggregate is explained in ALDOT-395 SMA Mix Design) and air voids of 4.0 percent. The SMA mix shall be designed with a minimum tensile strength ratio of 0.80 according to ALDOT-361. The dust from the mix combined with the liquid asphalt binder and fiber is the mortar. The mortar shall have a minimum unaged DSR $G^*/\sin\delta$ of 5 kPa, a minimum RTFO aged DSR $G^*/\sin\delta$ of 11 kPa, and a maximum PAV aged BBR Stiffness of 1500 MPa (Mortar Evaluation is explained in ALDOT-395, SMA Mix Design). The mix shall exhibit 4.50 mm or less rutting when tested according to ALDOT-401, Rutting Susceptibility Determination of Asphalt Paving Mixtures Using the Asphalt Pavement Analyzer.

423.04 Hot Mix Asphalt Plant Requirements.

(a) MINERAL FILLER.

The introduction of the mineral filler shall be in accordance with Section 4.3 of AASHTO M 156 as specified in ALDOT-324 to insure accurate metering and proportioning. Adequate dry storage shall be provided for the mineral filler. In a batch plant, mineral filler shall be added directly into the weigh hopper. In a drum plant, mineral filler shall be added directly into the drum mixer near enough to the liquid asphalt binder line so that the mineral filler is captured by the liquid asphalt binder. Note: for most SMA projects, the flow rate of the mineral filler governs the plant production rate.

(b) HOT-MIXTURE STORAGE.

SMA shall not be stored at elevated temperatures for more than three hours. SMA shall not be heated above 350 °F {177 °C} without the approval of the Engineer.

423.05 Construction Requirements.

(a) GENERAL.

Construction requirements shall be the same as specified in Articles 410.03 through 410.07 except as noted in this Article.

(b) WEATHER AND TEMPERATURE LIMITATIONS.

The weather, air and surface temperature limitations for (polymerized) HMA mixes are found in Subarticle 410.03(b).

(c) SURFACE PREPARATION.

A thin tack coat meeting the requirements of Section 405 shall be applied to ensure uniform and complete adherence of the overlay.

(d) COMPACTION.

The mixture, when delivered to the paver, shall have a temperature of not less than 290 °F {145 °C}.

Due to the nature of stone matrix asphalt mixture, the surface shall be rolled immediately. Rolling shall be accomplished with steel wheel rollers. Pneumatic tire rollers shall not be used on stone

matrix asphalt. Rollers shall move at a uniform speed, not to exceed 3 miles per hour {5 km/hr}, with the drive roller nearest the paver. Rolling shall be continued until all roller marks are eliminated and the required density has been obtained, but not after the mat has cooled to 240 °F {115 °C}. The Contractor shall monitor density during the compaction process by use of nuclear density gauges to ensure that the required density is being obtained. If vibratory compaction causes aggregate breakdown or forces liquid asphalt binder to the surface, the vibratory mode shall be turned off and the roller shall operate in static mode only.

To prevent adhesion of the mixture to the rollers, it shall be necessary to keep the wheels properly moistened with water mixed with very small quantities of detergent or other approved material.

423.06 Method of Measurement.

The accepted quantities of stone matrix asphalt binder layer and stone matrix asphalt wearing layer will be measured as provided in Article 410.08. The SMA mix shall be evaluated for liquid asphalt binder content, laboratory compacted air voids, and in-place density; pay factors will be applied.

423.07 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Stone Matrix Asphalt Binder Layer and Stone Matrix Asphalt Wearing Layer, measured as noted above, will be paid for at the contract unit price bid in accordance with Article 410.09.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

423-A Stone Matrix Asphalt Wearing Layer, __*__ Maximum Aggregate Size
- per ton {metric ton}

423-B Stone Matrix Asphalt Binder Layer, __*__ Maximum Aggregate Size
- per ton {metric ton}

* Specify Maximum Aggregate Size, either 1.5, 1, 3/4, or 1/2 inches {37.5 mm, 25 mm, 19 mm, or 12.5 mm}

SECTION 424
SUPERPAVE BITUMINOUS CONCRETE BASE, BINDER, AND WEARING SURFACE LAYERS

424.01 Description.

The work covered by this Section shall consist of a hot bituminous plant mixed pavement layer placed on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades, typical cross section, and the approximate placement rate shown on the plans or as directed. General requirements for all bituminous concrete pavements as specified in Section 410 are applicable to this Section, subject to any exceptions contained herein. Quality Control/Quality Assurance (QC/QA) requirements as specified in Section 106 are applicable to this section, subject to any exceptions contained herein.

The work will be accepted on a LOT by LOT basis in accordance with the applicable requirements.

424.02 Materials.

The materials furnished for use shall conform to the requirements of Section 410 and the following:

(a) AGGREGATES.

1. GENERAL.

All fine and coarse aggregate furnished shall come from an approved producer who is participating in and meeting the requirements of ALDOT-249, *Procedure for Acceptance of Coarse and Fine Aggregates*. The producer's name shall be listed in the Department's *Materials, Sources, and Devices with Special Acceptance Requirements Manual*, List I-1. The Department has established a list of qualified producers of fine and coarse aggregates. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

2. COARSE AGGREGATE.

Coarse aggregate shall be aggregate retained on the No. 4 {4.75 mm} sieve.

Coarse aggregate shall consist of crushed (or uncrushed) gravel with a bulk specific gravity greater than 2.550 (AASHTO T 85), crushed stone, or crushed slag, or a combination thereof having hard, strong, durable pieces, free from adherent coatings, and meeting all requirements of these specifications.

Aggregate Soundness.

The percent degradation of the source aggregate by the sodium sulfate soundness test (AASHTO T 104, *Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate)* after five cycles of testing shall not exceed 10 %.

Deleterious Materials, Flat or Elongated Particles, and Absorption.

The amount of deleterious substances, flat or elongated particles, and absorption in the coarse aggregate shall not exceed the following limits:

(a) Coal and Lignite (Visual)	0.25 %
(b) Clay Lumps and Friable Particles (AASHTO T 112)	0.25 %
(c) Flat or Elongated particles (5:1 Ratio) (ASTM D 4791 by Count)**	10.0 %
(d) Other local deleterious substances (Shale, Mica, Marcasite, etc.) (Visual)	2.0 %
(e) Absorption (Absorption on the material passing the 3/4 inch {19.0 mm} sieve and retained on the No. 4 {4.75 mm sieve}) (AASHTO T 85 *). Applies to gravel aggregates only.	2.0 %
* Section 8.1 of AASHTO T 85 modified to require a 15 minute vacuum saturation period as per Section 6.3 of AASHTO T 209 prior to the required 15-19 hour soaking period.	
** Measured by counting the number of particles where the maximum dimension is at least five times greater than the minimum dimension and comparing this count to the total number of particles; ESAL Range A is exempt from this requirement.	

Los Angeles Abrasion Criteria.

The percent loss of the coarse aggregate by the LA Abrasion test (AASHTO T 96, *Resistance to Abrasion of Small Size Aggregate by use of the Los Angeles Machine)* shall not exceed 48 % except that, for Sandstone and Blast Furnace Slag, the LA Abrasion shall not exceed 55 %.

3. FINE AGGREGATE.

Fine aggregate shall be aggregate passing the No. 4 {4.75 mm} sieve. Gravel used to manufacture fine aggregate shall have a bulk specific gravity greater than 2.550 (AASHTO T 85).

The fine aggregate shall be non-plastic when tested in accordance with AASHTO T 89, as modified by ALDOT-232, and AASHTO T 90 and shall have a maximum of 1.0 percent clay lumps and friable particles as determined by AASHTO T 112. It shall consist of hard, tough grain, free of injurious amounts of clay, loam, or other deleterious substances.

Clay Content.

The amount of clay material, as indicated by the sand equivalent, measured on the aggregate passing the No. 4 {4.75 mm} sieve as determined by AASHTO T 176, *Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test*, shall be no less than the values defined by Table 1 according to the total design traffic in equivalent single axle loads (ESALs).

Table 1.	Clay Content Criteria	
ESAL Range	Traffic (ESALs)	Sand Equivalent
A/B	ESALs $< 1.0 \times 10^6$	$\geq$ 40.0
C/D	$1.0 \times 10^6 \leq$ ESALs $< 1.0 \times 10^7$	$\geq$ 45.0
E	$1.0 \times 10^7 \leq$ ESALs $< 3.0 \times 10^7$	$\geq$ 45.0

4. MINERAL FILLER.

Mineral filler shall consist of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, or fly ash meeting the requirements of Section 805.

The introduction of mineral filler shall be in accordance with AASHTO M 156, Section 3.3, as specified in ALDOT-324, with the additional requirement that accurate proportioning shall be accomplished by means of pneumatic or mechanical metering.

(b) RECYCLED ASPHALT PAVEMENT (RAP).

When RAP is used as a component of a wearing layer or an upper binder layer, the coarse and fine aggregates contained in the RAP shall meet the respective requirements as outlined in Items 424.02(a)1., 2., & 3., except for the Clay Content requirement in Item 424.02(a)3 which will not be measured.

If the RAP contains any gravel with a bulk specific gravity of less than 2.550 or fine aggregate manufactured from this gravel, it may not be used in any wearing layer (even if this layer is to be covered by an OGFC) and is limited to 15% of any other layer. If the RAP does not contain any chert gravel, it is limited to 20%.

Percentages of RAP shall be based on total weight {mass} of the aggregate blend.

(c) BLEND OF AGGREGATES.

The coarse and fine aggregates shall be combined in a total blend that will produce an acceptable job mix within the gradation limits determined by the maximum and minimum control points and a restricted zone as defined by Tables 2A-2D. Restricted zones are a function of the maximum particle sizes in the blended gradations. Maximum particle size is defined as the sieve size that is two sizes larger than the first sieve to retain more than 10 percent of the material. The sequence of sieve sizes to be used in determining maximum particle size is that contained in Tables 2A-2D. Gradation charts illustrating gradation requirements are given in Article 424.03.

The plans and proposal will designate the mix to be used. Unless otherwise shown on the plans or in the proposal, lower binder and base layer mixtures may be designed on either the fine or coarse side, or through of the restricted zone. All upper binder and wearing layers shall be designed either through the restricted zone or on the fine side of the restricted zone. However, if the mix passes through the restricted zone, the job mix shall be designed to produce a minimum VMA meeting the requirements of a coarse graded mix as shown on Table 7. Also, all ESAL range "E" mixes shall exhibit 4.50 mm or less rutting when tested according to ALDOT-401, Rutting Susceptibility Determination of Asphalt Paving Mixtures Using the Asphalt Pavement Analyzer.

Production tolerances shall be as shown in Subarticle 424.04(e).

Table 2A. Aggregate Gradation Control Points and Boundaries of Restricted Zone (1.5" {37.5 mm} Maximum Size Mix)

	Control Point (Percent Passing)	
Sieve Size	Minimum	Maximum
No. 200 {75 µm}	1	7
No. 8 {2.36 mm}	19	45
3/4" {19 mm}	-	90
1" {25 mm}	90	100
1.5" {37.5 mm} Maximum	100	-
Restricted Zone		
No. 4 {4.75 mm}	39.5	39.5
No. 8 {2.36 mm}	26.8	30.8
No. 16 {1.18 mm}	18.1	24.1
No. 30 {600 mm}	13.6	17.6
No. 50 {300 mm}	11.4	11.4

Table 2B. Aggregate Gradation Control Points and Boundaries of Restricted Zone (1" {25.0 mm} Maximum Size Mix)

	Control Point (Percent Passing)	
Sieve Size	Minimum	Maximum
No. 200 {75 µm}	2	8
No. 8 {2.36 mm}	23	49
1/2" {12.5 mm}	-	90
3/4" {19 mm}	90	100
1" {25 mm} Maximum	100	-
Restricted Zone		
No. 4 {4.75 mm}	-	-
No. 8 {2.36 mm}	34.6	34.6
No. 16 {1.18 mm}	22.3	28.3
No. 30 {600 mm}	16.7	20.7
No. 50 {300 mm}	13.7	13.7

Table 2C. Aggregate Gradation Control Points and Boundaries of Restricted Zone (3/4 " {19.0 mm} Maximum Size Mix)		
	Control Point (Percent Passing)	
Sieve Size	Minimum	Maximum
No. 200 {75 µm}	2	10
No. 8 {2.36 mm}	28	58
3/8" {1.18 mm}	-	90
1/2" {12.5 mm}	90	100
3/4" {19.0 mm} Maximum	100	-
Restricted Zone		
No. 4 {4.75 mm}	-	-
No. 8 {2.36 mm}	39.1	39.1
No. 16 {1.18 mm}	25.6	31.6
No. 30 {600 mm}	19.1	23.1
No. 50 {300 mm}	15.5	15.5

Table 2D. Aggregate Gradation Control Points and Boundaries of Restricted Zone (1/2" {12.5 mm} Maximum Size Mix)		
	Control Point (Percent Passing)	
Sieve Size	Minimum	Maximum
No. 200 {75 µm}	2	10
No. 8 {2.36 mm}	32	67
No. 4 {4.75 mm}	-	90
3/8" {9.5 mm}	90	100
1/2" {12.5 mm} Maximum	100	-
Restricted Zone		
No. 4 {4.75 mm}	-	-
No. 8 {2.36 mm}	47.2	47.2
No. 16 {1.18 mm}	31.6	37.6
No. 30 {600 mm}	23.5	27.5
No. 50 {300 mm}	18.7	18.7

Coarse Aggregate Angularity.

The coarse aggregate angularity shall be measured on the total blended aggregate retained on the No. 4 {4.75 mm} sieve in accordance with ASTM D 5821.

A fractured face is defined as an angular, rough, or broken surface of an aggregate particle created by crushing, by other artificial means, or by nature. A face is considered fractured only if it has a projected area at least as large as one-quarter of the maximum projected area (maximum cross-sectional area) of the particle and also has sharp and well-defined edges.

The percent by weight {mass} of the coarse particles of the blended aggregate retained on the No. 4 {4.75 mm} sieve with one fractured face and with two or more fractured faces shall be no less than the values in Table 3.

Table 3. Coarse Aggregate Angularity Criteria			
ESAL Range	Traffic (ESALs)	Wearing Surface & Binder Layers	Base Layers
A/B	$\leq$ ESALs < 1.0×10^6	75 / -	50 / -
C/D	$1.0 \times 10^6 \leq$ ESALs < 1.0×10^7	85 / 80	60 / -
E	$1.0 \times 10^7 \leq$ ESALs < 3.0×10^7	95 / 90	80 / 75
Note: "85 / 80" denotes that 85 percent of the coarse aggregate has at least one fractured face and 80 percent has two or more fractured faces.			

Fine Aggregate Angularity.

The percent air voids in loosely compacted fine aggregate, measured according to AASHTO T 304, Method "A", or ASTM C 1252, Method "A", *Uncompacted Void Content of Fine Aggregate*

(as Influenced by Particle Shape, Surface Texture, and Grading) shall be no less than the values in Table 4.

Table 4. Fine Aggregate Angularity Criteria			
ESAL Range	Traffic (ESALs)	Minimum % Air Void	
		Base	Binder & Surface
A/B	ESALs < $1.0x10^6$	40	40
C/D	$1.0x10^6$ ≤ ESALs < $1.0x10^7$	40	45
E	$1.0x10^7$ ≤ ESALs < $3.0x10^7$	40	45

Use of Carbonate Stone.

The restrictions for the use of carbonate stone are given in Table 5. These restrictions do not apply to widening as defined in Article 410. 01, shoulder paving, underlying layers, and layers that are to be covered by Polymer Modified Open Graded Friction Course (Section 420) mix in this contract.

Table 5. Allowable Carbonate Stone Criteria	
BPN 9 Value Of Aggregate Source *	Maximum Allowable Percentage Of Carbonate Stone
≤ 25	30
26 through 28	35
29 through 31	40
32 through 34	45
≥ 35	50
* This value, BPN 9, is made using the British Pendulum Tester on aggregate source specimen polished for 9 hours on an accelerated polishing machine known as the British Wheel as per ASTM D 3319, ASTM E 303 and ALDOT-382.	

In no case shall the total amount of virgin carbonate stone in the combined mixture used as actual wearing surface layers that are exposed to traffic exceed the percentage shown in Table 5. When parts of the carbonate stone used in the mix are from differing stratas of material or coming from multiple sources that are represented by different BPN 9 values, the lowest BPN 9 value will be used.

(d) LIQUID ASPHALT BINDER.

Liquid asphalt binders shall come from an approved producer who is participating in and meeting the requirements of ALDOT-243, *Acceptance Program For Asphalt Materials*. The producer's name shall be listed in the Department's *Materials, Sources, and Devices With Special Acceptance Requirements* Manual, List I-4. The Department has established a list of qualified producers of asphalt materials. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list. Unless shown otherwise on the plans or in the proposal, liquid asphalt binder for use in all mixes shall meet the requirements of AASHTO MP1, *Standard Specification For Performance Graded Asphalt Binder,* as modified by Table 6 and Section 804.

Table 6. Allowable Asphalt Binder Grades			
ESAL Range	Traffic (ESALs)	Base & Lower Binder Layers	Upper Binder & Wearing Surface Layers
A/B	≤ ESALs < $1.0x10^6$	PG 67-22	PG 67-22
C/D	$1.0x10^6$ ≤ ESALs < $1.0x10^7$	PG 67-22	PG 67-22
E	$1.0x10^7$ ≤ ESALs < $3.0x10^7$	PG 67-22	PG 76-22 *
* For mainline paving the asphalt binder shall be polymer modified. For other than mainline paving (patching, leveling, and widening) the asphalt binder will not be required to be polymer modified.			

Asphalt Binders shall meet the requirements of Section 804.

Polymer modifiers shall be blended at an approved refinery and meet the requirements of Section 811.

(e) MIX PROPERTIES.

1. AIR VOIDS (AV).

The design air voids for all levels of traffic is 4.0 %.

2. VOIDS IN MINERAL AGGREGATE (VMA).

The job mix shall be designed to produce a minimum VMA according to Table 7.

Table 7. Voids in Mineral Aggregate Criteria		
Maximum Aggregate Size *	Minimum VMA (%) for Mixes Designed on the Fine Side of the Restricted Zone	Minimum VMA (%) for Mixes Designed on the Coarse Side of the Restricted Zone
1/2" {12.5 mm}	16.0	15.0
3/4" {19.0 mm}	15.0	14.0
1" {25.0 mm}	14.0	13.0
1.5" {37.5 mm}	13.0	12.0
* As defined in Subarticle 424.02(d)		

3. Dust Proportion.

The ratio of the percent by weight {mass} of aggregate passing the 75 µm sieve to the effective asphalt content expressed as percent by weight {mass} of the total mix shall be between 0.6 and 1.2 for mixes designed on the fine side of the restricted zone and between 0.6 and 1.6 for mixes designed on the coarse side of the restricted zone. These ratio limits apply to both the design and production phases. Effective asphalt content is that liquid asphalt binder not absorbed into the aggregate pore structure and is determined according to Section 4.09 of the Asphalt Institute's, MS-2, *Mix Design Methods for Asphalt Concrete*.

4. Asphalt Draindown.

The amount of draindown in an uncompacted asphalt-aggregate sample shall not exceed 0.3 % at the end of one hour in accordance with ALDOT-386, *Asphalt Draindown Test*.

5. RESISTANCE TO MOISTURE-INDUCED DAMAGE.

All mixes shall be designed and produced to have a tensile strength ratio (TSR) of at least 0.80 when compacted according to ALDOT-384 at seven percent air voids and tested in accordance with AASHTO T 283 as modified by ALDOT-361, except the specimen shall be 6.00" {150 mm} in diameter and 3.75" {95 mm} in height.

(f) DESIGN PROCEDURE.

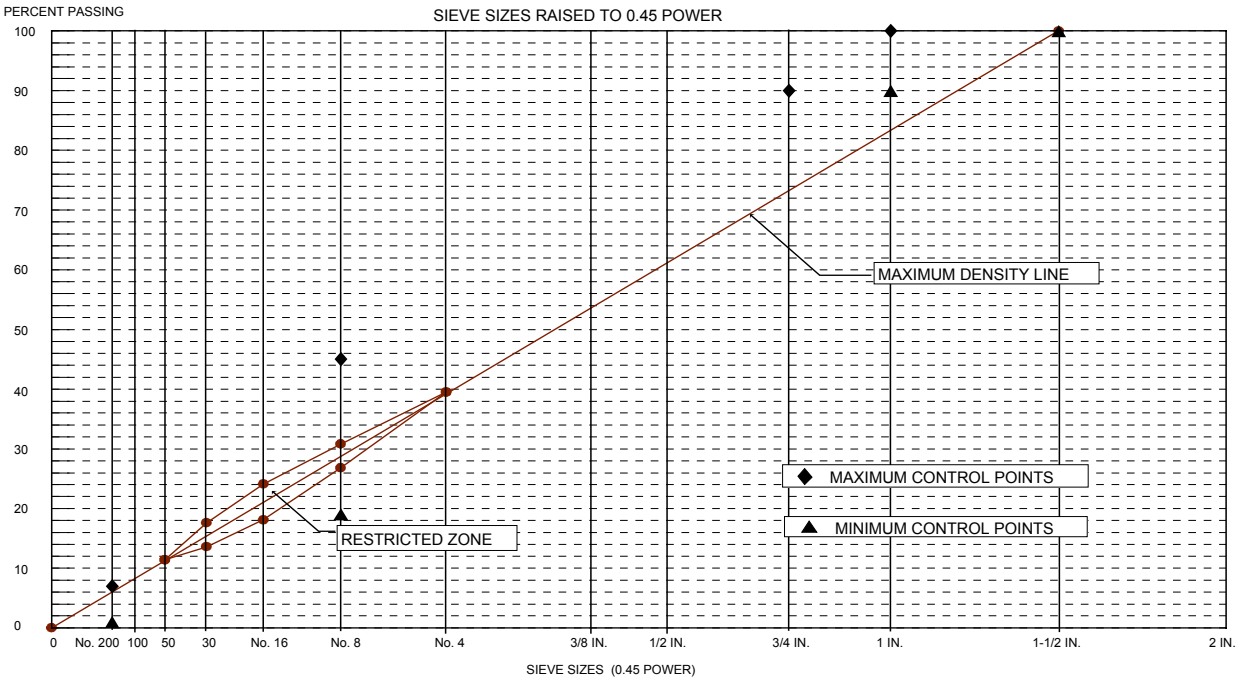
All Superpave mixes with 100 % virgin aggregate shall be designed in accordance with ALDOT-384, *Mix Design Procedure For Superpave Level I*. Superpave mixes containing RAP shall be designed in accordance with ALDOT-388, *Superpave Volumetric Mix Design Procedure Using Recycled Asphalt Pavement*. Any Superpave Gyratory Compactor may have its angle of gyration verified by the Engineer following the procedure given in ALDOT 404, "Evaluating the Superpave Gyratory Compactor's (SGC's) Angle of Gyration using the FHWA SGC Angle Validation Kit". This includes all design, quality control, and quality assurance SGC's. The average Peak-to-Peak 1/2 angle Average Summary should be validated to be 1.25 +/- 0.05 degrees (between 1.20 & 1.30 degrees). This should be done using standard mixes supplied by the State. If the SGC can not meet this specification, adjustments to the SGC's angle of gyration may be required. The aggregate structure and liquid asphalt binder content shall be selected to produce a densification curve which 1) passes through 96.0 % of theoretical maximum specific gravity (4.0 % air voids) at the design number of gyrations (N_d), 2) attains less than 98.0 % of theoretical maximum specific gravity (2.0 % air voids) at the maximum number of gyrations (N_m), and 3) unless otherwise shown, attains less than or equal to 89.0 % of theoretical maximum specific gravity (11.0 % air voids) at the initial number of gyrations (N_i). The number of initial (N_i), design (N_d), and maximum (N_m) gyrations shall be selected according to Table 8.

Table 8. Number of Initial (Ni), Design (Nd) and Maximum (Nm) Gyrations Criteria						
ESAL Range	Traffic (ESALs)	N_i	Base & Lower Binder		Upper Binder & Surface	
			N_d	N_m**	N_d	N_m**
A/B	ESALs < 1.0×10^6	7*	50	75	75	115
C/D	$1.0 \times 10^6 \leq$ ESALs < 1.0×10^7	8	75	115	100	160
E	$1.0 \times 10^7 \leq$ ESALs < 3.0×10^7	8	100	160	100	160
* For ESAL range A/B, the initial gyration density requirement is 90.5% or less. ** The N_m requirement is only for design. QC/QA testing shall be to N_d.						

424.03 Gradation Requirements.

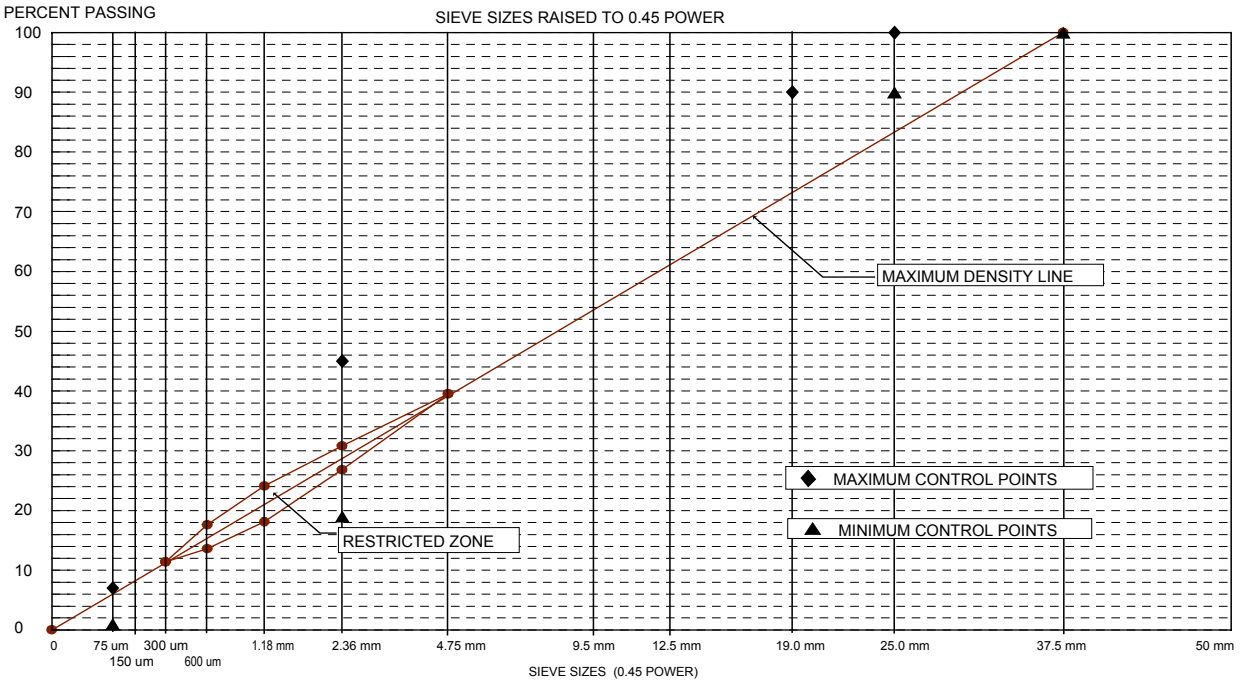
GRADATION CHART

1-1/2 Inch Maximum Size Mix



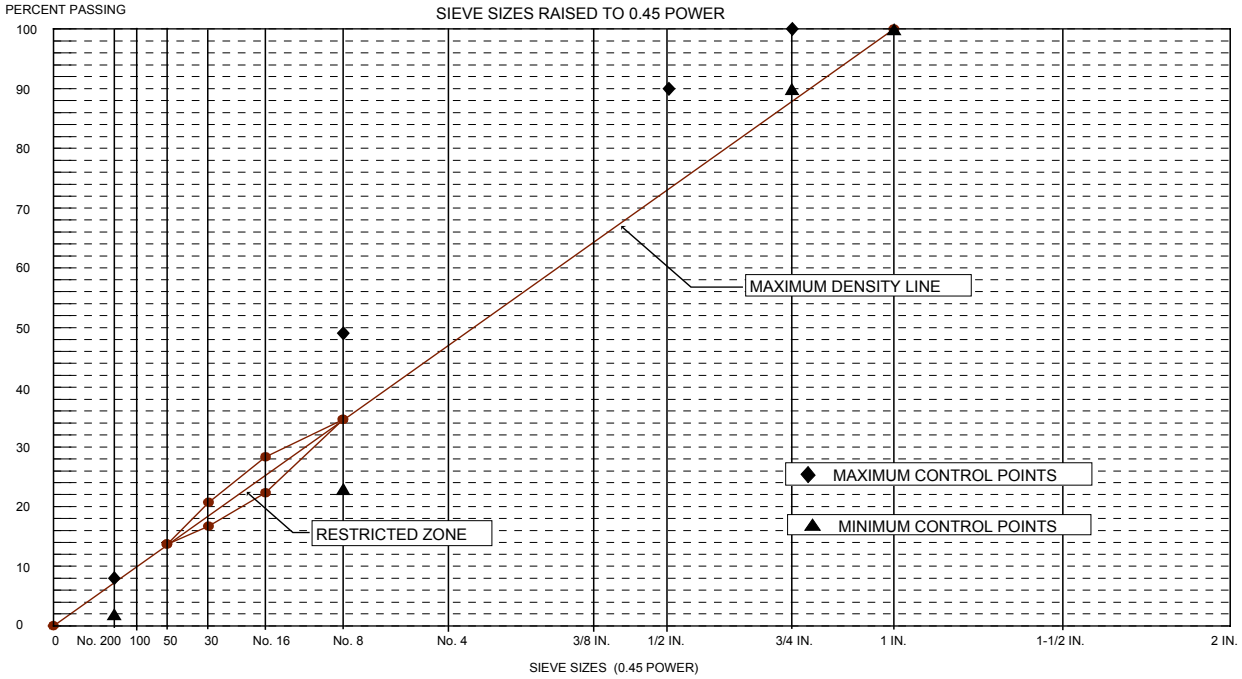
GRADATION CHART

37.5 mm Maximum Size Mix



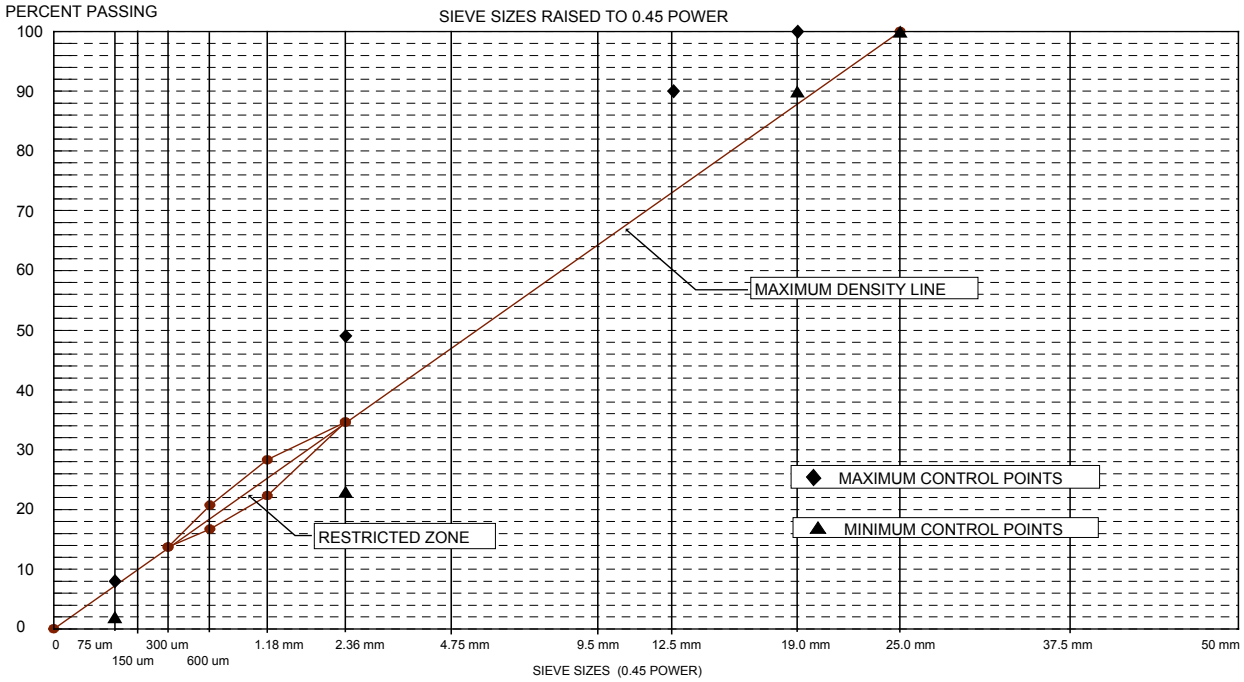
GRADATION CHART

1 Inch Maximum Size Mix



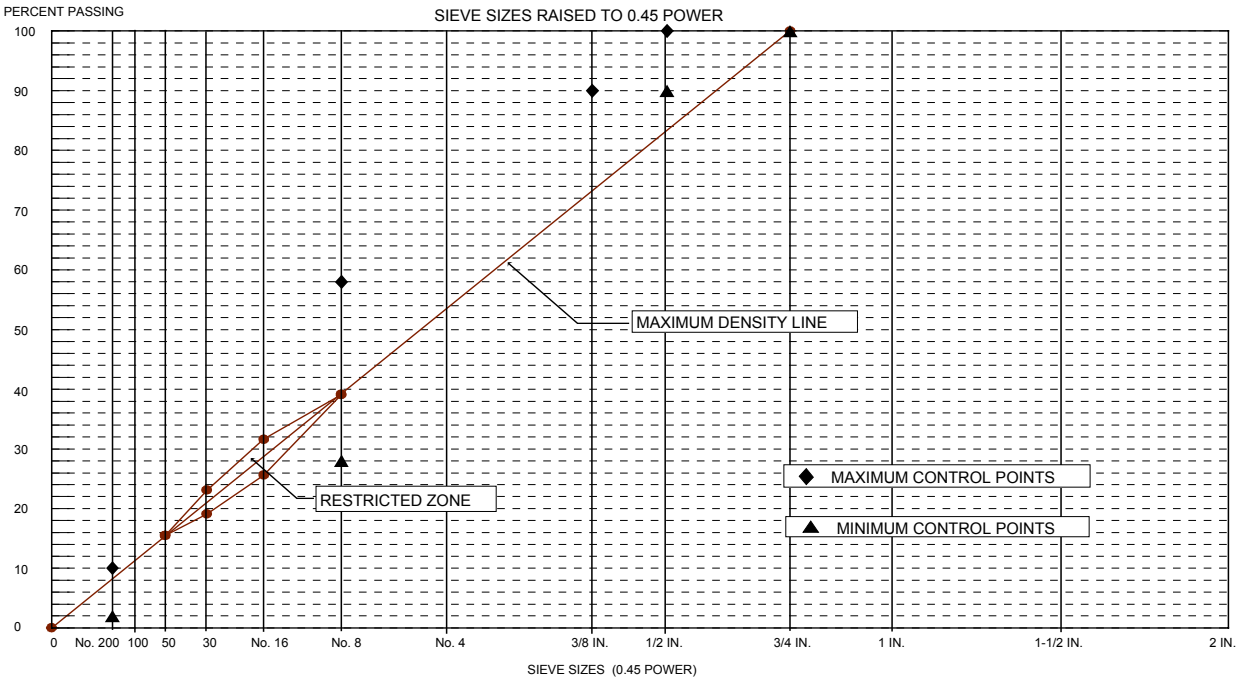
GRADATION CHART

25.0 mm Maximum Size Mix



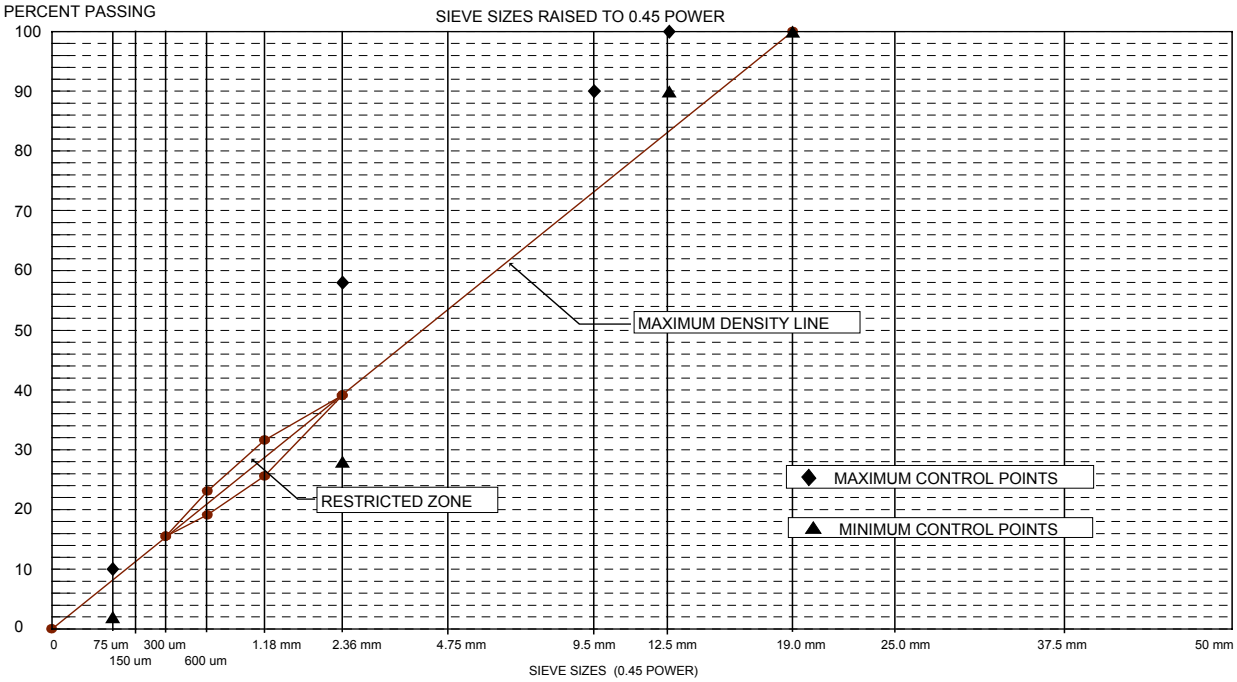
GRADATION CHART

3/4 Inch Maximum Size Mix



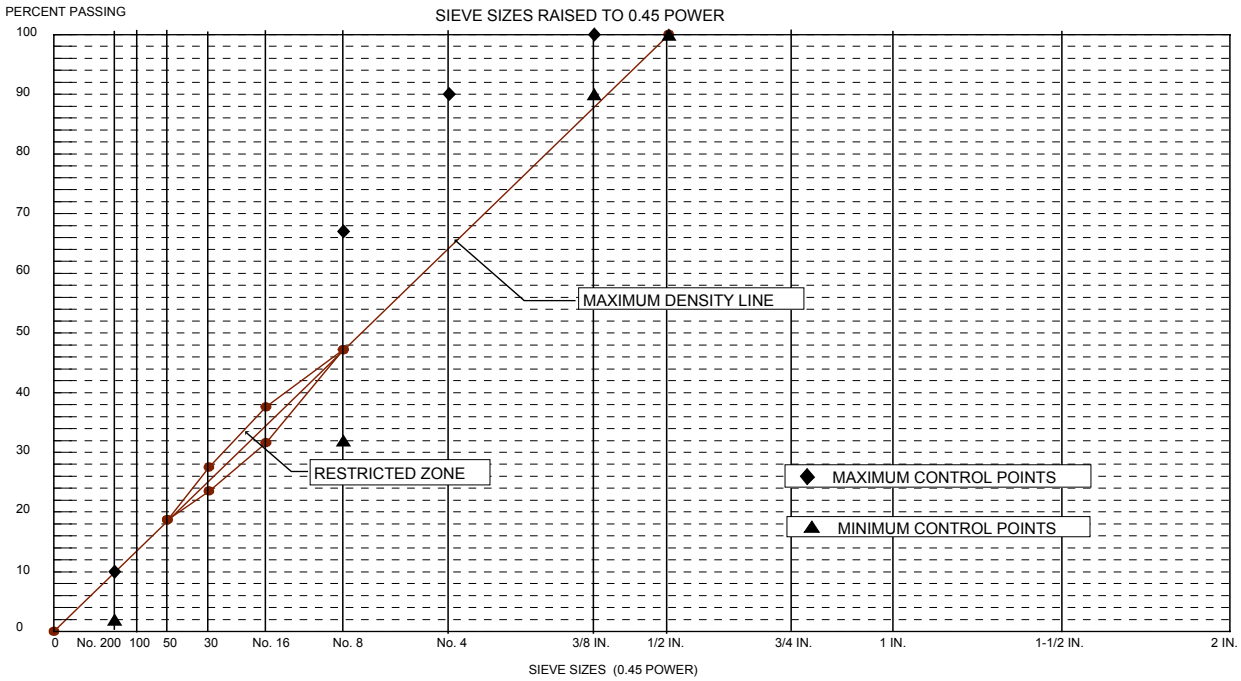
GRADATION CHART

19.0 mm Maximum Size Mix



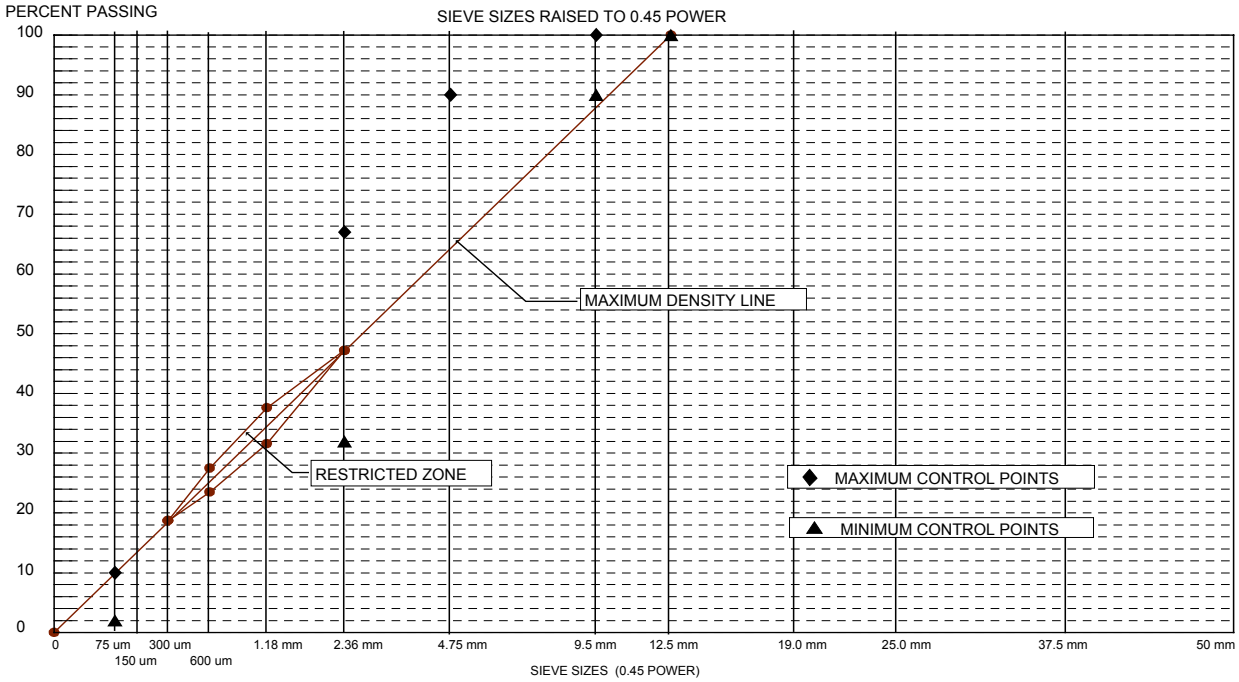
GRADATION CHART

1/2 Inch Maximum Size Mix



GRADATION CHART

12.5 mm Maximum Size Mix



424.04 Construction Requirements.

(a) GENERAL.

Mixing temperature shall not exceed 350 °F {180 °C}.

(b) BINDER LAYER AND WEARING SURFACE LAYER.

Construction requirements shall be as specified in Articles 410.03 through 410.07.

(c) BASE LAYER.

The construction requirements for base layers shall be as specified in Articles 410.03 through 410.07, except as follows:

The edges shall be trimmed immediately after final rolling, using an accurately aligned string or wire, to a tolerance of 2 inches {50 mm} outside the theoretical edge of the layer and to a slope not flatter than 1:1.

Any edge distorted by rolling shall be promptly corrected.

(d) PREPARATION OF MIXTURES - MOISTURE CONTENT.

Each time an asphalt content measurement is made (ALDOT-354 or AASHTO TP53), the amount of moisture in the mixture shall be determined, regardless of aggregate type, as specified in ALDOT-130 and reported on Form BMT-20. The moisture determination shall be used in computing the corrected asphalt content. Moisture samples shall be taken with the asphalt content samples from the loaded truck. Moisture in the mixture shall not exceed 0.2 % by weight {mass}.

(e) PRODUCTION TOLERANCES.

All mixtures furnished for use shall conform to the approved job mix formula (JMF) within the tolerances set in Item 410.02(b)2. Mixture gradations may be produced within the restricted zone provided the gradations are within the tolerances.

424.05 Method of Measurement.

The accepted quantities of Superpave Bituminous Concrete Wearing Surface Layer, Superpave Bituminous Concrete Binder Layer, and Superpave Bituminous Concrete Base Layer will be measured as provided in Article 410.08, subject to any exceptions contained herein.

424.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Superpave Bituminous Concrete Wearing Surface Layer, Superpave Bituminous Concrete Binder Layer, and Superpave Bituminous Concrete Base Layer will be paid for at the contract unit price bid in accordance with Article 410.09, subject to any exceptions contained herein.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

424-A Superpave Bituminous Concrete Wearing Surface Layer, ___**___ ,
___***___ Maximum Aggregate Size Mix, ESAL Range ___****___- per ton {metric ton}

424-B Superpave Bituminous Concrete ___*___ Binder Layer, ___**___ ,
___***___ Maximum Aggregate Size Mix, ESAL Range ___****___- per ton {metric ton}

424-C Superpave Bituminous Concrete Base Layer, ___**___ ,
___***___ Maximum Aggregate Size Mix, ESAL Range ___****___- per ton {metric ton}

* Specify either "Upper" or "Lower".

** Specify "Patching", "Leveling", "Widening", etc. only when required.

*** Specify Maximum Aggregate Size,
1/2", 3/4", 1", or 1.5" {12.5 mm, 19.0 mm, 25.0 mm, or 37.5 mm}

**** Specify "A/B", "C/D", or "E".

SECTION 428
SCORING BITUMINOUS PAVEMENT SURFACE

428.01 Description.

This Section shall cover the work of scoring bituminous plant mix pavement surfaces at locations shown on the plans or directed by the Engineer. The scoring shall consist of creating impressions, or grooves, at regular intervals in the shoulder pavement surface. The creation of the grooves shall be made by roller or cutter as indicated on the Plans.

428.02 Materials.

N/A

428.03 Construction Requirements.

(a) GENERAL.

It is intended that areas of the pavement surface designated by the plans or by the Engineer to be scored shall be so done as to produce a rumble strip effect to alert inattentive drivers.

The size, shape, and spacing of the grooves formed during the rolling or cutting procedure shall be as shown on the plans unless a different configuration is approved by the ALDOT Construction Engineer. Unless ordered otherwise by the Engineer, all grooves shall be perpendicular to the pavement edge.

(b) EQUIPMENT.

(1) ROLLING.

The roller scoring equipment shall consist of a modified self-propelled steel wheel, or combination steel wheel and rubber tire, roller of a sufficient size to satisfactorily perform the work. Only rubber tires having a smooth or slick tread design will be permitted. The roller shall be equipped with a water system to moisten the drums and tires to prevent picking up the bituminous material.

The roller shall be modified by welding or otherwise attaching semicircular pipes or rods, of the size and configuration necessary to form the impressions called for by the plans, to the center of one steel roller drum on each roller. The roller shall be equipped with an acceptable guide, clearly visible to the operator, in order that proper alignment of the completed scored shoulder is obtained.

(2) CUTTING.

The cutting scoring equipment shall consist of a rotary type cutting head with cutting tips arranged in a pattern that will provide a smooth cut. The cutting head shall be on its own independent suspension from that of the power unit to allow the tool to align with the slope of the shoulder and any irregularities in the shoulder surface.

(c) OPERATIONAL REQUIREMENTS.

The equipment shall be operated in a workmanlike manner that will satisfactorily produce a pavement surface having uniform grooves of the dimensions and spacing as shown on the plans or specified in this Article.

Equipment used to construct scored shoulders shall be positioned by using methods which will avoid scoring at locations other than those designated on the plans or directed by the Engineer.

The debris that results from cutting shall be removed on a daily basis by a sweeper/vacuum or other approved methods.

428.04 Method of Measurement.

The scoring of bituminous pavement surface ordered and accepted will be measured in linear feet {meters} of each row of grooves placed. When more than one row of grooves is required on a surface, each row will be measured separately.

428.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The scoring of bituminous pavement surface, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the scoring of the pavement, and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

428-B Scoring Bituminous Pavement Surface By Rolling - per linear foot {meter}
428-C Scoring Bituminous Pavement Surface By Cutting – per linear foot {meter}

SECTION 429
IMPROVED BITUMINOUS CONCRETE BASE, BINDER, AND WEARING SURFACE LAYERS

429.01 Description.

The work covered by this Section shall consist of a hot bituminous plant mixed pavement layer placed on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades, typical cross section, and the approximate placement rate shown on

the plans or as directed. General requirements for all bituminous concrete pavements as specified in Section 410 are applicable to this Section, subject to any exceptions contained herein. Quality Control/Quality Assurance (QC/QA) requirements as specified in Section 106 are applicable to this section, subject to any exceptions contained herein.

The work will be accepted on a LOT by LOT basis in accordance with the applicable requirements.

429.02 Materials.

The materials furnished for use shall conform to the requirements of Section 410 and the following:

(a) AGGREGATES.

1. GENERAL.

All fine and coarse aggregate furnished shall come from an approved producer who is participating in and meeting the requirements of ALDOT-249, Procedure for Acceptance of Coarse and Fine Aggregates. The producer's name shall be listed in the Department's Materials, Sources, and Devices with Special Acceptance Requirements Manual, List I-1. The Department has established a list of qualified producers of fine and coarse aggregates. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

2. COARSE AGGREGATE.

Coarse aggregate shall be aggregate retained on the No. 4 {4.75 mm} sieve.

Coarse aggregate shall consist of crushed (or uncrushed) gravel with a bulk specific gravity greater than 2.550 (AASHTO T 85), crushed stone, or crushed slag, or a combination thereof having hard, strong, durable pieces, free from adherent coatings, and meeting all requirements of these specifications.

Aggregate Soundness.

The percent degradation of the source aggregate by the sodium sulfate soundness test (AASHTO T 104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate), after five cycles of testing, shall not exceed 10.0 %.

Deleterious Materials, Flat or Elongated Particles, and Absorption.

The amount of deleterious substances, flat or elongated particles, and absorption in the coarse aggregate shall not exceed the following limits:

(a) Coal and Lignite (Visual)	0.25 %
(b) Clay Lumps and Friable Particles (AASHTO T 112)	0.25 %
(c) Flat or Elongated particles (5:1 Ratio) (ASTM D 4791 by Mass)	10.0 %
(d) Flat or Elongated particles (3:1 Ratio) (ASTM D 4791 by Mass)	20.0 %
(e) Other local deleterious substances (Shale, Mica, Marcasite, etc.)(Visual)	2.0 %
(f) Absorption (Total sample absorption on the material passing the 3/4 inch {19.0 mm} sieve and retained on the No. 4 {4.75 mm} sieve)(AASHTO T 85 *). Applies to gravel aggregates only.	2.0 %
* Section 8.1 of AASHTO T 85 modified to require a 15 minute vacuum saturation period as per Section 6.3 of AASHTO T 209 prior to the required 15-19 hour soaking period.	

Los Angeles Abrasion Criteria.

The percent loss of the coarse aggregate by the LA Abrasion test (AASHTO T 96, Resistance to Abrasion of Small Size Aggregate by use of the Los Angeles Machine) shall not exceed 48 %, except that for Sandstone and Blast Furnace Slag, the LA Abrasion shall not exceed 55 %.

3. FINE AGGREGATE.

Fine aggregate shall be aggregate passing the No. 4 {4.75 mm} sieve. Gravel used to manufacture fine aggregate shall have a bulk specific gravity greater than 2.550 (AASHTO T 85).

The fine aggregate shall be non-plastic when tested in accordance with AASHTO T 89, as modified by ALDOT-232, and AASHTO T 90 and shall have a maximum of 1.0 percent clay lumps and friable particles as determined by AASHTO T 112. It shall consist of hard, tough grain, free of injurious amounts of clay, loam, or other deleterious substances.

Clay Content.

The amount of clay material, as indicated by the sand equivalent, measured on the aggregate passing the No. 4 {4.75 mm} sieve as determined by AASHTO T 176, *Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test*, shall be no less than the values defined by Table 1 according to the total design traffic in equivalent single axle loads (ESALs).

Table 1. Clay Content Criteria		
ESAL Range	Traffic (ESALs)	Sand Equivalent
A	ESALs < $3.0x10^5$	≥ 40.0
B	$3.0x10^5$ ≤ ESALs < $1.0x10^6$	≥ 40.0
C	$1.0x10^6$ ≤ ESALs < $3.0x10^6$	≥ 40.0
D	$3.0x10^6$ ≤ ESALs < $1.0x10^7$	≥ 45.0
E	$1.0x10^7$ ≤ ESALs < $3.0x10^7$	≥ 45.0
F	ESALs ≥ $3.0x10^7$	≥ 50.0

4. MINERAL FILLER.

Mineral filler shall consist of finely divided mineral matter such as rock dust, slag dust, hydrated lime, hydraulic cement, or fly ash meeting the requirements of Section 805.

The introduction of mineral filler shall be in accordance with AASHTO M 156 Section 3.3 as specified in ALDOT-324 with the additional requirement that accurate proportioning shall be accomplished by means of pneumatic or mechanical metering.

(b) RECYCLED ASPHALT PAVEMENT (RAP).

When RAP is used as a component of a wearing or an upper binder layer, the coarse and fine aggregates contained in the RAP shall meet the respective requirements as outlined in Items 429.02(a)1., 2., & 3., except for the Clay Content requirement in Item 429.02(a)3.

If the RAP contains any gravel with a bulk specific gravity of less than 2.550 or fine aggregate manufactured from this gravel, it may not be used in any wearing layer (even if this layer is to be covered by an OGFC) and is limited to 15% of any other layer. If the RAP does not contain any chert gravel, it is limited to 20%.

Percentages of RAP shall be based on total weight {mass} of the aggregate blend.

(c) BLEND OF AGGREGATES.

The coarse and fine aggregates shall be combined in a total blend that will produce an acceptable job mix within the gradation limits determined by the maximum and minimum control points and a restricted zone as defined by Tables 2A-2D. The plans and proposal will designate the mix to be used. Unless otherwise shown on the plans or in the proposal, mixtures may be designed on either the fine or coarse side of the restricted zone.

Blended aggregate gradation curves shall not pass through the restricted zone. Restricted zones are a function of the maximum particle sizes in the blended gradations. Maximum particle size is defined as the sieve size that is two sizes larger than the first sieve to retain more than 10 percent of the material. The sequence of sieve sizes to be used in determining maximum particle size is that contained in Table 2A, 2B, 2C, or 2D. Gradation charts illustrating gradation requirements are contained in Article 429.03.

Production tolerances shall be as shown in Subarticle 429.04(e).

Table 2A. Aggregate Gradation Control Points and Boundaries of Restricted Zone (1.5" {37.5 mm} Maximum Size Mix)		
	Control Point (Percent Passing)	
Sieve Size	Minimum	Maximum
No. 200 {75 μm}	1	7
No. 8 {2.36 mm}	19	45
3/4" {19 mm}	-	90
1" {25 mm}	90	100
1.5" {37.5 mm} Maximum	100	-
Restricted Zone		
No. 4 {4.75 mm}	39.5	39.5
No. 8 {2.36 mm}	26.8	30.8
No. 16 {1.18 mm}	18.1	24.1
No. 30 {600 mm}	13.6	17.6
No. 50 {300 mm}	11.4	11.4

Table 2B. Aggregate Gradation Control Points and Boundaries of Restricted Zone (1"{25 mm} Maximum Size Mix)		
	Control Point (Percent Passing)	
Sieve Size	Minimum	Maximum
No. 200 {75 µm}	2	8
No. 8 {2.36 mm}	23	49
1/2" {12.5 mm}	-	90
3/4" {19 mm}	90	100
1" {25 mm} Maximum	100	-
Restricted Zone		
No. 4 {4.75 mm}	-	-
No. 8 {2.36 mm}	34.6	34.6
No. 16 {1.18 mm}	22.3	28.3
No. 30 {600 mm}	16.7	20.7
No. 50 {300 mm}	13.7	13.7

Table 2C. Aggregate Gradation Control Points and Boundaries of Restricted Zone (3/4" {19.0 mm} Maximum Size Mix)		
	Control Point (Percent Passing)	
Sieve Size	Minimum	Maximum
No. 200 {75 µm}	2	10
No. 8 {2.36 mm}	28	58
3/8" {9.5 mm}	-	90
1/2" {12.5 mm}	90	100
3/4" {19.0 mm} Maximum	100	-
Restricted Zone		
No. 4 {4.75 mm}	-	-
No. 8 {2.36 mm}	39.1	39.1
No. 16 {1.18 mm}	25.6	31.6
No. 30 {600 mm}	19.1	23.1
No. 50 {300 mm}	15.5	15.5

Table 2D. Aggregate Gradation Control Points and Boundaries of Restricted Zone (1/2" {12.5 mm}Maximum Size Mix)		
	Control Point (Percent Passing)	
Sieve Size	Minimum	Maximum
No. 200 {75 µm}	2	10
No. 8 {2.36 mm}	32	67
No. 4 {4.75 mm}	-	90
3/8" {9.5 mm}	90	100
1/2" {12.5 mm} Maximum	100	-
Restricted Zone		
No. 4 {4.75 mm}	-	-
No. 8 {2.36 mm}	47.2	47.2
No. 16 {1.18 mm}	31.6	37.6
No. 30 {600 mm}	23.5	27.5
No. 50 {300 mm}	18.7	18.7

Coarse Aggregate Angularity.

The coarse aggregate angularity shall be measured on the total blended aggregate retained on the No. 4 {4.75 mm} sieve in accordance with ASTM D 5821.

A fractured face is defined as an angular, rough, or broken surface of an aggregate particle created by crushing, by other artificial means, or by nature. A face is considered fractured only if it has a projected area at least as large as one-quarter of the maximum projected area (maximum cross-sectional area) of the particle and also has sharp and well-defined edges.

The percent by weight {mass} of the coarse particles of the blended aggregate retained on the No. 4 {4.75 mm} sieve with one fractured face and with two or more fractured faces shall be no less than the values in Table 3.

Table 3. Coarse Aggregate Angularity Criteria			
ESAL Range	Traffic (ESALs)	**Wearing Surface** & Binder Layers	Base Layers
A	ESALs < $3.0x10^5$	55 / -	- / -
B	$3.0x10^5 \leq$ ESALs < $1.0x10^6$	65 / -	- / -
C	$1.0x10^6 \leq$ ESALs < $3.0x10^6$	75 / -	50 / -
D	$3.0x10^6 \leq$ ESALs < $1.0x10^7$	85 / 80	60 / -
E	$1.0x10^7 \leq$ ESALs < $3.0x10^7$	95 / 90	80 / 75
F	ESALs $\geq 3.0x10^7$	100 / 100	100/100
Note: "85 / 80" denotes that 85 percent of the coarse aggregate has at least one fractured face and 80 percent has two or more fractured faces.			

Fine Aggregate Angularity.

The percent air voids in loosely compacted fine aggregate measured according to AASHTO TP33-93, Method "A", or ASTM C 1252, Method "A", *Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)* shall be no less than the values in Table 4.

Table 4. Fine Aggregate Angularity Criteria		
ESAL Range	Traffic (ESALs)	Minimum % Air Void
A	ESALs < $3.0x10^5$	-
B	$3.0x10^5 \leq$ ESALs < $1.0x10^6$	40
C	$1.0x10^6 \leq$ ESALs < $3.0x10^6$	40
D	$3.0x10^6 \leq$ ESALs < $1.0x10^7$	45
E	$1.0x10^7 \leq$ ESALs < $3.0x10^7$	45
F	ESALs $\geq 3.0x10^7$	45

Use of Carbonate Stone.

Carbonate stone which tends to polish under traffic will be permitted only in underlying layers, shoulder paving, and widening as defined by Article 410.01 and layers that are to be covered by Polymer Modified Open Graded Friction Course (Section 420) mix in this contract, except as specified in Table 5, or otherwise shown on the plans.

Table 5. Allowable Carbonate Stone Criteria	
BPN 9 Value Of Aggregate Source *	Maximum Allowable Percentage Of Carbonate Stone
≤ 25	30
26 through 28	35
29 through 31	40
32 through 34	45
≥ 35	50
* This value, BPN 9, is made using the British Pendulum Tester on aggregate source specimen polished for 9 hours on an accelerated polishing machine known as the British Wheel as per ASTM D 3319 and ASTM E 303.	

In no case shall the total amount of virgin carbonate stone in the combined mixture used as actual wearing surface layers exceed the percentage shown in Table 5. When parts of the carbonate stone used in the mix are from differing stratas of material or coming from multiple sources that are represented by different BPN 9 values, the lowest BPN 9 value will be used.

(d) LIQUID ASPHALT BINDER.

Liquid asphalt binders shall come from an approved producer who is participating in and meeting the requirements of ALDOT-243, *Acceptance Program For Asphalt Materials*. The producer's name shall be listed in the Department's *Materials, Sources, and Devices With Special Acceptance Requirements* Manual, List I-4. The Department has established a list of qualified producers of asphalt materials. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list. Unless shown otherwise on the plans or in the proposal, liquid asphalt binder for use in all mixes shall meet the requirements of AASHTO MP1, *Standard Specification For Performance Graded Asphalt Binder,* as modified by Table 6 and Section 804.

Table 6. Allowable Asphalt Binder Grades

ESAL Range	Traffic (ESALs)	Base & Binder Layers	Upper Binder & Wearing Surface Layers
A	ESALs $< 3.0 \times 10^5$	PG 67-22	PG 67-22
B	$3.0 \times 10^5 \leq$ ESALs $< 1.0 \times 10^6$	PG 67-22	PG 67-22
C	$1.0 \times 10^6 \leq$ ESALs $< 3.0 \times 10^6$	PG 67-22	PG 67-22
D	$3.0 \times 10^6 \leq$ ESALs $< 1.0 \times 10^7$	PG 67-22	PG 67-22
E	$1.0 \times 10^7 \leq$ ESALs $< 3.0 \times 10^7$	PG 67-22	PG 76-22 *
F	ESALs $\geq 3.0 \times 10^7$	PG 67-22	PG 76-22 *

* For mainline paving the asphalt binder shall be polymer modified. For other than mainline paving (patching, leveling, and widening), the asphalt binder will not be required to be polymer modified.

Polymer modifiers shall be blended at an approved refinery and meet the requirements of Section 811.

(e) MIX PROPERTIES.

1. AIR VOIDS (AV).

The design air voids for all levels of traffic is 4.0 %.

2. VOIDS IN MINERAL AGGREGATE (VMA).

The job mix shall be designed to produce a minimum VMA according to Table 7.

Table 7. Voids in Mineral Aggregate Criteria

Maximum Aggregate Size *	Minimum VMA (%) for Mixes Designed on the Fine Side of the Restricted Zone	Minimum VMA (%) for Mixes Designed on the Coarse Side of the Restricted Zone
1/2" {12.5 mm}	16.0	15.0
3/4" {19.0 mm}	15.0	14.0
1" {25.0 mm}	14.0	13.0
1.5" {37.5 mm}	13.0	12.0

* As defined in Subarticle 429.02(c)

3. DUST PROPORTION.

The ratio of the percent by weight {mass} of aggregate passing the No. 200 sieve to the effective asphalt content expressed as percent by weight {mass} of the total mix shall be between 0.6 and 1.2 for mixes designed on the fine side of the restricted zone and between 0.6 and 1.6 for mixes designed on the coarse side of the restricted zone. These ratio limits apply to both the design and production phases. Effective asphalt content is that asphalt cement not absorbed into the aggregate pore structure and is determined according to Section 4.09 of the Asphalt Institute's, MS-2, *Mix Design Methods for Asphalt Concrete*.

4. ASPHALT DRAINDOWN.

The amount of draindown in an uncompacted asphalt-aggregate sample shall not exceed 0.3 % at the end of one hour in accordance with ALDOT-386, *Asphalt Draindown Test*.

5. RESISTANCE TO MOISTURE INDUCED DAMAGE.

All mixes shall be designed and produced to have a tensile strength ratio (TSR) of at least 0.80 when compacted according to ALDOT-307 at seven percent air voids and tested in accordance with AASHTO T 283 as modified by ALDOT-361.

(f) DESIGN PROCEDURES.

Mixes with 100 % virgin aggregates shall be designed with ALDOT-307, *Design Method for Selecting Optimum Asphalt Cement Content of Bituminous Mixture by Means of the Marshall Apparatus*. Mixes containing recycled asphalt pavement (RAP) shall be designed by ALDOT-344, *Design*

Method for Selecting the Grade of Recycling Agent and Optimum Asphalt Content of Hot-Mix Recycled Bituminous Mixtures.

The 75 Blow Marshall Mix Design method shall be used for all mixes if the total design traffic ESALs is greater than or equal to 3.0×10^6. If the total design traffic ESALs is less than 3.0×10^6, the 50 Blow Marshall Mix Design method shall be used for all mixes. Marshall stability and flow values shall be no less than the values defined in Table 8.

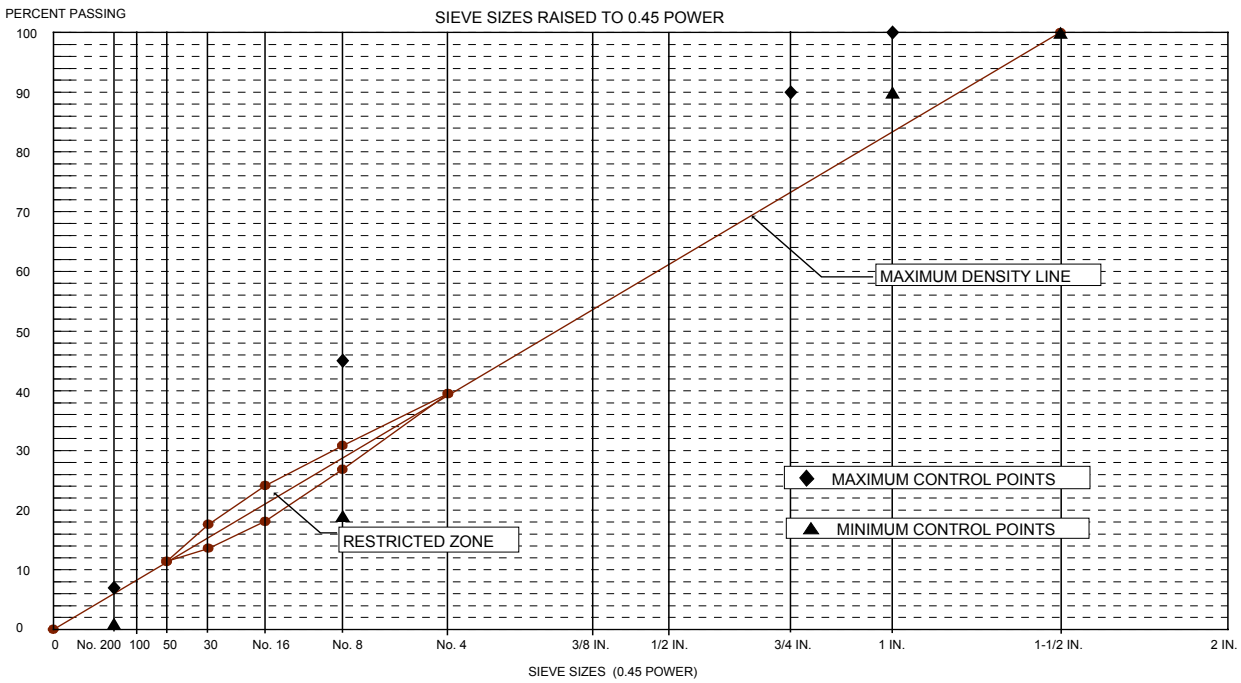
Table 8. Marshall Stability and Flow Criteria

Mix	Stability (lbs){kN}	Flow (0.01 in.) {mm}	
		50 Blow	75 Blow
Wearing Surface Layers	≥ 1600 {7.5}	8 - 18 {2.0 - 4.5}	8 - 16 {2.0 - 4.0}
Binder Layers	≥ 1400 {6.5}	8 - 18 {2.0 - 4.5}	8 - 16 {2.0 - 4.0}
Base Layers	≥ 1200 {5.5}	8 - 18 {2.0 - 4.5}	8 - 16 {2.0 - 4.0}

429.03 Gradation Requirements.

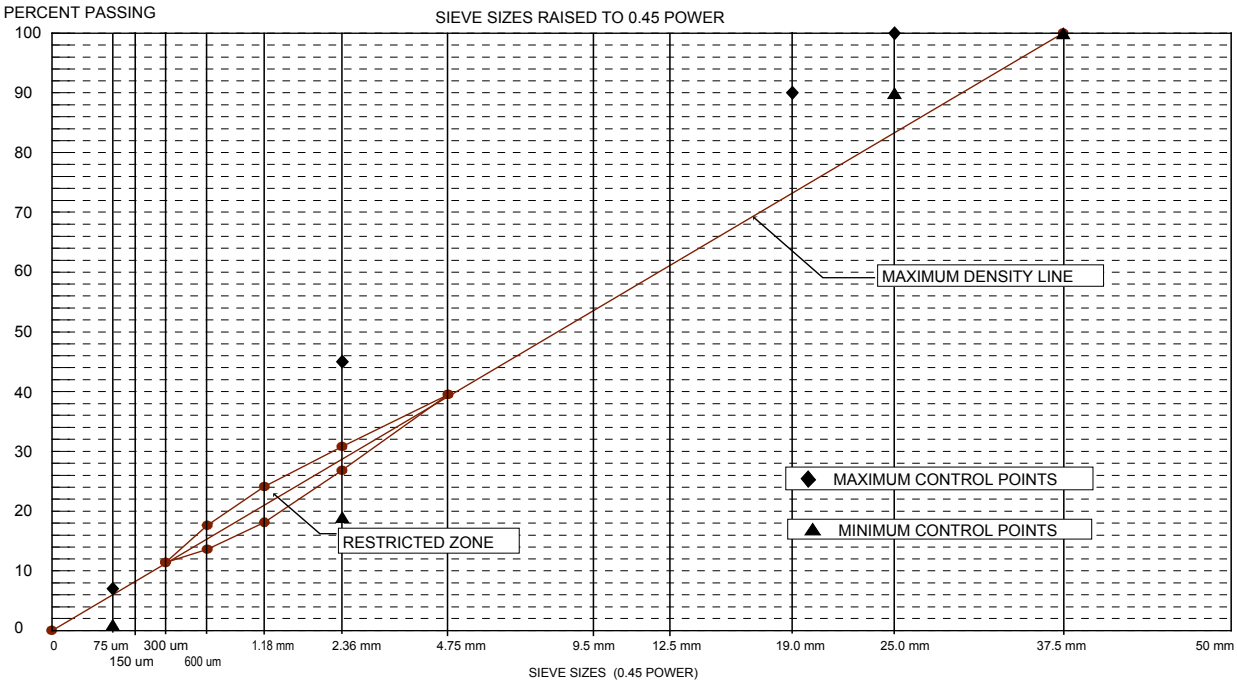
GRADATION CHART

1-1/2 Inch Maximum Size Mix



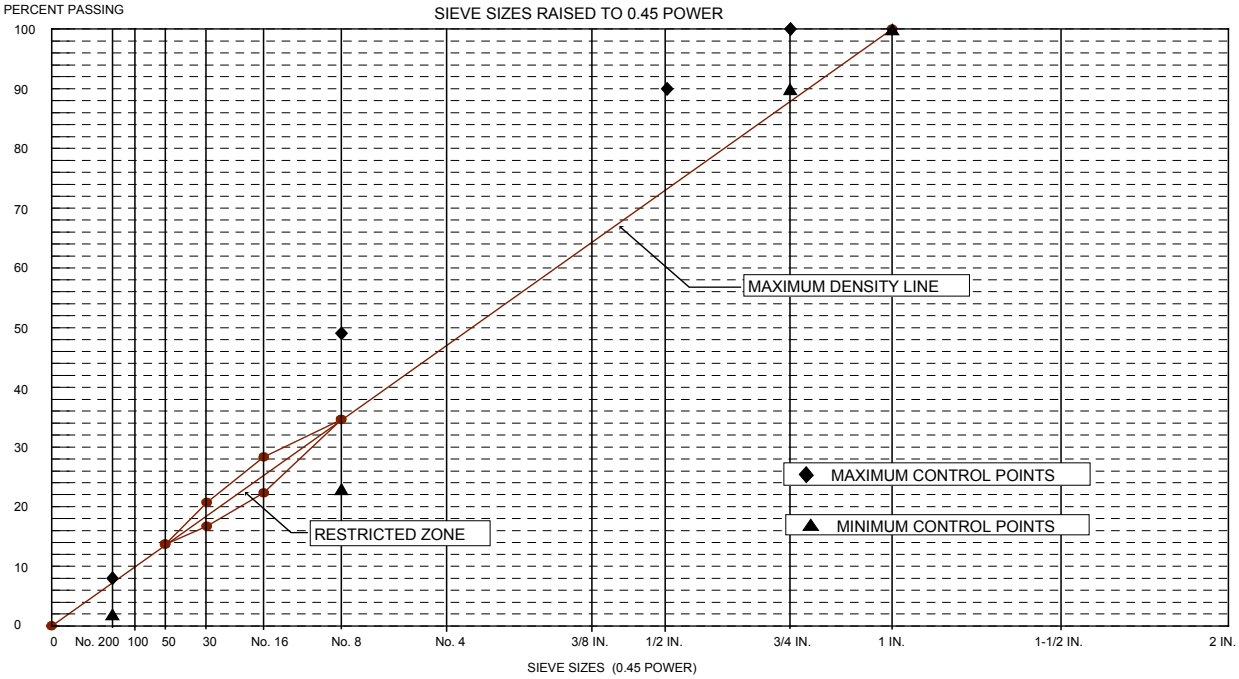
GRADATION CHART

37.5 mm Maximum Size Mix



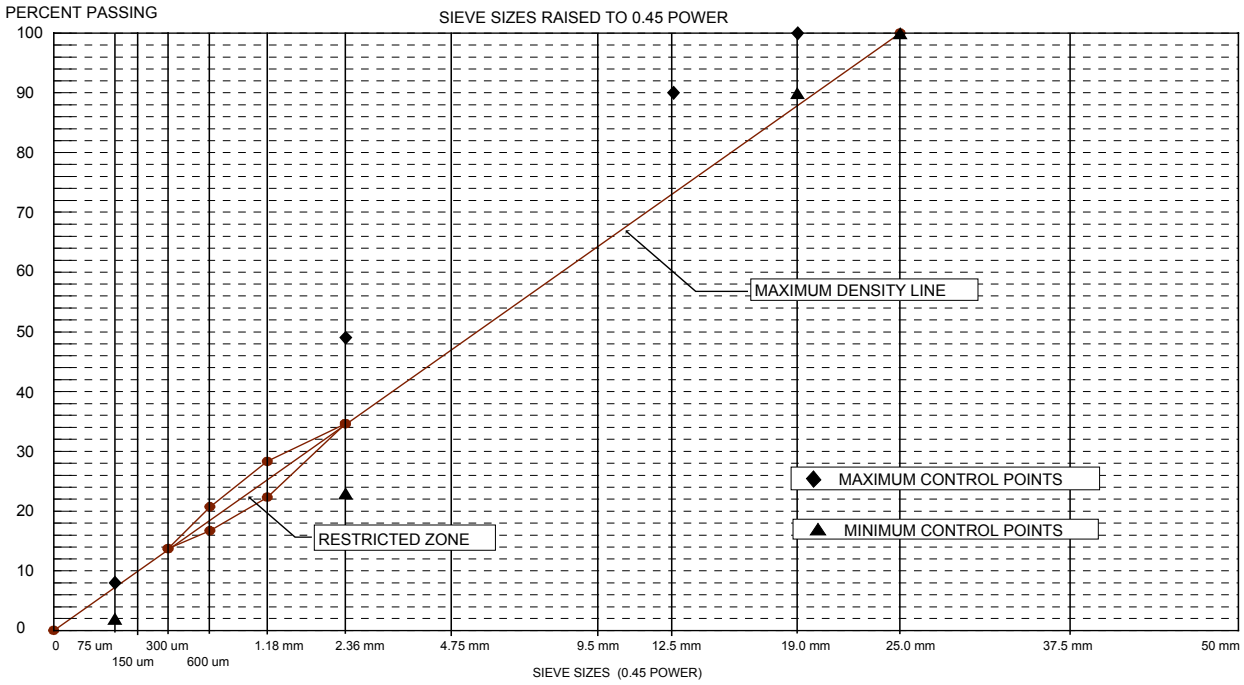
GRADATION CHART

1 Inch Maximum Size Mix



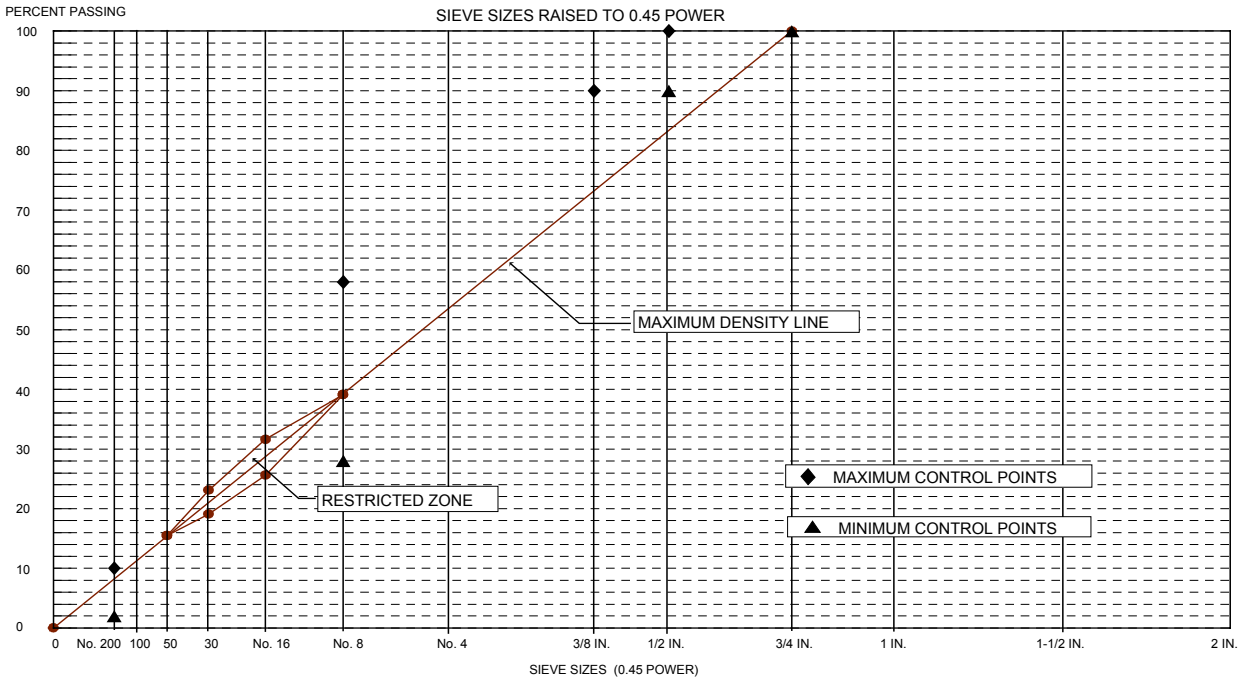
GRADATION CHART

25.0 mm Maximum Size Mix



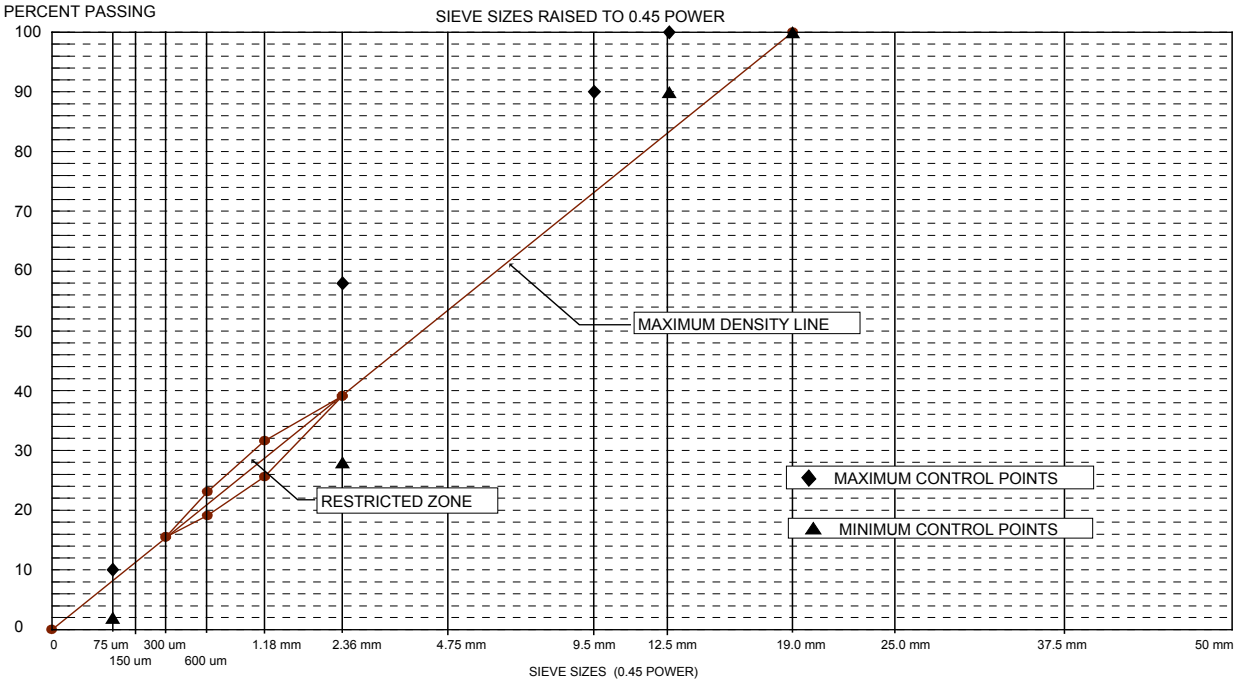
GRADATION CHART

3/4 Inch Maximum Size Mix



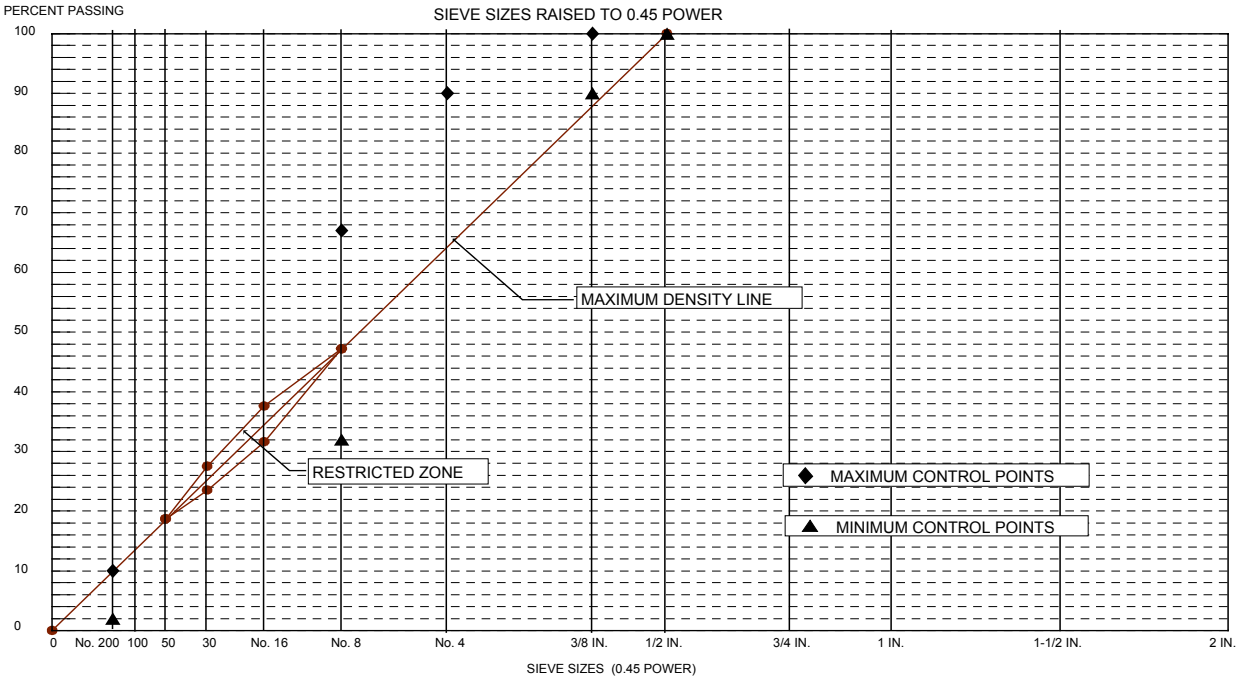
GRADATION CHART

19.0 mm Maximum Size Mix



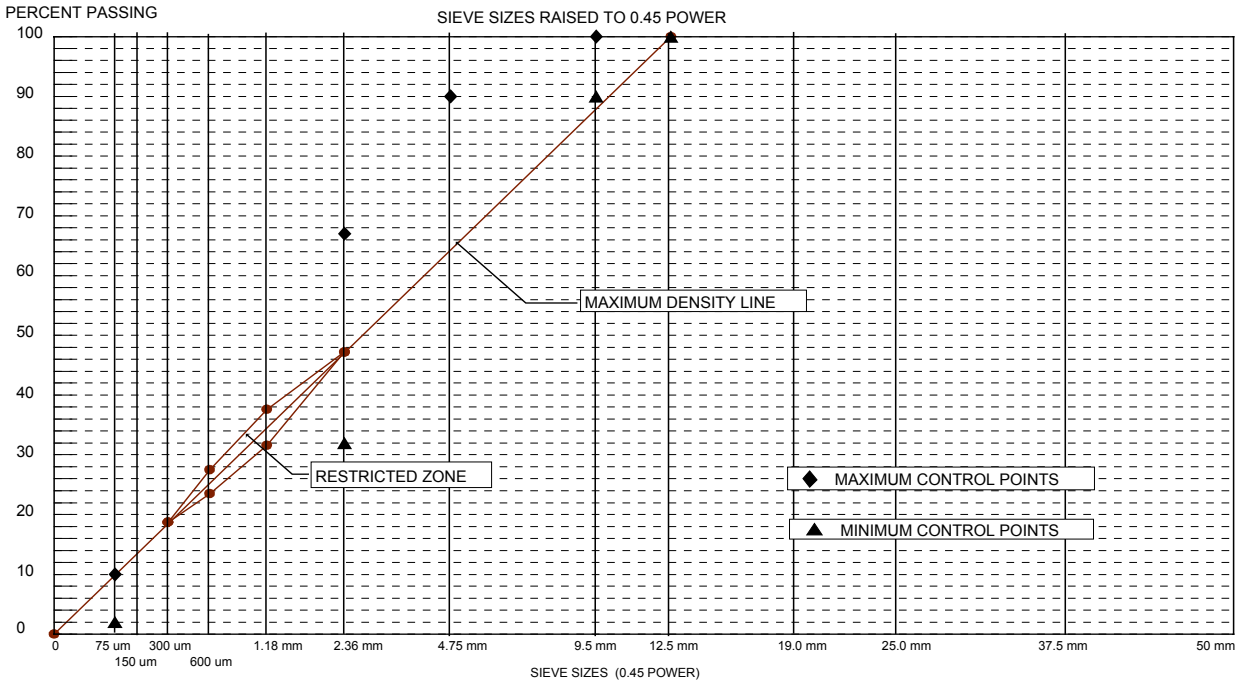
GRADATION CHART

1/2 Inch Maximum Size Mix



GRADATION CHART

12.5 mm Maximum Size Mix



429.04 Construction Requirements.

(a) GENERAL.

Mixing temperature shall not exceed 350 °F {180 °C}.

(b) BINDER LAYER AND WEARING SURFACE LAYER.

Construction requirements shall be as specified in Articles 410.03 through 410.07.

(c) BASE LAYER.

The construction requirements for base layers shall be as specified in Articles 410.03 through 410.07, except as follows:

The edges shall be trimmed immediately after final rolling, using an accurately aligned string or wire to a tolerance of 2 inches {50 mm} outside the theoretical edge of the layer and to a slope not flatter than 1:1.

Any edge distorted by rolling shall be promptly corrected.

(d) PREPARATION OF MIXTURES - MOISTURE CONTENT.

Each time an asphalt content measurement is made (ALDOT-354 or AASHTO TP53) the amount of moisture in the mixture shall be determined, regardless of aggregate type, as specified in ALDOT-130 reported on Form BMT-20. The moisture determination shall be used in computing the corrected asphalt content. Moisture samples shall be taken with the asphalt content samples from the loaded truck. Moisture in the mixture shall not exceed 0.2 % by weight {mass}.

(e) PRODUCTION TOLERANCES.

All mixtures furnished for use shall conform to the approved job mix formula (JMF) within the tolerances set in Item 410.02(b)2. Mixture gradations may be produced within the restricted zone provided the gradations are within the tolerances.

429.05 Method of Measurement.

The accepted quantities of Improved Bituminous Concrete Wearing Surface Layer, Improved Bituminous Concrete Binder Layer, and Improved Bituminous Concrete Base Layer will be measured as provided in Article 410.08.

429.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Improved Bituminous Concrete Wearing Surface Layer, Improved Bituminous Concrete Binder Layer, and Improved Bituminous Concrete Base Layer will be paid for at the contract unit price bid in accordance with Article 410.09.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

429-A Improved Bituminous Concrete Wearing Surface Layer, ____** ,
____*** Maximum Aggregate Size Mix, ESAL Range ____**** - per ton {metric ton}
429-B Improved Bituminous Concrete ____* Binder Layer, ____** ,
____*** Maximum Aggregate Size Mix, ESAL Range ____**** - per ton {metric ton}
429-C Improved Bituminous Concrete Base Layer, ____** ,
____*** Maximum Aggregate Size Mix, ESAL Range ____**** - per ton {metric ton}

* Specify either "Upper" or "Lower"
** Specify "Patching", "Leveling", "Widening", etc. only when required
*** Specify Maximum Aggregate Size,
1/2", 3/4", 1", or 1.5" {12.5 mm, 19.0 mm, 25.0 mm, or 37.5 mm}
**** Specify "A", "B", "C", "D", "E", "F", or "G"

SECTION 430
SOIL OR AGGREGATE TYPE SURFACE

430.01 Description.

The work under this Section shall consist of constructing a temporary or permanent surface course of soil type material (Selected Material, Granular Soil or Soil Aggregate, etc.) or graded aggregate type material.

The plans or proposal will designate the type of material to be used.

430.02 Material.

All material furnished for use shall meet the appropriate requirements of Division 800, Materials, for the classification of material specified by the pay item.

430.03 Construction Requirements.

(a) EQUIPMENT.

Selection of the appropriate type of equipment to satisfactorily accomplish the work will, in general, be at the option of the Contractor.

(b) PREPARATION OF UNDERLYING SURFACE.

Before placing the surface material, the subgrade shall comply with the requirements of Subarticle 301.03(a). If this material is to be used in a temporary manner for handling traffic, the requirements for underlying surface preparation may be modified and control elevation stakes will not be necessary.

(c) PLACING, SPREADING AND SHAPING.

Local type materials (Selected Material, Granular Soil, and Soil Aggregate) shall be yard mixed as described in Item 301.03(c)3 before being hauled to the roadbed.

Approved surfacing material may be dumped directly on the prepared subsurface and the material spread to the width and depth shown on the plans or directed.

Water shall be added if so directed.

Mixing will not be required unless so specified on the plans. If mixing is specified, it shall be performed in accordance with the requirements of Item 301.03(c)2.

Upon completion of the spreading, the material shall be shaped to the cross section shown on the plans and rolled to a smooth riding surface, free from high spots or depressions and satisfactory to the Engineer. Specific density requirements are waived; however, it shall be compacted to the satisfaction of the Engineer.

After being placed and shaped to proper crown and grade the surface shall be shaped at frequent intervals as directed and shall be kept free of ruts and holes. New material shall be added and

bladed as needed and as directed. The surface shall be maintained in satisfactory condition in the manner described above until the contract is accepted.

430.04 Method of Measurement.

The quantity of surfacing material placed on the roadbed will be measured in cubic yards {cubic meters} in accordance with the provisions of Subarticle 109.01(i), or per ton {metric ton} measured by weight {mass} in accordance with the provisions of Subarticle 109.01(h).

430.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Surfacing material ordered and accepted, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the material complete in place on the roadbed and includes all costs incident to furnishing and producing the material, all hauling, spreading, mixing, watering, compacting, shaping, and for all equipment, tools, labor, and incidentals necessary to complete the work. Additional material used in the maintenance will be measured and paid for under this item.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

430-A Soil Type Surfacing(Kind Material) - per cubic yard {cubic meter}
430-B Aggregate Surfacing(ALDOT Size of Material) - per ton {metric ton}

SECTION 450
PORTLAND CEMENT CONCRETE PAVEMENT

450.01 Description.

The work covered by this Section consists of constructing a pavement of Portland Cement Concrete, with or without reinforcement as specified by the plans or proposal, on a prepared surface (subgrade, subbase, or base layer) in accordance with these specifications and in reasonably close conformity with the lines, grades, and design shown on the plans or directed by the Engineer.

450.02 Materials.

(a) GENERAL.

Handling, storage, and control of materials shall comply with appropriate portions of Section 106. All materials shall conform to the requirements set forth in Division 800, Materials. Specific reference is made to applicable portions of the following Sections:

Section 801 Coarse Aggregate
Section 802 Fine Aggregates
Section 804 Bituminous Materials
Section 806 Mineral Admixtures
Section 807 Water
Section 808 Air Entraining Additives
Section 809 Chemical Admixtures for Concrete
Section 815 Cement
Section 830 Concrete Curing Material
Section 832 Concrete Joint Fillers, Sealers, and Waterstop Material
Section 835 Steel Reinforcement

(b) SPECIAL REQUIREMENTS.

AGGREGATES. Sand shall be natural sand except that it may include 20 percent of crushed quartzite particles. A blend of two natural sands will be permitted.

Gravel may be used in combination with slag or stone. When slag is used as any part of the combined coarse aggregate, the cement factor (weight {mass} of cement in pounds per cubic yard {kilograms per cubic meter} of concrete) shown in the Master Proportion Table for slag aggregate shall be used.

REINFORCING STEEL. Tie bars shall be new billet steel; other bars may be either billet or rail steel.

Reinforcement for continuous reinforced pavement shall be deformed bars or fabric of the size and shape shown on the plans.

Specific reference is made to applicable portions of Section 502.

(c) PROPORTIONING OF MATERIAL.

1. GENERAL.

A Master Proportion Table has been provided below as a guide in proportioning components of mixes based on type and size of aggregate used in the mix. Mix A is for gravel, Mix B is for slag, and Mix C is for stone.

Unless otherwise provided on the plans or proposal, the Contractor will be allowed to select either the "A" or "C" Mix and either the #357 or #467 coarse aggregate for use on the project. The "B" Mixes and the "A" Mixes with #57 coarse aggregate will be allowed only if so specified on the plans or in the proposal.

The Contractor shall furnish the Department with data concerning the type of material and sources thereof for determination of a job mix formula by the Engineer. The mix and aggregate size, once selected, shall be used throughout the project unless written permission is granted by the Department.

The cement factor will be that shown in the Master Proportion Table for the designated mix unless a different factor is specified on the plans, in the proposal, or by written instructions. The approximate quantities of aggregates, additives, etc., are in the Master Proportion Table, but the exact amounts of coarse aggregates, fine aggregate, additives, water, and cement per cubic yard {cubic meter} will be established by the Engineer and will be furnished the Contractor as a "Job Mix." The mix will be designed for a maximum slump of 1.5 inches {40 mm}, measured by AASHTO T 119 Method. With prior approval of the Materials & Tests Engineer, the slump may be increased to 2.5 inches {65 mm}, provided an approved water reducer is used at no expense to the State. When a water reducer is used, the water to total cementitious material (cement plus fly ash) ratio shall not exceed that shown in the Master Proportion Table. Substitute job mixes designed by the Contractor will not be accepted.

MASTER PROPORTION TABLE
One Cubic Yard {Cubic Meter} Proportions

Mix	A	A	A	A	B	C	C
Type of Cement	I or II	IP	I or II	IP	I or II	I or II	IP
Combined Coarse Aggregate Size Number	467	467	57	57	357 or 467	357 or 467	357 or 467
Cement Factor (pounds {kg})	470 {279}	583 {346}	470 {279}	658 {390}	508 {301}	470 {279}	583 {346}
Fly Ash (pounds {kg})	113 {67}	None	113 {67}	None	128 {76}	113 {67}	None
Maximum Water in gallons {liters}	34 {168}	34 {168}	34 {168}	33 {163}	40 {198}	36 {178}	34 {168}
Fine Aggregate (pounds {kg})	1000 {593}	988 {586}	1012 {600}	1034 {613}	985 {584}	1003 {595}	1089 {646}
Coarse Aggregate (pounds {kg})	1986 {1178}	2033 {1206}	1974 {1171}	1946 {1155}	1592 {945}	2013 {1194}	2007 {1191}
Entrained Air % by Volume	3 - 5	3 - 5	3 - 5	3 - 5	3 - 5	3 - 5	3 - 5
Minimum 14 Day Flexural Strength (psi {MPa})	550 {3.8}	550 {3.8}	550 {3.8}	550 {3.8}	550 {3.8}	550 {3.8}	550 {3.8}

Explanation of Table:

The mixes shown by the Table were designed on a specific gravity of 2.63 for sand and gravel, 2.30 for slag, and 2.73 for stone (bulk, saturated surface dry). The basic design fineness modulus for sand is 2.60. Reference is made to Subarticle 802.02(g) for gradation uniformity. The design weights {masses} will be adjusted on the job mix formula to reflect the specific gravities of the actual aggregates being used.

Coarse aggregate size #357 shall be made up of approximately 50% size #57 and 50% size #3; likewise, size #467 shall be made up of approximately 50% size #67 and 50% size #4 with each component size stockpiled separately at the batching plant.

2. JOB MIX FORMULA.

A job mix will be designated by the Engineer after the materials which the Contractor proposes to use have been accepted and tested in the laboratory. Trial mixes may be required for materials for which the Department has no prior records,

The job mix formula will be based on the Master Proportion Table. These formulas have proven they will produce concrete of strength in excess of that shown in the Master Proportion Table, provided the aggregate is from an approved source, is clean and not segregated, and proper batching and mixing methods are used. The actual job mix may not be exactly as shown in the Master Proportion Table due to local variations in material or special design considerations.

During the progress of the work, the relative proportions between the fine and coarse aggregates and between aggregate and water may be varied as needed for best results, but the cement factor and the water to total cementitious material (cement plus fly ash) ratio will not be changed except as noted below:

If the Engineer finds it advisable to increase the minimum design strength of the concrete and orders the cement factor increased, the State will reimburse the Contractor for the actual amount only of the additional cement used, based on actual f.o.b. destination with the additional quantity calculated from the theoretical cement factor determined by the Engineer and not from count of bags or weight {mass} used.

The Master Proportion Table is based on the use of Type I, II, or IP cement. The Contractor may select either of these types of cement for use for his own convenience and without additional compensation, use additional cement, or substitute Type III cement, provided prior approval is given by the Materials and Tests Engineer.

It shall be the Contractor's responsibility to furnish suitable aggregate and carry out uniform construction practices which will produce concrete of not less than the minimum psi {MPa} strength indicated by the Master Proportion Table. Should the concrete not produce the required minimum strength, the cement content noted in the Master Proportion Table shall be increased by ten percent and the additional cost thereof paid for by the Contractor.

(d) SAMPLING AND INSPECTION.

Aggregates from approved sources will be accepted in stockpiles provided there is no segregation, but production of required gradation in the mix shall be the Contractor's responsibility.

Cement will be tentatively accepted on the basis of mill tests.

The right is reserved to take samples of aggregates from stockpiles and cement from storage bins at the mixing or batching plant and to make further tests as needed as a basis for continued acceptance of the materials.

The Contractor shall furnish, without extra compensation, samples of the concrete mixture for making tests and test specimens as required to comply with Departmental policy or more often as directed if additional testing is deemed necessary by the Engineer.

Preparation of the mix shall be subject to inspection at all times. The Engineer or his authorized representative shall have access at any time to all parts of the plant and facilities for inspecting and checking all equipment, operations, and materials involved in preparation of the concrete mix. Any unsatisfactory equipment or operation shall be changed and improved as required.

Concrete beams and cylinders shall be prepared in accordance with current Departmental policy. Cylinders shall have a minimum 28 day compressive strength of 3000 psi {21 MPa}.

The Contractor shall furnish, without extra compensation, a protected environment for all concrete test specimens as specified in Subarticle 501.02(d).

450.03 Construction Requirements.

(a) EQUIPMENT.

Equipment and tools necessary for handling materials and performing all parts of the work shall be at the option of the Contractor provided it meets the following basic requirements and produces satisfactory results. Improved equipment which will produce equally satisfactory results, such as automatically or electronically controlled batching, measuring, mixing, or finishing devices of proven performance may be used in lieu of specified equipment.

Any equipment furnished for use found by the Engineer to cause unsatisfactory work shall be promptly replaced or supplemented as required to produce satisfactory results.

All concrete batching plants shall be certified by the National Ready Mix Concrete Association (NRMCA) to be in conformance with the NRMCA Plant Certification Checklist. The concrete producer

shall submit proof of NRMCA certification to the Concrete Engineer (Materials & Tests Bureau) prior to any batching of concrete. The right is reserved by the Engineer for the Department to verify compliance with the NRMCA requirements and the Specifications as needed.

All batching plants shall meet the requirements of the Standard Specifications and ALDOT-352. Producers who request that their batching plants be placed on the PORTLAND CEMENT CONCRETE PRODUCERS LIST will be charged a submittal fee as specified by ALDOT-355, General Information Concerning Materials, Sources, and Devices With Special Acceptance Requirements.

1. BATCHING PLANT AND EQUIPMENT.

a. General.

The batching plant shall include bins, measuring hoppers, and scales for the fine aggregate and for each size of coarse aggregate. The weight {mass} of the cement and fly ash shall be determined on a scale and in a measuring hopper which is separate and distinct from those used for other materials. Fly ash may be measured cumulatively with cement. Cement shall be measured before fly ash. Should this method of measuring produce unsatisfactory results, it shall be discontinued and separate scales and hoppers provided for these ingredients. Measuring hoppers shall be properly sealed and vented to preclude dusting during operation. The plant shall be equipped with a suitable nonresettable batch counter which will correctly indicate the number of batches proportioned.

A semi-automatic batching plant will be required and shall be so designed that the controls for batch weights {masses} can be preset, and locked to prevent unauthorized tampering, and the material batched automatically and manually dumped. The equipment shall be provided with interlock devices to prevent a new cycle starting until all balances are emptied; the discharge gate will not open until scales are in balance nor close until all materials have been discharged.

A batching plant, while paving operations are in progress, shall serve only one project.

b. Bins and Hoppers.

Bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant. Each compartment shall discharge efficiently and freely into the measuring hopper or hoppers. Means of control shall be provided so that, as the quantity desired in the measuring hopper is being approached, the material may be added slowly and shut off with precision. A port or opening shall be provided for removing an overload of any one of the several materials from the hopper. Measuring hoppers shall be constructed so as to eliminate accumulations of tare materials and to discharge fully without jarring the scales. Partitions between compartments, both in bins and in hoppers, shall be ample to prevent spilling under any working condition.

c. Scales.

The scales for determining the weight {mass} of aggregates and cement shall be of either beam or springless dial scales, designed as an integral unit of the batching plant and meeting the requirements of Subarticle 109.01(h). Methods of determining weight {mass} (electric, hydraulic, load cells, etc.) other than beam or springless dial scales which meet the required weight {mass} determination tolerances are also acceptable.

2. MIXERS.

a. General.

Each mixer shall have attached to it in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

An automatic graduated measuring device, accurate within three percent and satisfactory to the Engineer, shall be provided at the mixer for measuring the amount of air-entraining agent to be added to each batch requiring such admixture.

b. Mixers at Site of Construction.

Mixing at the site shall be in approved drum-type mixers capable of combining the aggregates, additives, cement, and water into a thoroughly mixed and uniform weight {mass} within the specified mixing period, and of discharging the mixture without segregation. The mixer shall be equipped with a suitable charging hopper, water storage, water measuring device accurate within one percent and readily adjustable, with lock that will prevent unauthorized changes, and a boom and bucket that is fully power controlled and so operated that the batches are uniformly distributed on the subbase. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The

device shall be equipped with a bell adjusted to ring each time the lock is released. Failure of the timing device shall be cause for discontinuance of the use of the mixer until the device is repaired or a new timer substituted.

Multiple drum traveling mixers will be permitted, provided such mixers otherwise conform to pertinent requirements of these specifications, and provided the mixer units are designed and built for synchronized operation.

The mixers shall be examined daily and cleaned at needed intervals. The pick-up and throw-over blades in the drum or drums shall be repaired or replaced when they are worn down 3/4 of an inch {20 mm} or more. The Contractor shall (1) have available at the job site a copy of the manufacturer's design, showing dimensions and arrangement of blades in reference to original height and depth, and (2) provide permanent marks on blades to show points of 3/4 of an inch {20 mm} wear from new conditions. (Drilled holes of 1/4 inch {6 mm} diameter near each end and at midpoint of each blade are recommended.)

c. Central Plant Mixers.

Mixers for central mixed concrete shall conform to the applicable requirements listed above for on-site mixers and the requirements of AASHTO M 157. While paving operations are in progress, the central mixer shall serve only one project at a time.

d. Truck Mixers and Truck Agitators.

Truck agitators used to haul central-mixed concrete shall conform to the requirements of AASHTO M 157 and shall be capable of discharging at the rate of 8 cubic yards {6 m^3} of 1.5 inch {40 mm} slump concrete within one minute. Mixing by truck or transit mixers will be permitted only when so specified on the plans or in the proposal. Transit mixers and mixing shall comply with requirements of AASHTO M 157 and the following conditions:

Each transit mixer shall be equipped with an approved automatic counter that will record the number of drum revolutions turned at mixing speed; or in lieu thereof, it may be equipped with an approved automatic counter that will record the number of revolutions regardless of drum speed, provided the drum is turned the required number of revolutions at mixing speed before leaving the batching plant. In either alternate the counter must furnish a visible record of the count for inspection, and must be so designed as to prevent tampering. Water measuring equipment shall be so arranged that only the specified amount of water can be added to the batch and shall be equipped with a lock to prevent tampering. Water for flushing the drum shall be carried in a separate container with separate controls.

Mixer blade design shall approximate that of a stationary mixer to facilitate mixing rather than discharging. Discharge of the batch may be expedited by tilting the drum toward the discharge end. The mixer shall be capable of discharging an 8 cubic yards {6 m^3} batch of maximum 1.5 inch {40 mm} slump within one minute.

e. Nonagitator Trucks.

Nonagitator truck bodies for hauling concrete will be accepted for use only on a trial basis and subject to satisfactory performance without segregation.

Bodies for nonagitator hauling equipment shall be designed or modified for that purpose and shall be smooth, mortar tight, metal containers equipped with gates or positive means that will permit control of the discharge rate without segregation. Covers shall be provided when needed for protection against the weather.

3. SPREADING AND FINISHING EQUIPMENT.

Minimum spreading and finishing equipment shall consist of a mechanical spreader and/or strike-off screed, a finishing machine, vibrators for full width vibration of the paving slab, smoothing float, 15 foot {5 m} straightedge, floats, burlap drags, and curing equipment. Approved means for placing reinforcement, tie bars, joint assemblies, and contraction joints, where required, shall be provided in the proper sequence in the paving train.

Appropriate changes in the equipment train shall be made when stationary mixers are used.

For ramps of narrow widths, where the width of slab changes, and at other points where the use of a full paving train is impractical, the Engineer may permit the use of a modified paving train, providing essentially the same basic operation of a standard paving train.

a. Finishing Machine.

The transverse finishing machine shall be equipped with at least two oscillating type transverse screeds capable of being accurately adjusted to the specified crown of the pavement, shall be power driven, shall be mounted in a substantial frame capable of withstanding severe use, shall ride

on the side forms, and shall be so designed as to finish the concrete to the required grade and crown. The longitudinal finishing machine shall consist of a cutting and/or smoothing float, or floats, suspended from and guided by a rigid frame. The frame shall be carried by four or more wheels riding on side forms or the prepared subgrade.

b. Vibrators.

Consolidation of the concrete paving slab shall be accomplished by the use of internal vibrators either of the immersed tube or multiple spud type. These vibrators may be attached to the spreader, the finishing machine, or mounted on a separate carriage. The frequency of the tube type vibrators shall not be less than 5000 impulses per minute; for the spud type not less than 7000 impulses per minute except when either hand operated or used adjacent to forms, then the frequency shall not be less than 3500 impulses per minute. The vibrators shall not come in contact with the joint, load transfer devices, reinforcing steel, subgrade, or side forms. The spacing of the equipment mounted vibrators and the amplitude of vibration shall be such that the vibration will be perceptible on the full width of the concrete slab being placed. Controls for the machine mounted vibrators shall be such that vibration will cease immediately when the forward motion of the machine is stopped. The Contractor shall provide a suitable device for checking or monitoring the actual frequency of the vibrators.

4. CONCRETE SAWS.

For sawing of joints, the Contractor shall provide sawing equipment, adequate in number of units and power to complete the sawing to the required dimensions and at the required rate. At least one standby saw in good working order with an ample supply of saw blades shall be maintained at the site of the work at all times during paving operations. The Contractor shall provide adequate approved artificial lighting facilities for night sawing.

5. FORMS.

When the use of forms is specified or elected, the forms shall be straight side forms made of a metal having a thickness of not less than 7/32 of an inch {6 mm}. They shall have a depth at least equal to the prescribed edge thickness of the concrete, without horizontal joint, and a base width equal to the depth of the forms. Flexible or curved forms of proper radius shall be used for curves of 100 foot {30 m} radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer. Forms shall be provided with adequate devices for secure setting so that when in place they will withstand the impact and vibration of the consolidating and finishing equipment. Flange braces shall extend outward on the base not less than 2/3 the height of the form. Forms with battered top surfaces, and bent, twisted, broken, or built up forms shall be removed from the work.

The top face of the form shall not vary from a true plane more than 1/8 of an inch in 10 feet {3 mm in 3 m}, and the upstanding leg shall not vary more than 1/4 of an inch {6 mm}. The forms shall contain provisions for locking the ends of abutting form sections together tightly, and for secure setting. Auxiliary forms for the construction of raised edge or integral curb, unless otherwise directed, shall be of metal and of such design as will permit secure fastening to the regular forms.

6. EQUIPMENT FOR SMALL CONTRACTS.

For contracts requiring less than 10,000 square yards {8500 m^2} of concrete pavement, exceptions to the equipment previously noted in this Section will be permitted within the following guide lines:

A complete batching plant will not be required; however, the Contractor shall provide satisfactory equipment for measuring and batching of materials within the accuracy requirements previously noted.

At least a three bag mixing unit capable of providing an acceptable mixture will be required.

In lieu of a complete paving train, suitable equipment capable of providing all of the designated steps of placement, spreading, vibration, shaping, placement of steel, finishing, and curing within the requirements previously noted in this Section shall be provided.

(b) MIXING AND PLACEMENT LIMITATIONS.

1. WEATHER.

Concreting operation will not be permitted when, in the opinion of the Engineer, the weather or other conditions are in any way unsuitable.

In case of rain of sufficient intensity to damage the surface of fresh concrete, mixing shall be discontinued promptly. The Contractor shall have available at all times, in the vicinity where

pavement is being placed, a sufficient supply of polyethylene or strong paper sheeting to cover all pavement soft enough to be damaged by rain. Any pavement damaged by rain shall be removed and replaced without additional compensation.

2. TEMPERATURE CONTROL.

Concrete shall not be mixed or spread when the ambient air temperature in the shade is 40 °F {4 °C} or below.

Should the air temperature drop below 35 °F {2 °C} within 24 hours after placement of the concrete, protection shall be furnished the new pavement in accordance with the requirements of Item 450.03(m)4.

3. LIGHT REQUIREMENTS.

No concrete shall be mixed, placed, or finished when the natural light is insufficient for proper inspection of the work, unless an adequate approved lighting system is available. The Contractor shall have an approved and available lighting system for any finishing operation that cannot be completed in normal daylight hours. Sawing of or preparation of joints, as well as grinding of the surface to correct surface deficiencies, may of necessity require night operations to keep abreast of the work and will also require an adequate approved lighting system.

(c) PRECONDITIONING OF SUBBASE PRIOR TO PLACEMENT OF PAVEMENT.

1. GENERAL.

Regardless of the method to be used in placement of the pavement (with or without forms), the subbase shall be checked by a check template just ahead of the concrete placement, so as to indicate positively any high or low spots for final correction before placement of concrete. All high areas shall be brought to correct elevation before the concrete is placed. Low areas shall be filled with concrete integral with the concrete pavement.

2. WATERING OF SUBBASE.

Where the subbase has not been primed, the subbase shall be thoroughly wetted the previous night or not less than six hours prior to placing of the concrete. Then, unless a waterproof cover is used, the subbase shall be sprinkled just before the placement of the concrete so as to be uniformly moist, but the method of sprinkling shall not be such as to form mud or pools of water.

Where the subbase has been primed, watering will not be required; however, the Engineer may direct the sprinkling of the area just ahead of the concrete placement if the area appears too dry.

(d) USE OF FORMS.

1. GENERAL.

When forms are to be used, the foundation under the forms shall be hard and true to grade so that the form, when set, will be firmly in contact for its whole length and at specified grade. Any grade which at the form line is found below established grade shall be filled to grade with the same material used in the subgrade, or other approved material, in thin, well-compacted lifts for a distance of 12 inches {300 mm} on each side of the base of the form, moistened as required, and thoroughly compacted. Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary.

2. FORM SETTING.

The Contractor shall provide suitable means acceptable to the Engineer for the fine grading of the strip which the forms are to be placed.

Forms shall be set sufficiently in advance of the point where concrete is being placed to permit proper checking. After the forms have been set to correct line and grade, the subbase shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. Sufficient forms shall be provided so that they may be left in place at least 12 hours after concrete is placed.

Forms shall be rigidly staked into place with each section tightly locked, free from play or movement in any direction. The forms, after concrete is placed, shall not deviate from true line by more than 1/4 of an inch {6 mm} at any point. Forms shall be cleaned and oiled prior to the placing of concrete.

3. CHECKING OF FORMS.

Just prior to placing of the concrete, the alignment and grade elevations of the forms shall be checked by the Contractor and any necessary corrections made. When any form has been disturbed or any subbase becomes unstable, the form shall be reset and rechecked.

(e) SLIP FORM METHOD.

1. GENERAL.

If the Contractor elects to use the slip form method in lieu of fixed forms, the following provisions shall apply along with all other provisions of this Section not in conflict therewith.

Special attention is directed to the treatments noted herein for the paver tracks and the pavement edges where multilanes are to be placed.

2. PREPARATION OF UNDERLYING SURFACE.

In addition to the preparation of the underlying surface as prescribed in Subarticle 450.03(c), the subgrade or the surface over which the tracks of the slip form paver travel shall be compacted and finished to the same requirements as required for the base layer immediately under the pavement. Any additional cost required to prepare the paving track paths will be considered incidental to the placing of the pavement by slip form method.

If the density of the base is disturbed by the fine grading on the above operation, it shall be corrected by additional compaction before the concrete is placed. The base shall be completed at least 500 feet {150 m} in advance of placing the concrete and, if any traffic is allowed to use the prepared base, it shall be rechecked and corrected, if necessary, immediately ahead of the placing of the concrete.

3. PLACING AND FINISHING.

a. General.

The concrete shall be placed with an approved slip-form paver designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine, in such a manner that only a minimum of hand finish will be necessary to provide a dense and homogeneous pavement in conformity with the plans and these specifications. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibration shall be accomplished with vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. The sliding forms shall be rigidly held together, laterally to prevent spreading of the forms, and shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur.

b. Placing of Concrete.

The slip-form paver shall be operated with a continuous forward movement and all operations of mixing, delivery, and spreading concrete shall be so coordinated as to provide a uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

Where sections of pavement are to be subsequently abutted with other lanes of pavement involving longitudinal or nearly longitudinal joints, the concrete adjacent to these joints shall be placed and finished either as required for fixed form paving methods or by use of false forms adjacent to the slip forms. The false forms shall be metal of a thickness sufficient to maintain the proper shape and continuity of the form line and shall be approved by the Engineer. The use of the false forms shall be subject to their performance in the field. If the Contractor is able to construct the pavement in a manner such that there is no measurable edge slump or misalignment, the Engineer may waive the use of the false form. Bracing of the false forms will be required and shall be accomplished at a rate such that at no time will there be more than 10 feet {3 m} of unbraced forms in use. False forms shall remain in place for a minimum of 90 minutes, unless the Engineer directs a longer period to prevent damage to the adjacent concrete.

c. Surface Finishing.

The surface smoothness and texture requirements shall be the same as when fixed forms are used, except that the tolerance for the 6 inch {150 mm} width just inside the edge of the pavement may be 3/8 of an inch {10 mm} under the 15 foot {5 m} straightedge, except where the edge will be a longitudinal joint in widening the pavement.

d. Curing.

Unless otherwise specified, curing shall be done in accordance with one of the methods included in Subarticle 450.03(m) of these specifications. The curing media shall be applied at the appropriate time and shall be applied uniformly and completely to all surfaces and edges of the pavement.

e. Protection of Pavement.

In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times materials for the protection of the edges and surfaces of the unhardened concrete. Such protective materials shall consist of standard metal forms or wood plank having a nominal thickness of not less than 2 inches {50 mm} and a nominal width of not less than the thickness of the pavement at its edge for the protection of the pavement edges, and covering material such as burlap or cotton mats, curing paper, or plastic sheeting material for the protection of the surface of the pavement. An adequate supply of the materials described above shall be available, loaded on vehicles which can be promptly delivered to where paving operations are in progress. When rain appears imminent, all paving operations shall stop and all available personnel shall begin placing forms against the sides of the pavement and covering the surface of the unhardened concrete with the protective covering.

f. Joints and Anchor System.

Joints and anchor system shall be constructed of the type, dimension, length, arrangement, and spacing and at the locations shown on the plans or directed. Reference is made to Subarticle 450.03(j) for additional data.

(f) HANDLING, MEASURING, AND BATCHING MATERIALS.

Aggregates shall be stockpiled in conformity with Subarticle 801.11(b).

Aggregates shall be handled from stockpiles or other sources to the batching plant in such a manner as to secure a uniform grading of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used. All aggregates produced or handled by hydraulic methods, and all washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipment requiring more than 12 hours in transit will be accepted as adequate binning only if the car bodies permit free drainage. Aggregates shall be in at least a saturated surface-dry condition at the time of the mixing. Sprinkling or spray mist as needed to insure this condition shall be provided.

The fine aggregate and each size of coarse aggregate shall be separately measured into hoppers in the respective amounts set by the Engineer in the job mix. Cement shall be measured by the bag or by weight {mass}. One bag of bulk cement shall be considered 94 pounds {42 kg}. Batches involving fractional bags shall not be allowed, except when bulk cement is used.

When mixing is at the site of the work, the aggregates and cement shall be transported separately from the batching plant to the mixer in batch boxes, vehicle bodies, or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped. Where cement or fly ash is batched in bulk, the Contractor shall use a suitable method of handling to prevent loss of material and arrange to provide positive assurance of the actual presence in each batch of the entire cement or fly ash content specified.

Loose cement and fly ash shall be transported to the mixer in tight compartments, separate from the aggregate, carrying the full amount required for the batch. Cement and fly ash in original shipping packages may be transported on top of the aggregates, each batch containing the number of bags required by the job mix.

Batches shall be delivered to the mixer separate and intact.

Loose cement not used the same day as batched shall be rejected.

Water may be measured either by volume or by weight {mass}. The accuracy of the water-measuring equipment shall be within a range of error of not over one percent. Unless the weight {mass} of the water is to be determined, the water-measuring equipment shall include an auxiliary tank of at least equal capacity from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to provide for checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank.

An approved air-entraining agent shall be added that will produce the required amount of entrained air. Methods and equipment for adding air-entraining agent, fly ash, or other additives into

the batch shall be approved by the Engineer. Equipment which will not accurately and continuously dispense the correct amount of additives will not be permitted.

Additives other than fly ash and air-entraining agents shall be used only when specified on the plans or authorized in writing by the Engineer. No additional compensation will be allowed for use of additives.

(g) MIXING AND TRANSPORTING CONCRETE.

The concrete may be mixed at the site of the work, in a central mixing plant or in transit mixers, all in accordance with Item 450.03(a)2.

Mixing time shall be measured from the time all materials, except water, are in the drum to the time the discharge chute opens.

Mixing time for a central mixing plant shall be in accordance with the requirements of AASHTO M 157.

Mixing time for on site mixers shall be as follows: For mixers having a rated capacity of 2 cubic yards {1.5 m^3} or less shall not be less than 60 seconds; for mixers of greater capacity, the mixing time shall not be less than 90 seconds. These mixing times may be reduced to 50 and 70 seconds, respectively, if evaluation by the Engineer determines a smooth, uniform, consistent mixture can be produced. Transfer time in multiple drum mixers is included in the mixing time.

Mixing time for transit mixers shall be in accordance with the provisions of Subitem 450.03(a)2.d. and AASHTO M 157.

The site or central mixer shall be operated at a drum speed as shown on the manufacturer's name plate of the mixer. Any concrete mixed less than the specified time shall be discarded and disposed of. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic feet {cubic meters}, as shown on the manufacturer's A.G.C. standard rating plate on the mixer; except that an overload up to 10 percent above the mixer's nominal capacity may be permitted provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

The batch shall be so charged into the drum that a portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.

Mixed concrete shall be transported in approved truck agitators at agitator speed or non-agitating trucks. When truck agitators are used, the maximum time of delivery of the concrete shall be as specified in ALDOT-170. When non-agitating trucks are used, discharge shall be completed within 30 minutes after introduction of the mixing water to the cement and aggregates. In the event it is found impractical to finish the surface satisfactorily within these time limits, the right is reserved to decrease the time limits as needed.

Retempering concrete by adding water or other means will not be permitted. Slump shall be determined by AASHTO T 119, and shall not exceed the specified slump plus 1/2 inch {13 mm}. Concrete that is not within the specified limits at time of placement shall not be used.

Air content shall be determined by ASTM C 173 or ASTM C 231 for stone and gravel and by ASTM C 173 for slag. The Chase Air Method may be used for quick checks of the approximate air content, but it shall not be used as a substitute for the more accurate volumetric and pressure methods.

Test specimens shall be made and cured by AASHTO T 23. Cylinders shall be tested by AASHTO T 22. Beams shall be tested by AASHTO T 97. Cement content, yield, unit weight {mass}, and air content (gravimetric) shall be tested by AASHTO Method T 121.

(h) PLACING CONCRETE.

Concrete shall be placed only on approved subgrade.

The concrete shall be spread in the process of being deposited on the subbase in such manner as to require as little rehandling as possible. Unless truck mixers, truck agitators, or nonagitating hauling equipment are equipped with means for discharge of concrete without segregation of the materials, the concrete shall be unloaded into a bucket or hopper from which it shall be discharged and then mechanically spread on the subbase in such manner as to prevent segregation of the materials. However, the Contractor will be permitted, if requested in writing, to dump, on a trial basis, directly from the transporting vehicle on the subbase through an approved spreader which will deposit the fresh concrete within the limits of the paving equipment's guides. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Any necessary hand

spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Pavement shall be constructed full width in one operation, unless separate lane construction is specified on the plans. When pavement is constructed in separate lanes, the junction line shall not deviate from the true line shown on the plans by more than 1/4 of an inch {6 mm} at any point.

Where concrete is to be placed adjoining a previously constructed concrete slab, that slab shall be at least 10 days old or shall have attained a modulus of rupture of at least 550 psi {3.8 MPa} as shown by tests of standard specimens cured under the same climatic and moisture conditions as the slab.

Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately by approved methods.

Concrete shall be thoroughly consolidated against and along the faces of all forms, joints, and throughout the pavement by vibrators.

Vibrators shall not be permitted to come in contact with a joint assembly, the subbase, or side form. Single unit vibrators shall be used along the side forms, joints, and at other locations not thoroughly vibrated by the vibrator assembly. In no case shall the vibrator be operated longer than 15 seconds in any one location. Carriage mounted vibrators shall be equipped to cut off automatically when the vibrator carriage stops. Vibration shall be completed ahead of the finishing machine screed.

Expansion joint assemblies shall be installed in proper sequence ahead of placement of concrete.

Concrete shall be deposited as near to expansion joints as possible without disturbing them, but shall not be dumped from the dishcarge bucket or hopper onto a joint assembly.

Concrete shall be shoveled against both sides of the joint simultaneously, maintaining equal pressure on both sides. It shall be deposited to a height of approximately 2 inches {50 mm} more than the depth of the joint and shall be vibrated so that honeycomb and voids are prevented. The vibrator shall be inserted in the concrete and worked along the full length and both sides of the joint.

(i) STRIKE-OFF AND PLACEMENT OF REINFORCEMENT.

1. GENERAL.

After the concrete has been placed as specified above, it shall be spread, struck off, and screeded by mechanical means. The spreader may be either paddle, screw, hopper, or other type that will spread the mixture uniformly for the full width between forms. The spreader unit may include a strike-off screed or the strike-off may be a supplementary unit. The strike-off screed shall be designed to operate on top of the forms for plain concrete and inside the forms for the first layer of reinforced concrete when placed in two layers.

Concrete strike-off and screeding shall conform to the crown and cross section shown on the plans or ordered in writing and shall be so performed that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation indicated on the plans and free from porous areas. At points where it is impractical to use a mechanical strike-off, other methods may be employed, subject to the approval of the Engineer.

2. PLACEMENT OF STEEL.

Care shall be taken before and during paving operations to insure that the reinforcement (including dowels as well as tie bars) will stay within the plan tolerances after the finishing operations.

Reinforced concrete pavement shall be placed in two layers except for continuously reinforced concrete, unless otherwise provided. The entire width of the bottom layer shall be struck off to such length that the sheet of fabric or bar mat shall be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete after which the top layer of the concrete shall be placed, struck off, and screeded as specified for plain concrete pavement in the preceding Subarticle. Any portions of the bottom layer which have been placed more than 15 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete.

With written approval of the Engineer, the Contractor may, by use of a satisfactory mechanical mesh placer, embed the wire mesh reinforcement in the concrete placed full depth in one layer in lieu of the two layer method. Approval of this method will be on a trial basis and subject to continued satisfactory operation of the mesh placing equipment.

Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale, and loose or thick rust which would impair bond of the steel with the concrete. Rust that produces only discoloration without reducing the cross section of the steel will not be considered objectionable. Bars shall be

handled with such care that loose bars shall be free from kinks or bends sufficient to prevent proper assembly or installation.

When bar mat assemblies or continuous reinforcement are used, the reinforcing shall be assembled, placed, secured (firmly fastened together at all intersections), and lapped as detailed on the plans.

Longitudinal continuous reinforcement bars shall be lapped and tied in a skewed pattern as shown on the Plans.

When steel fabric is used, it shall be placed in sheets or strips at the depth shown on the plans. Equal clearance shall be provided on each side of the slab, and successive sheets shall be lapped as called for on the plans. Reinforcement shall be continuous without interruption at emergency construction joints. All laps between sheets shall be held firmly together by wires or clips spaced not more than 4 feet {1.2 m} apart.

Continuous reinforcement shall be installed in accordance with details shown on the plans. Preset chairs shall be similar to one of the alternates provided by the plans, or other approved devices. The height of preset chairs or supports shall be that shown on the plans within a tolerance of 1/8 of an inch {3 mm}; the arrangement and spacing shall be such that the reinforcement will be supported and held in the correct position within the allowable tolerances during the placing and consolidating of the concrete; sufficient bearing at the base of the device shall be provided to prevent overturning or penetration into the subbase; the design of the devices shall be as not to interfere with placing and consolidating the concrete.

Temporary gaps in continuous reinforced concrete pavement should be avoided. If "leave-outs" cannot be eliminated, one of the following methods shall be used:

a. Placement of the proposed "leave-outs" first and the placing of the larger sections last. In this case the construction joint shall be modified to require 50% additional longitudinal steel to be added using the same nominal size deformed bars used in the regular longitudinal reinforcement and be of a sufficient length to provide a 3 foot {1 m} bonded length in the first pour and a 7 foot {2 m} bonded length in the second pour.

b. If a "leave-out" is an absolute necessity, the "leave-outs" shall have the longitudinal steel through the construction joint increased 50% using the same nominal size deformed bars used as the regular longitudinal reinforcement. The additional bars shall be bonded at least 3 feet {1 m} into the pavement adjacent to the "leave-outs" and all longitudinal bars shall extend into the "leave-outs" a minimum of 7 feet {2 m}.

The "leave-outs" should be paved during stable weather conditions (small daily temperature cycle between 0-10 degrees). Extreme care shall be taken to prevent honey combing and insure consolidation of concrete around the steel reinforcement. If the temperature change is anticipated to exceed 15 °F {10 °C}, the curing operations shall be modified to require stabilization of the curing temperature by the use of insulating material on the adjacent pavement surface for a minimum distance of 200 feet {60 m} (longer if directed by the Engineer) from each free end of the pavement slab. The insulating material shall be installed at least 72 hours prior to placing of the concrete and kept wet. The "leave-outs" shall be wet cured until the new concrete obtains a modulus of rupture of 550 psi {3.8 MPa}; the insulating material shall be kept on the adjacent pavement during this curing period.

(j) JOINTS.

1. GENERAL.

Joints shall be constructed of the type, dimensions, lengths, arrangement, spacing, and at the locations shown on the plans or directed, and in accordance with the following requirements:

A joint is defined as a designed separation, formed by material extending full depth of the slab or saw cut extending part way through the slab.

A contraction joint is a transverse joint located at regular intervals in a slab to control transverse cracking or at other designated sites to control longitudinal cracking.

An expansion joint is one providing space for expansion of the slab without damage. For clarity, all expansion joints, including those in intersections at whatever angle, are regarded as transverse joints.

A construction joint is one made necessary by interruption of more than 30 minutes in continuous placing of concrete, including a transverse joint placed at the end of a day's operation or at the point of a breakdown, or a longitudinal joint where adjacent lanes are constructed at different times.

Longitudinal joints shall be constructed coincident with or parallel to the pavement centerline.

Transverse joints shall be constructed skewed to the pavement centerline as indicated by plan details.

All vertical joints shall be constructed perpendicular to the pavement surface.

All joints except expansion joints shall be prepared by sawing. Sawing by means of an approved concrete saw equipped with a guide frame or other approved devices that will assure cutting of the joint within 1/4 of an inch {6 mm} of the designated alignment and to the required size sealing slot designated by the plans or directed.

Because of the importance of placing the joints at the proper location and at the proper time, all joints shall be formed or constructed, except for sealing, either during the actual paving operations or as soon as the concrete has hardened to the degree that tearing and raveling is not excessive, and before uncontrolled shrinkage cracking begins. This time may be as short as four hours or even less in extremely warm weather, but not over six hours unless authorized by the Engineer. Early sawing is imperative and raveling of occasional particles of aggregate in sawing will not be considered excessive. Sawing shall be omitted where a crack has already formed at or near the joint location, or develops ahead of the saw. These joints in the green concrete shall be sawed initially at intervals designated on the plans or directed. Special saw blades may be required. The Contractor shall be responsible for marking locations of joint steel in advance of placement of concrete so that sawed joints will be properly located over dowels and tie bars.

If extreme conditions exist which make it impractical to prevent uncontrolled cracking by early sawing, the procedure shall be revised immediately to adjust the sequence of sawing.

2. LONGITUDINAL JOINTS.

Deformed steel tie bars of specified length, size, spacing, and material shall be placed perpendicular to the longitudinal joints; they shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement. The bars shall not be painted or coated with asphalt or other material, or enclosed in tubes or sleeves.

The longitudinal joint shall be constructed so that it is in contact with all transverse joints.

When adjacent lanes (including shoulders) are constructed separately, the joint shall be of a type shown on the plans. When using the fixed form method, the use of a keyway with a sectional tie bar or a straight tie bar bent against the form of the first slab constructed is acceptable, or in lieu thereof the procedure noted for use with the slip-form method may be used. When using the slip-form method, the tie bars shall be anchored in appropriately sized holes drilled into the first lane constructed in accordance with the following: (1) Drilling equipment shall be adequately sized and capable of providing an accurately drilled hole 1/8 inch {3 mm} larger than the nominal size of the tie bar being used and of the depth necessary to properly install the tie bar at locations specified by the plans without damaging the pavement surface or the side of the pavement slab. A template to control vertical and horizontal alignment shall be used during the drilling operation. Said equipment must demonstrate acceptable results before the Engineer will approve its use on the work. (2) No drilling will be allowed on any slabs until the concrete has obtained a compressive strength of 3000 psi {21 MPa} or is seven days old. (3) Tie bars shall be anchored in the drilled holes with an approved adhesive material meeting the requirements of Article 870.04. Installed tie bars shall meet a 7200 pound {32 kN}, minimum, pull-out requirement. The Department will perform the pull-out tests in accordance with ALDOT-366.

When adjacent lanes of pavement are constructed simultaneously, a weakened plane joint shall be constructed by sawing.

Sawing of the joint to the size and shape indicated by the plan details for this type joint, and the joint shall be sealed with an approved joint sealer.

3. TRANSVERSE EXPANSION JOINTS.

a. The materials for a transverse expansion joint, including dowels and supports, shall be assembled off the subbase, and placed into position as a unit, in accordance with the requirements noted herein. Expansion joint filler shall be limited to the types specified in Subarticle 832.01(c) unless otherwise specified on the plans. Expansion joints shall be sealed as provided in Article 450.05. Load transfer devices shall be as specified in Item 450.03(j)7.

b. After the subbase has been approved, the expansion joint assembly shall be carefully placed in position at the angle to the centerline of the pavement as shown on the plans. The

top of the joint filler shall be set at the indicated distance below the pavement surface, and the elevation checked.

Concrete shall not be placed unless the methods and devices used by the Contractor for installing and securing the joint filler and finishing the joint meet with the approval of the Engineer. Finished joints shall not deviate more than 1/4 of an inch {6 mm} in horizontal alignment from a straight line. If joint fillers are assembled in sections, or if joints as a whole are constructed in sections, there shall be no offsets between adjacent units. Load transfer units shall be checked for exact position when the assembly is staked in place on the subgrade.

4. SPECIAL TRANSVERSE EXPANSION JOINTS AND EXPANSION JOINTS AT STRUCTURES.

At each end of a fixed structure such as a bridge, a special slab section, or a bridge end slab, a special expansion joint with filler will be required when shown on the plans. In addition to these special joints, two standard expansion joints will be required from the end of the bridge end slab at locations shown on the plans or designed.

An expansion joint shall be placed around each structure which extends into or through the pavement. Filler for expansion joints at manholes, curbs, and adjacent to other curving surfaces shall be 3/4 of an inch {20 mm} thick flexible premolded material of any type provided under Section 832. Joint sealer material shall be the same as used for other expansion joints.

5. TRANSVERSE CONTRACTION JOINTS.

Transverse contraction joints shall consist of planes of weakness created by sawing grooves in the surface of the pavement as described in Item 450.03(j)1 in accordance with the details shown on the plans.

All contraction joints shall be sealed as specified in Article 450.05.

All contraction joints shall be properly aligned and, except at intersections, shall be formed in continuous lines reaching across all traffic lanes.

6. TRANSVERSE CONSTRUCTION JOINTS.

Transverse construction joints shall be formed as shown on the plans.

Transverse construction joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 10 feet {3 m} of an expansion or contraction joint. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet {3 m} long, the excess concrete back to the last preceding joint shall be removed and disposed of as directed.

The construction joint shall be formed by placing the concrete against a header board set so as to form a joint at right angles to the pavement centerline vertically and horizontally. The board shall be shaped to the crown of the pavement and shall be sufficiently rigid to prevent bending or movement during finishing operations.

7. LOAD TRANSFER DEVICES.

All transverse joints requiring the use of load transfer devices shall utilize dowel bars and an approved supporting assembly capable of rigidly maintaining the dowel bars in the proper horizontal and vertical alignment during and after the concrete placing and finishing operations, all in accordance with plan details and the provisions of this Item.

Dowel bars shall meet the requirements of Article 835.05, unless otherwise noted by plan detail, with the ends ground or dressed to eliminate any projections due to cutting operations.

Expansion joints shall, in addition to the above, require any support assembly unit or part thereof crossing the joint to permit unrestrained movement of the joint. An approved dowel cap or sleeve shall be furnished for each dowel bar with one end which will fit tightly around the bar and the other closed and watertight. The cap or sleeve shall be provided with a stop to insure an unobstructed expansion space not less than the width of the joint being constructed will be left inside the cap beyond the end of the bar after the paving operation.

(k) BLANK.

(l) FINISHING.

1. GENERAL.

After the concrete has been placed, consolidated, and struck off as specified in Subarticles 450.03(h) and (i), finishing, floating, correcting surface, texturing, and edging shall proceed as specified herein.

2. TRANSVERSE FINISHING.

The surface shall be screeded by the approved finishing machine to the crown and cross section shown on the plans so that the surface of the pavement will be at the grade elevation indicated on the plans and free from porous places. During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of each screed for its entire length. The machine shall go over each area of pavement as many times and at such intervals as necessary to give a surface of uniform texture, true to grade and crown. Excessive operation over a given area shall be avoided.

The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variations tending to affect the precision finish. The finishing machine shall be fully and accurately adjustable for loss of crown, or other derangement due to wear.

The screed shall be moved forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing, and so manipulated that neither end is raised from the side forms during the screeding process.

3. FLOATING.

After the concrete has been consolidated and finished transversely, it shall be further finished longitudinally, trued, and consolidated by means of a float.

4. PRELIMINARY STRAIGHTEDGING AND SURFACE CORRECTION.

After the finishing has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested by the Contractor for trueness with an accurate 15 foot {5 m} floating straightedge.

The straightedge shall be held in contact with the surface in successive positions parallel to the road centerline and the whole area gone over from one side of the slab to the other as necessary with advancement along the road centerline made in successive stages of not more than 1/2 the length of the straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface correction shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and crown.

Final straightedging and correction of surface deficiencies shall be in accordance with Article 450.04.

5. SURFACE TEXTURE.

The pavement surface shall, unless otherwise specified by plan details, be finished by the use of a burlap drag followed by the further texturing of all mainline sections, acceleration and deceleration lanes, and ramps by the formation of transverse grooves.

The burlap drag finish shall consist of dragging longitudinally along the full width of the pavement with a seamless strip of damp burlap or cotton fabric which will produce a gritty texture. For pavements 16 feet {5 m} or more in width, the drag shall be mounted on a bridge which spans and transverses the pavement. The dimensions of the drags shall be such that a strip of fabric at least 3 feet {1 m} wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than two layers of fabric with the bottom layer approximately 6 inches {150 mm} wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance. Drags shall be maintained clean and free from encrusted mortar. Drags which cannot be cleaned shall be discarded.

Immediately after the pavement has been finished by the burlap drag, the surface shall be grooved. Grooving shall be produced by mechanical equipment designed for grooving plastic concrete utilizing rectangular shaped spring steel tines that will produce clean cut transverse grooves in the hardened surface. The tines shall be randomly spaced at intervals between center to center of tines of not less than 1/2 of an inch {13 mm} nor more than 1 inch {25 mm}. The tines shall produce grooves in the hardened surface which are 0.08 to 0.13 of an inch {2 to 3 mm} in width and from 1/8 to 3/16 of an inch {3 mm to 5 mm} in depth.

The completed grooved surface finish shall meet the groove depth requirements noted herein when tested in accordance with ALDOT-248 and all straightedge requirements noted in Article 450.04, shall be uniform in appearance and free of irregular, rough, or porous areas. Any grooved surface damaged or destroyed may be restored if the concrete is still plastic; otherwise, it shall be

regrooved after the concrete has obtained its designed strength. Grooving after the concrete has hardened shall be done by equipment designed specifically for grooving pavements.

6. EDGING AND JOINTS.

After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of expansion joints, including those adjacent to structures, curbs, and the like shall be edged with an approved tool and rounded to the radius required by the plans. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use. No edging or rounding shall be done at sawed or insert joints.

At all expansion joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. Along the edges of the slabs, the tool marks shall be left in place. All concrete on top of the joint filler shall be removed completely.

All joints shall be tested with a 15 foot {5 m} straightedge before the concrete has set, and correction made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

(m) CURING.

1. GENERAL.

Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly laid concrete shall be covered and cured in accordance with one of the following approved methods. In all cases in which curing requires the use of water, the curing operation shall have first claim to all water supply or supplies. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour between stages of curing and during the curing period.

Reference is made to Section 830 for material requirements of concrete curing agents.

2. BURLAP CLOTH, WATERPROOF PAPER, AND POLYETHYLENE SHEETING.

These covering materials shall be of sufficient size that the surface and both sides of the pavement slab shall be completely covered. The covering shall be so placed and ballasted as to cause it to remain in intimate contact with the pavement surface. Burlap Cloth shall be saturated with water before being placed and kept wet while in position. The covering shall remain in position for 72 hours after the concrete has been placed unless otherwise specified or directed.

3. IMPERVIOUS MEMBRANE.

Impervious membrane shall be applied under pressure at a rate of 1 gallon {4 liters} to not more than 135 square feet {12 m^2} of surface (applied in two applications) with a spray nozzle or nozzles, in such a manner as to cover the entire surface of the pavement with a uniform film and shall be of such character that it will harden within 30 minutes after application. If applied by hand, the two applications shall be at right angles. Hand or machine sprays, either single or multiple units, shall be equipped with a covering or hood over the spray to prevent it from being dispersed by the wind. The amount of liquid applied shall be ample to seal the surface of the pavement. The liquid shall be applied immediately after the surface film has disappeared and before the set of the concrete has taken place, or if the pavement is cured initially with burlap or cotton mats, it may be applied upon removal of the mats.

Upon removal of side forms, the sides of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

4. CURING IN COLD WEATHER.

When concrete is being placed and the air temperature may be expected to drop below 35 °F {2 °C}, a sufficient supply of suitable straw, hay, grass, or other suitable insulating material shall be provided along the work, and any time the temperature may be expected to reach the freezing point during the day or night, the material so provided shall be spread over the pavement to a sufficient depth to prevent freezing of the concrete. The period of time such protection shall be maintained shall not be less than five days. If required by the Engineer, concrete laid less than 24 hours shall also be protected by approved insulating material. The Contractor shall be responsible for the quality and strength of the concrete laid during cold weather, and any concrete injured by frost action shall be removed and replaced.

(n) REMOVAL OF FORMS.

Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least 12 hours, except auxiliary forms used temporarily in widened areas. They shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the ends of all joints shall be cleaned, after which the sides of the slab shall be covered with earth or other approved curing agent.

As soon as the side forms have been removed, any minor honeycombed areas shall be filled with mortar composed of one part of cement to two parts of fine aggregate by weight {mass}. Major honeycombed areas will be considered as defective work and shall be removed and replaced. Any area or section so removed shall be not less than 10 feet {3 m} in length nor less than the full width of the lane involved. If the area to be removed extends to a point less than 10 feet {3 m} from a joint, it shall be extended on to the joint.

450.04 Surface Test.

(a) TESTING DEVICE.

1. DESCRIPTION.

The testing device shall be a longitudinal profilograph including all accessories and chart paper herein described. The chart paper containing the log of the smoothness index shall become the property of the Department at the time the measurements are taken. The following categories cover the furnishing and disposition of the profilograph:

Pay Item 450-E - The furnishing, by the Contractor, of a new profilograph, including chart paper, and its reconditioning, if deemed necessary by the Engineer, and title transfer to the Department upon completion of its use on the project.

Pay Item 450-F - The furnishing, by the Department, of a profilograph for use on the project. The Contractor shall furnish the chart paper.

Pay Item 450-G - The furnishing, by the Contractor, of a new or acceptable used profilograph, including chart paper, for use on the project with the Contractor retaining ownership of the profilograph.

2. EQUIPMENT REQUIREMENTS.

The profilograph shall be a California type profilograph, completely equipped with all necessary accessories. The profilograph shall be hand-propelled and shall have multiple averaging wheels.

When the profilograph is required to be furnished by the Contractor, the Contractor shall calibrate the profilograph prior to delivery to the project and shall maintain the profilograph during the time its use is required on the project. When the profilograph is furnished by the State, the Department will calibrate and maintain the profilograph.

Chart paper for the profilograph shall be furnished in sufficient quantities for all calibration, test runs, and actual tests deemed necessary by the Engineer.

3. EQUIPMENT DELIVERY.

The profilograph shall be delivered to the project a minimum of two weeks before the beginning of the paving operation of the pavement layer to be tested to allow time for checking the profilograph.

(b) TESTING PROCEDURE.

1. DESCRIPTION.

The actual testing procedure shall be as outlined in ALDOT-335, a copy of which may be obtained from the office of the Materials and Tests Engineer. The Engineer reserves the right to make minor modifications to this procedure if he deems such will produce better results.

The profilograph test shall be performed as soon as practical after the pavement hardens sufficiently to prevent damage to the surface finish but no later than the next work day after placement of the concrete, unless otherwise authorized by the Engineer. The Contractor shall furnish the necessary personnel to operate the profilograph under the direction of the Engineer. Membrane curing damaged during the testing operation shall be repaired by the Contractor as directed by the Engineer.

Any pavement placed which the use of the profilograph is deemed inappropriate by ALDOT-335 or the Engineer shall be tested with a 15 foot {5 m} straightedge placed on the surface parallel to the centerline of the lane at points directed by the Engineer. Areas showing high spots of

more than 1/4 of an inch {6 mm} but not more than 1/2 of an inch {13 mm} under the 15 foot {5 m} straightedge shall be marked and immediately ground down with approved grinding equipment until the high spot is less than 1/4 of an inch {6 mm} high. Areas more than 1/4 of an inch {6 mm} low or 1/2 of an inch {13 mm} high under the 15 foot {5 m} straightedge shall be removed and replaced without additional compensation. Any area so removed shall not be less than 10 feet {3 m} in length nor less than the full width of the lane involved. If the area to be removed extends to a point less than 10 feet {3 m} from a joint, it shall be extended to the joint.

The profilograph test is considered a part of the paving operation and will be performed immediately in the proper sequence, in a satisfactory manner, even to the exclusion of other work.

2. RIDEABILITY REQUIREMENTS.

The results of the profilograph tests shall be evaluated by Department personnel as outlined in ALDOT-335.

If a Profile Index of 10 inches per mile {160 mm/km} is exceeded in any test section of any daily paving operation, the paving operation will be suspended as soon as possible after results of the unacceptable test section are obtained. The paving will not be allowed to resume until corrective action is taken by the Contractor.

All areas represented by high points having deviations in excess of 0.3 of an inch {7.6 mm} in 25 feet {7.6 m} or less shall be removed by the Contractor, without additional compensation, with an approved grinding device or a device consisting of multiple diamond saw blades until they are within the 0.3 of an inch {7.6 mm} tolerance.

All areas represented by low points having deviations in excess of 0.3 of an inch {7.6 mm} in 25 feet {7.6 m} or less shall be removed and replaced by the Contractor without additional compensation.

After removing all individual deviations in excess of 0.3 of an inch {7.6 mm}, as stated above, additional corrections shall be performed if necessary to reduce the Profile Index, as measured by the profilograph, to a maximum of 10 inches per mile {160 mm/km} per test section. When the Profile Index is 6 inches per mile {95 mm/km}, or more, per section, the Contractor may elect to take a cost reduction instead of reducing the Profile Index. When the Profile Index is below 3 inches per mile {45 mm/km} per section, a unit price increase will be added. The following schedule lists the Profile Index obtained with the corresponding price adjustment:

Profile Index Inches/mile/section {millimeters/kilometer/section}	Contract Price Adjustment Percent of Pavement Unit Bid Price
Under 3.0 {Under 45}	105
3.0 to less than 6.0 {45 to less than 95}	100
6.0 to less than 8.0 {95 to less than 125}	95
8.0 thru 10.0 {125 thru 160}	90
Over 10.0 {Over 160}	Unacceptable

The above price adjustment will be in addition to any reduction, if applicable, due to deficient pavement thickness as specified in Subarticle 450.15(b). Any price adjustment for rideability considerations will be applied to the square yardage {square meters} placed in those sections testing under 3, or 6 or more, inches/mile {under 45, or 95 or more, millimeters per kilometer} per section.

450.05 Sealing Joints.

Before the pavement is opened to traffic, and as early as is feasible, all joints, both longitudinal and transverse, shall be filled with joint sealing material of a type specified by the plans. The joint faces shall be clean and surface dry when the seal is applied. Suitable tools for installing the seal to the proper depth and dimensions shall be used. The joints shall be sealed as outlined in Section 454.

450.06 Reinforced Bridge End Slabs.

Special pavement slabs, reinforced as shown by plan details, shall be constructed adjacent to bridges using concrete of the same type and proportions in the adjoining concrete pavement or an approved Class A bridge concrete mix.

No direct payment will be made for reinforced steel used in the bridge end slabs.

The end slabs shall be constructed in the same manner prescribed for regular concrete pavement with the following exceptions:

1. A full paving train is not required.
2. Where the bridge end slab will be covered with a bituminous overlay, the final screeding of the surface of the concrete shall be by any means that will leave a slightly roughened surface.
3. Where the bridge end slab will not have a bituminous overlay, the final screeding of the surface of the concrete shall be done with a mechanical longitudinal screed and the hardened surface of the concrete shall be machine grooved in accordance with the requirements given for grooving the surface of concrete bridge decks.

450.07 Handling and Facilitating Public Traffic.

The Contractor shall be responsible for handling of traffic through the project when required by the plans or proposal.

Except where otherwise provided on the plans or in the proposal, all costs of handling and protecting traffic, or special equipment, of temporary road surfacing and its maintenance, of temporary protective barriers, and of other things to be provided or to be done under these provisions, shall be at the expense of the Contractor.

450.08 Opening To Traffic.

The Engineer will decide when the pavement shall be opened to traffic. The pavement will not be opened to traffic until specimen beams prepared in accordance with AASHTO T 23 have attained a flexural strength of 550 psi {3.8 MPa}, when tested in accordance with AASHTO T 97. If this strength is not obtained, or if such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening to traffic, the pavement shall be cleaned.

450.09 Protection of Pavement.

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. Any material deposited on the pavement considered detrimental to the surface shall be removed immediately. This requirement shall include erection and maintenance of warning signs, lights, watchmen to direct traffic, pavement bridges, or crossovers, etc., as needed or directed.

Any damage to the pavement by traffic or other causes, occurring prior to final acceptance of the pavement, shall be repaired or replaced in a satisfactory manner without additional compensation.

450.10 Blank.

450.11 Tolerance in Pavement Thickness.

Pavement (main roadway and shoulders) thicknesses will be checked for compliance with plan required thickness by measuring of cores in accordance with AASHTO T 148. Deficient thickness will be paid for on an adjusted unit price as provided in Subarticle 450.15(b). Determination of the limits of the paving units are to be used with the adjusted unit price will be as noted below.

Thickness measurements shall be made after all operations, if applicable, have been performed to improve rideability as specified in Article 450.04.

For main roadways, pavement units to be considered separately are defined as 1000 feet {300 m} of pavement in each traffic lane starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be 1000 feet {300 m} plus the fractional part of 1000 feet {300 m} remaining. One core will be taken at random by the Department in each unit. When the measurement of the core from a unit is not deficient more than 0.2 of an inch {5 mm} from the plan thickness, full payment will be made. Where such measurement is deficient more than 0.2 of an inch {5 mm} but not more than 1 inch {25 mm} from the plan thickness, two additional cores at intervals not less than 300 feet {90 m} will be taken and used in the average thickness for that unit.

For shoulder pavements 10 feet {3 m} and wider, the same method noted for main roadway units will apply, for shoulder pavement less than 10 feet {3 m} wide, the same method noted for the main roadway modified to use 2000 foot {600 m} pavement units and for additional cores, intervals of not less than 500 feet {150 m}.

Other areas such as intersections, entrances, crossovers, ramps, etc. will be considered as one unit, and the thickness of each unit will be determined separately. Small irregular unit areas may be included as part of another unit. At such points as the Engineer may select in each unit, one core will be taken for each 1000 square yards {850 m^2} of pavement, or fraction thereof, in the unit. If the core

so taken is not deficient more than 0.2 of an inch {5 mm} from the plan thickness, full payment will be made. If the core is deficient in thickness by more than 0.2 of an inch {5 mm} but not more than 1 inch {25 mm} from the plan thickness, two additional cores will be taken from the area represented and the average of the three cores determined. If the average measurement of these three cores is not deficient more than 0.2 of an inch {5 mm} from the plan thickness, full payment will be made. If the average thickness of the three cores is deficient more than 0.2 of an inch {5 mm} but not more than 1 inch {25 mm} from the plan thickness, the adjusted unit price provided in Subarticle 450.15(b) will be paid for the area represented by these cores.

In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 of an inch {5 mm}will be considered as the specified thickness plus 0.2 of an inch {5 mm}, and measurements which are less than the specified thickness by more than 1 inch {25 mm} will not be included in the average.

When the measurement of any core is less than the specified thickness by more than 1 inch {25 mm}, the actual thickness of the pavement in this area will be determined by taking additional cores at (not less than) 10 foot {3 m} intervals parallel to the center line in each direction from the affected location until in each direction a core is found which is not deficient by more than 1 inch {25 mm}. Areas found deficient in thickness by more than 1 inch {25 mm} shall be evaluated by the Engineer, and if, in his judgment, the deficient areas warrant removal, the Contractor shall remove and replace such with pavement of the thickness shown on the plans, all at no additional cost to the State. Replacement shall be in accordance with plan details and the details noted herein. Measurement of replacement pavement for thickness shall be as for a new section; however, in no event shall less than one core be taken.

Sections of deficient pavement designated for removal and replacement shall not be less than one traffic lane wide provided the required cross section and surface tolerances can be met, if not a full width section shall be removed; for length, the removal shall extend 5 feet {1.5 m} beyond the limits of the deficient thickness on both ends, except where standard joints of satisfactory construction are encountered. Formation of new construction joints will not be permitted.

For standard reinforced and plain concrete pavement, replacement pavement shall be joined to the retained section with the tie bars and dowels as would be required by the appropriate type joints used in the original construction.

For continuously reinforced pavement, no section less than 10 feet {3 m} in length shall be removed. All existing materials, with the exception of a 36 inch {900 mm} section of all longitudinal reinforcing bars at each end of the area and a 24 inch {600 mm} section of all transverse bars, shall be removed. New longitudinal bars 6 inches {150 mm} less than the length of the section involved shall be placed and firmly tied to the protruding retained bars. In addition, the same number of longitudinal bars less two shall be supplied in such length as to provide a 24 inch {600 mm} intrusion of each bar into each end of the retained pavement. These bars will be placed midway between the normal longitudinal bars, drilled and grouted into place. New transverse bars of the proper length to provide a minimum 20 inch {500 mm} lap to the protruding retained bars shall be provided; all steel reinforcement bars shall be firmly affixed to each other as required by the original details. For sections between 10 and 30 feet {3 and 9 m} in length, the additional longitudinal bars shall extend the full length of the area to be replaced, for sections greater than 30 feet {9 m} a minimum of 10 feet {3 m} at each end of the section shall have the additional longitudinal bars with the intermediate section reconstructed in accordance with the original details.

Special care shall be taken to place the repair pavement during stable weather conditions when the temperature cycle is small and to avoid honeycombing under the reinforcement. A wet cure method shall be used to minimize the temperature change of the concrete. An insulating material shall be placed on the retained portions of the pavement on each side of the repair area to minimize temperature changes in the existing pavement. This special curing method shall be used for at least 72 hours or until the new concrete obtains a flexural strength of 550 psi {3.8 MPa}.

Exploratory cores for deficient pavement thickness will not be used in averages for adjustments to unit price. No payment for areas deficient by more than 1 inch {25 mm} in thickness will be made until such is replaced with pavement of the proper thickness.

The Contractor shall fill all core holes with the proper mix without undue delay and without additional compensation.

450.12 Tolerance for Reinforcement and Other Steel.

The plan designated location for the distributed steel, tie bars, and dowel assemblies have been designed to provide the maximum design characteristics. Out-of-place steel will not allow proper functioning joints, etc., or furnish uniform design characteristics; hence, every effort shall be made to place and retain the steel in its plan designated location.

Excessive joint cracking should be investigated and should the steel be found to be misaligned in excess of 1/4 of an inch {6 mm} vertically and 1/2 of an inch {13 mm}, horizontally unless otherwise provided by the plans, the joint shall be removed and replaced. In such case, a section of not less than 5 feet {1.5 m} nor more than 10 feet {3 m} on one or both sides of the affected joint shall be removed and replaced. The replacement section shall be installed so as to provide a new acceptable joint in place of the one removed and a suitable tie with that portion of the slab retained by the use of a contraction joint consistent with the type pavement being installed. Any damage to reinforcement during removal operations considered by the Engineer to be detrimental to the pavement design shall be cause for ordering the removal and replacement of the affected steel. All of the above shall be in accordance with the provision of Article 105.10.

Tie bar steel shall be placed in such a manner that the bars will be retained in a reasonably true horizontal and vertical plane with the pavement surface. However, since the tie bar steel location is not as critical as the dowel steel, minor variation from the plan designated location will be acceptable provided the steel in no case is closer to either surface than 2.5 inches {65 mm}. Should, however, the tie bar placement be unacceptable or cause excessive joint cracking, the affected area shall be removed and replaced as prescribed above for dowel steel.

Mats of welded wire fabric or reinforcing bars used to provide the distributed steel for reinforced concrete pavement shall be placed in such a manner as to be retained at the location provided by the plans for this reinforcement.

Because of variations in the final distributed steel location due to acceptable construction and steel placement practices, the final slab will be evaluated in accordance with the following:

NOTE: The neutral axis (N.A.) of the paving slab is defined as the horizontal plane which passes thru the vertical center of the as poured paving slab. The N.A. for the "as poured slab" will be computed from coring samples taken for paving thickness check.

1. ACCEPTABLE LIMITS.

a. Standard Reinforced Pavement.

Upper limit of steel in vertical plane - plan specified locations + 1/2 of an inch {13 mm}, but in no case closer than 2 inches {50 mm} from the surface of the slab.

Lower limit of steel in vertical plane - plan specified locations + 1 inch {25 mm}, but in no case below the neutral axis of the slab.

b. Continuous Reinforced Pavement.

Upper limit of steel in vertical plane - plan specified locations + 1 inch {25 mm}, but in no case closer than 2.5 inches {65 mm} from the surface of the slab.

Lower limit of steel in vertical plane - plan location + 1/2 of an inch {13 mm}, but in no case more than 1/2 of an inch {13 mm} below the neutral axis of the slab.

2. MODIFIED ACCEPTABLE LIMITS.

a. Standard Reinforced Pavement.

Distributed steel between the NA and 2 inches {50 mm} from the bottom surface of the slab will not be considered as 100% effective and the slab may be accepted provided 100% of the certified cost of the steel FOB jobsite is deducted from the unit bid price for the item.

b. Continuous Reinforced Pavement.

Steel outside the limits noted in Subitem 1.b above but in no case less than 2 inches {50 mm} from the upper surface of the slab may be accepted provided 100% of the certified cost of the steel FOB jobsite is deducted from the unit bid price for the item. Steel outside the lower vertical plane limits noted in Subitem 1.b above will not be acceptable.

3. NON ACCEPTABLE LIMITS.

Distributed steel outside of the extreme upper and lower limits noted in Items 1 and 2 above are not acceptable, and the pavement shall be removed and replaced at no additional cost to the State.

The location of the reinforcing steel shall be checked by evaluation of the corings taken for pavement thickness as provided in Article 450.11 or the use of a suitable non-destructive type steel locating device.

When a core indicates the steel to be misplaced, additional checks will be made as directed by the Engineer to locate the limits of the misplacement.

450.13 Blank.

450.14 Method of Measurement.

The amount of concrete pavement to be paid for under this section shall be the number of square yards {square meters} of pavement completed and accepted, measured in place and calculated to the nearest square yard {square meter}. The width will be the width of the pavement shown on the typical cross section of the plans plus additional widening where called for, or directed by the Engineer in writing. The width will be the outside to outside measurement of the pavement including any area covered by integral curb or concrete median strip. The length will be measured along the surface of the centerline.

Reinforced concrete bridge end slabs will be measured in square yards {square meters} and will be paid for separately.

Completed and accepted integral curb will be measured in feet {meters} of curb along the surface of each curb.

The number of profilographs measured for payment will be the actual number of units ordered and accepted.

450.15 Basis of Payment.

(a) GENERAL.

The square yardage {square meters} of concrete pavement and bridge end slab, measured as provided above, will be paid for at the contract unit price bid per square yard {square meter}, which payment shall be full compensation for furnishing and placing all materials, including any reinforcing steel and supports, anchor concrete, sleeper slab concrete, steel beams, dowels, and all other joint material, any additives, and for all materials, equipment, tools, labor, and incidentals required to complete the work (including the finishing, grooving, or tining of the surface), provided, however, that for any pavement found deficient in thickness by more than 0.2 inch {5 mm} but not more than 1 inch {25 mm} of the specified thickness, only the reduced price stipulation below shall be paid; and provided appropriate adjustment is made for reinforced pavement as provided in Article 450.12 should steel reinforcement be outside the tolerances provided.

No additional payment over the contract unit bid price will be made for any pavement which has an average thickness in excess of that shown on the plans.

Integral curb, measured as provided above, will be paid for at the contract unit price per linear foot {meter} which shall be payment in full for all materials and work required in completing the item.

The ordered and accepted profilographs, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for furnishing the unit and includes all equipment, tools, labor, calibration, maintenance, services, supplies, chart paper, and incidentals necessary to complete these items of work.

(b) PRICE ADJUSTMENTS.

Where the thickness of pavement as described in Article 450.11 is deficient by more than 0.2 of an inch {5 mm} but not more than 1 inch {25 mm} from the specified thickness, payment will be made at an adjusted price specified in the following table.

Where steel reinforcement is outside the tolerance specified by the plans, the contract unit price bid shall be adjusted in accordance with the provisions of Article 450.12.

CONCRETE PAVEMENT DEFICIENCY	
Deficiency in Thickness Determined by Cores inches {millimeters}	Proportional Part of Unit Price Allowed Percent
0.00 to 0.19 {0.0 to 5.0}	100
0.20 to 0.39 {5.1 to 10.0}	80
0.40 to 0.59 {10.1 to 15.0}	70
0.60 to 0.79 {15.1 to 20.0}	60
0.80 to 1.00 {20.1 to 25.0}	50

When the thickness of pavement is deficient by more than 1 inch {25 mm} and in the judgment of the Engineer the area of such deficiency need not be removed and replaced, no payment for such deficient area will be made.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

450-A __* Cement Concrete Pavement, ___ inches {mm} Thick – per square yard {square meter}
450-B Reinforced Cement Concrete Bridge End Slab - per square yard {square meter}
450-C Integral Curb - per linear foot {meter}
450-E Profilograph - per each
450-F State Furnished Profilograph - per each
450-G Contractor Retained Profilograph - per each
* Plain, Reinforced, Plain High Early Strength, Reinforced High Early Strength, Continuous Reinforced

SECTION 452
SLABJACKING OF PORTLAND CEMENT CONCRETE PAVEMENT

452.01 Description.

The work covered by this Section consists of the raising and leveling of concrete pavements that have settled by the injection of grout under the pavement using hydraulic pressure to raise the pavement to its designated grade.

Due to the variations in quantities that can be experienced in this type work, the quantities for the items in this Section cannot be accurately determined before the work is done; therefore, the items in this Section shall be excluded from those items which may have their unit price adjusted as allowed by Subarticle 104.02(a). At any time during the life of the project, should any process or work herein be deemed ineffective or unnecessary by the Engineer, the Engineer may order any and/or all work under this Section stopped, reduced, and/or eliminated. In such case, the Contractor will be paid for all work ordered and performed. No claim will be considered because of elimination or reduction of work under this Section.

452.02 Materials.

(a) GENERAL.

Materials furnished for use shall conform to the appropriate requirements of Division 800, Materials, and the requirements noted in this Article.

(b) GROUT.

The grout used in slabjacking shall consist of one of the mixtures shown in Table I with the materials complying with the following:

Type I or III Cement - Article 815.01 and 815.03
Calcium Chloride - Section 805 Type I
Fly Ash - Section 806 Modified to waive the Loss on Ignition requirement
Water - Section 807
Admixtures - Sections 808 and 809

Limestone Dust - Limestone dust shall be thoroughly dry, free of lumps, meeting the following gradation requirements:

Size	% Passing by Weight {Mass}
No. 30 {600 µm} Sieve	100
No. 100 {150 µm} Sieve	90 - 100
No. 200 {75 µm} Sieve	65 - 100

Fine Sand - Fine sand shall comply with the appropriate requirements of Section 802 allowing the use of manufactured sand from limestone, sandstone or granite, or natural silica fine sand meeting the following gradation requirements:

Size	% Passing by Weight {Mass}
No. 10 {2.00 mm} Sieve	95 - 100
No. 60 {250 µm} Sieve	40 - 90
No. 200 {75 µm} Sieve	0 - 50
Percent Silt	0 - 25
Percent Clay	0 - 12
Percent Organic Material	0 - 3

Sand shall be non-plastic as determined by AASHTO T 89 and T 90.

452.03 Construction Requirements.

(a) EQUIPMENT.

1. The equipment for slabjacking of concrete pavement shall be that customarily used in the slabjacking of concrete pavement consisting of at least the following:

a. Air Compressors of sufficient capacity for operating pneumatic hammers.

b. A discharge pipe with an adequate securing device.

c. Pneumatic hammers equipped with drills that will cut 1.5 inch {38 mm} diameter or other approved diameter holes through the rigid pavement. The equipment shall be operated in such a manner so as to prevent unnecessary damage to the slab.

d. A 15 foot {4.5 m} (min.) straightedge and such other equipment as may be necessary to insure that the jacked slabs meet the alignment and surface requirements.

e. Blow pipe to enlarge void area.

f. Equipment for accurately measuring and proportioning by volume or weight {mass} the various materials composing the grout. When volume is used, the weight per cubic foot {mass per cubic meter} of the materials will be determined and mix proportions adjusted accordingly.

g. A batch type mixer, capable of thoroughly mixing the various components of the grout. A high speed, colloidal type mixer will be required for grout mixes containing only cement and fly ash.

h. A positive action pump capable of forcing grout through a drilled hole into voids and cavities beneath the pavement slab. The pump shall be capable of supplying adequate pressure at the end of the discharge pipe to insure filling of all voids at the required hole spacing. A gage shall be located on the discharge side of the pump to measure the pumping pressure.

i. A flow cone with all necessary components so that the Engineer may make an accurate field determination of the consistency of the grout. The flow cone shall conform to the dimensions and other requirements of U.S. Army Corps of Engineers' Test Method No. CRD-C79-58.

(b) JACKING OF PAVEMENT SLABS.

1. WEATHER LIMITATIONS.

Unless approved otherwise by the Engineer in writing, all slabjacking shall be performed between the dates of April 1 and November 1.

Slabjacking operations may not be started unless the air temperature, in the shade and away from artificial heat, is at least 35 °F {2 °C} and rising. Slabjacking shall stop if the temperature is 40 °F {4 °C} and falling or when the subgrade contains an abnormal amount of moisture as evidenced by standing water on the pavement or in joints or cracks.

To accelerate setting and provide early strength to mixes utilizing Type I cement, calcium chloride shall be used in the proportions tabulated below for respective temperature ranges.

Atmospheric Temperature	% Calcium Chloride by Weight {Mass} Of Type I Cement
35 – 55 °F {2 - 12 °C}	5
56 – 69 °F {13 - 20 °C}	4
70 – 79 °F {21 - 26 °C}	3
80 – 89 °F {27 - 31 °C}	2
90 °F {32 °C} and above	1

When Type III cement is used, 0-2 % calcium chloride may be required as needed to accelerate setting in cold weather.

2. PREPARATION OF GROUT MIXTURE.

The mixtures used in slabjacking shall consist of the proportions tabulated in Table I. The consistency may be varied by the addition of water and/or other additives. The quantity by weight {mass} of equivalent 100 % pure calcium chloride to be included in the mixture shall be in accordance with Item 1 above. The calcium chloride, when required, shall be thoroughly pre-mixed in the approximate quantity of mixing water required for a pre-determined batch size before combining with the other ingredients. The consistency of the grout shall be determined by the U.S. Army Corps of Engineers' Test Method No. CRD-C79-58. The quantity of mixing water used shall be that which will produce a grout of such consistency that the time of efflux from the flow cone will be a minimum of eighteen seconds and a maximum of twenty-five seconds for slabjacking. After the initial introduction of a sufficient amount of water into the mixture to obtain the necessary consistency, no additional water shall be added. The grout shall be used within one and one-half hours after introduction of water into the mixture.

Dry ingredients may be added to a mixed batch only in the amounts necessary to bring a too thin mixture to the required consistency. In this case the added dry ingredients shall be in the specified ratio. Grout which fails to meet the flow requirements specified above shall not be used in jacking operations.

A grout mixture shall be selected by the Contractor from the mixtures shown in Table I below. The Engineer reserves the right to specify a different mixture if the one chosen by the Contractor fails to produce the desired results.

TABLE I
GROUT MIXTURES
MIX PROPORTIONS
PERCENT BY VOLUME OF DRY INGREDIENTS

	GROUT TYPE					
	1	2	3	4	5	6
Fine Sand				30	50	50
Limestone Dust		50	80			30
Fly Ash	80	30		50	30	
Cement	20	20	20	20	20	20

3. CONSTRUCTION.

a. General.

Except as specifically outlined in these specifications, the techniques involved in the slabjacking operation shall be the option of the Contractor as long as the desired results are achieved.

Hole drilling patterns for pavement jacking shall be determined by the Contractor in the field based on conditions such as the size or length of the pavement area to be raised, the elevation difference, subgrade and drainage conditions, location of joints and cracks, and similar local circumstances. Extra holes may be required during the jacking process to apply additional pressure in a local area.

Holes may be washed with water or blown with air to create a small hole from which the grout slurry can then spread. The injection holes shall be drilled through treated base so the base may be lifted with the pavement.

Before slabjacking begins at a location, the Engineer will furnish the Contractor with the profile grade to be attained along with a nearby referenced point of elevation. The Contractor shall pump in a pattern and in the amount required to raise the pavement to within 1/4 of an inch {6 mm} of the designated grade.

b. Jacking.

During the jacking operation, the discharge end of the grouting apparatus shall not extend below the lower surface of the concrete pavement. Continuous pressures up to 200 psi {1.5 Mpa} will be permitted. Pressures to 300 psi {2.0 Mpa} will be allowed only for short periods. If the pavement is bonded to the subgrade, brief bursts of pressure to 600 psi {4.0 Mpa} will be allowed.

After slabjacking has been completed in a hole and the discharge pipe removed, the hole shall be plugged immediately with wooden plugs tapered to fit in the hole to retain the pressure of the grout and stop any waste or return flow of the mixture. When slabjacking to the desired elevation has been accomplished, the temporary plugs shall be removed and the hole filled with an approved stiff cement grout or concrete mixture.

Unless approved otherwise by the Engineer, slabjacking operations shall cease as early as necessary to permit the grout to harden at least three hours prior to allowing traffic back on the grouted slab before first darkness.

Lifting shall be done using sufficiently sized increments and change in injection locations to keep slab stresses to a minimum and to avoid cracking. Slabs which, in the opinion of the Engineer, have been damaged by the Contractor's operation or lack of control such that their repair or replacement is necessitated shall be repaired or removed and replaced at no cost to the Department.

c. Overjacking.

Any part of the pavement raised above the tolerances listed in Subitem 452.03(b)3.a. above shall, if so directed by the Engineer, be brought to grade by grinding. Should the overjacking be greater than 0.1 foot {30 mm}, the Department at its option may require removal and replacement of the pavement without cost to the Department and to its satisfaction with regard to area involved, method and time of replacement, and materials involved.

d. Radial Cracks.

Cracks emanating radially from the grout injection holes will be presumed to have been caused by improper injection techniques by the Contractor. For each 5 feet {1.5 m} of such crack measured, the Contractor's pay quantity shall be reduced by 0.25 bag of cement.

e. Unanticipated and Changed Conditions.

Should the Engineer deem that continued grout injection at any specific location is no longer economically feasible, he may direct the Contractor to cease grout injection at that location. The Contractor will be paid at the unit bid price for the material used up to that point. The Engineer, at his discretion, may delete any location or may add a new location to be raised. Due to unknown conditions and the experimental nature of this type work, variations of any size in the plan quantity will not be considered cause for any increase or decrease in the unit contract bid price.

452.04 Surface Requirements.

After the slabjacking has been completed at a location, and before cleaning and sealing of cracks, the pavement surface shall be tested with a 15 foot {4.5 m} straightedge placed on the surface parallel to the centerline of the lane at points as directed across the width of the pavement and lapping 1/2 the length of the straightedge progressing longitudinally along the pavement or with an approved rolling straightedge. The Contractor shall furnish the straightedge and personnel to operate it under the direction of the Engineer. Areas showing high spots of more than 1/4 of an inch {6 mm}, but less than 1/2 of an inch {13 mm}, under the 15 foot {4.5 m} straightedge shall be ground down with approved grinding equipment until the high spot is less than 1/4 of an inch {6 mm} high. If the area is more than 1/4 of an inch {6 mm} low or 1/2 of an inch {13 mm} high under the 15 foot {4.5 m} straightedge, the pavement in the affected area shall be repaired to the Engineer's satisfaction without additional compensation; such repair may require removal and replacement of the affected area. Any area so removed shall not be less than 8 feet {2.5 m} in length nor less than the full width of the lane involved. If the area to be removed extends to a point less than 8 feet {2.5 m} from a joint, it shall be extended to the joint.

452.05 Opening To Traffic.

Unless specifically authorized otherwise, no traffic, including construction equipment, will be permitted on the jacked slabs until at least three hours after the grouting has ceased. When Type III cement is used, traffic will be prohibited until initial set occurs. Initial set shall be defined as 800 psi {5.5 MPa} when tested in accordance with AASHTO T 197.

Slabs that have been removed shall be replaced the same day they are removed. No traffic, including construction equipment, will be permitted on the replaced slab until at least six hours after the slab has been poured.

Traffic shall be placed on grouted slabs before first darkness of the same day that the slabs were grouted; traffic shall be placed on replaced slabs no later than the morning following the day the slabs were replaced.

452.06 Method of Measurement.

Portland cement pressure grout for slabjacking will be measured for payment by the bag (94 pounds {42 kg}) of Portland cement used in the grout; all other ingredients required in the grout will not be measured for payment.

No other work under this Section will be measured for payment; this includes all hole drilling and any slab repair, removal, replacement, or grinding which may become necessary due to the slabjacking operation.

452.07 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Portland cement pressure grout for slabjacking, measured as noted above, will be paid for at the contract unit price bid per bag of cement used in the grout. This price shall be full compensation for furnishing of the grout, including all ingredients for the type mix designated, for mixing, for pumping of the grout, for all holes drilled, for any and all slab repair, removal, replacement, or grinding, and all equipment, tools, labor, and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

452-A Portland Cement Pressure Grout for Slabjacking - per bag

SECTION 453
PRESSURE GROUTING AND REPAIR OF PORTLAND CEMENT CONCRETE PAVEMENT

453.01 Description.

The work covered by this Section consists of the stabilization of existing unstable concrete pavement slabs by pressure pumping of a specified grout under the slabs along with the removal and replacement of designated shattered paving slabs or sections of slabs. The word slab in this Section shall mean not only a slab, or a portion of a slab, in a jointed concrete pavement system, but also a portion of a continuously reinforced concrete pavement.

Pressure pumping of grout or subsealing of the pavement slabs is intended to stabilize the slab by filling voids and cavities under the slabs with a grout mixture that will form a hard insoluble mass.

Removal and replacement of concrete pavement shall be as directed by the Engineer.

Cracking in concrete pavement is defined as follows:

Hairline cracks - Small, tight cracks which in width resemble shrinkage cracks. No corrective repair procedure is required.

Low severity cracks - Wider than hairline cracks with the crack opening clearly visible. The concrete on both sides of the crack is acting with interlock between the cracked pieces limiting movement of the individual pieces.

Medium severity cracks - The concrete on both sides of the crack is acting with partial interlock between the cracked pieces allowing potential or actual small movement of the individual pieces.

High severity cracks - The concrete on both sides of the crack is acting independently allowing unrestricted movement of the individual pieces.

If the crack does not have the same severity level along the entire length, the crack will be rated as the highest severity level present.

Appropriate repair procedures for the various types of cracked slabs in a jointed pavement are as follows:

Low severity cracking will not require the removal of pavement. These cracks will be routed and sealed under Item 454-A.

Medium severity cracking will require the removal and replacement of at least a portion of the concrete slab. The entire slab is to be removed and replaced if broken into four or more pieces by at least medium severity cracks.

High severity cracking will require the removal and replacement of at least a portion of the concrete slab. The entire slab is to be removed and replaced if it is broken into three or more pieces of high severity cracks.

Due to the variations in quantities that can be experienced in this type work, the quantities for the items in this Section cannot be accurately determined before the work is done; therefore, the items in this Section shall be excluded from those items which may have their unit price adjusted as allowed by Subarticle 104.02(a). At any time during the life of the project, should any process or work herein be deemed ineffective or unnecessary by the Engineer, the Engineer may order any and/or all work under this Section stopped, reduced, and/or eliminated. In such case, the Contractor will be paid for all work ordered and performed. No claim will be considered because of elimination or reduction of work under this Section.

453.02 Materials.

(a) GENERAL.

Materials furnished for use shall conform to the appropriate requirements of Division 800, Materials, and the requirements noted in this Article.

(b) GROUT.

The grout used in pressure grouting shall consist of one of the mixtures shown in Table I with the materials complying with the following:

Type I or III Cement - Articles 815.01 and 815.03
Calcium Chloride - Section 805 Type I
Fly Ash- Section 806 modified to waive the Loss on Ignition requirement
Water - Section 807
Admixtures - Section 808 and 809

Limestone Dust - Limestone dust shall be thoroughly dry, free of lumps, meeting the following gradation requirements:

Size	% Passing by Weight {Mass}
No. 30 {600 µm} Sieve	100
No. 100 {150 µm} Sieve	90 - 100
No. 200 {75 µm} Sieve	65 - 100

Fine Sand

Fine sand shall comply with the appropriate requirements of Section 802 allowing the use of manufactured sand from limestone, sandstone or granite, or natural silica fine sand meeting the following gradation requirements:

Size	% Passing by Weight {Mass}
No. 10 {2.00 mm} Sieve	95 - 100
No. 60 {250 µm} Sieve	40 - 90
No. 200 {75 µm} Sieve	0 - 50
Percent Silt	0 - 25
Percent Clay	0 - 12
Percent Organic Material	0 - 3

Sand shall be non-plastic as determined by AASHTO T 89 and T 90.

(c) CONCRETE.

Concrete for Portland Cement concrete pavement replacement shall meet the requirements of Section 501 for Class A, Type 1a mix, utilizing either Type III cement or Type I cement containing a non-chloride accelerator. The use of an accelerator will not be required when the ambient air temperature is above 85 °F {29 °C}.

(d) ADHESIVES.

Adhesives furnished for anchoring tie bars and dowel bars shall meet the requirements of Article 870.04.

453.03 Construction Requirements.

(a) EQUIPMENT.

1. The equipment for pressure grouting of concrete pavement shall be that customarily used in the pressure grouting of earthen embankments or in mud-jacking of concrete pavement consisting of at least the following:

a. Air compressors of sufficient capacity for operating pneumatic hammers.

b. A discharge pipe with an adequate securing device.

c. Pneumatic hammers equipped with drills that will cut 1.5 inch {38 mm} diameter or other approved diameter holes through the rigid pavement. The equipment shall be operated in such a manner so as to prevent unnecessary damage to the slab.

d. A portable gage apparatus which operates from the shoulder and is capable of monitoring slab movement during grouting of holes near the pavement edge. Dial gages with at least 1 inch {25 mm} of travel arm and capable of detecting 0.001 of an inch {25 μm} of movement shall be placed within 1 foot {300 mm} of the hole being grouted and 1 foot {300 mm} outside the edge of paving. The dial gage measuring movement within 1 foot {300 mm} of the hole being grouted shall have an arm length of at least 6 feet {1.8 m}. The base of the support for the gage apparatus shall be a minimum of 5 feet {1.5 m} outside the edge of paving during the monitoring of movement and shall be moved along the shoulder during the grouting of holes along the pavement edge. An engineer's level, furnished and operated by the Department, will be used, periodically throughout the day, to supplement the gage apparatus to monitor slab movement.

Alternate gage apparatus setups may be used if requested in writing by the Contractor and approved by the Engineer.

e. Blow pipe to enlarge void area.

f. Equipment for accurately measuring and proportioning by volume or weight {mass} the various materials composing the grout. When volume is used, the weight per cubic foot {mass per cubic meter} of the materials will be determined and mix proportions adjusted accordingly.

g. A batch type mixer, capable of thoroughly mixing the various components of the grout. A high speed, colloidal type mixer will be required for grout mixes containing only cement and fly ash.

h. A positive action pump capable of forcing grout through a drilled hole into voids and cavities beneath the pavement slab. The pump shall be capable of supplying adequate pressure at the end of the discharge pipe to insure filling of all voids at the required hole spacing. A gage shall be located on the discharge side of the pump to measure the pumping pressure.

i. A flow cone with all necessary components so that the Engineer may make an accurate field determination of the consistency of the grout. The flow cone shall conform to the dimensions and other requirements of ALDOT-338.

2. The equipment for removal and replacement of the concrete pavement slabs shall be suitable for the purpose intended and approved by the Engineer. Attention is directed to the operational requirements for removal and replacement in Subarticle (c) below.

(b) PRESSURE GROUTING OF PAVEMENT SLABS.

1. WEATHER LIMITATIONS.

Unless approved otherwise by the Engineer in writing, all pressure grouting shall be performed between the dates of April 1 and November 1.

Pressure grouting operations may not be started unless the air temperature, in the shade and away from artificial heat, is at least 35 °F {2 °C} and rising. Pressure grouting shall stop if the temperature is 40 °F {4 °C} and falling or when the subgrade contains an abnormal amount of moisture as evidenced by standing water on the pavement or in joints or cracks.

To accelerate setting and provide early strength to mixes utilizing Type I cement, calcium chloride shall be used in the proportions tabulated below for respective temperature ranges. Normal traffic flow may be resumed three hours after grouting.

Atmospheric Temperature	% Calcium Chloride by Weight {Mass} Of Type I Cement
35 – 55 °F {2 - 12 °C}	5
56 – 69 °F {13 - 20 °C}	4
70 – 79 °F {21 - 26 °C}	3
80 – 89 °F {27 - 31 °C}	2
90 °F {32 °C} and above	1

When Type III cement is used, 0-2% calcium chloride may be required as needed to accelerate setting in cold weather. Grouted slabs may be opened to traffic in accordance with Subarticle 453.03(d).

2. PREPARATION OF GROUT MIXTURE.

The mixtures used in pressure grouting shall consist of the proportions tabulated in Table I. The consistency may be varied by the addition of water and/or other additives. The quantity by weight {mass} of equivalent 100% pure calcium chloride to be included in the mixture shall be in accordance with Item 1 above. The calcium chloride, when required, shall be thoroughly pre-mixed in the approximate quantity of mixing water required for a predetermined batch size before combining with the other ingredients. The consistency of the grout shall be determined in accordance with ALDOT-338. The quantity of mixing water used shall be that which will produce a grout of such consistency that the time of efflux from the flow cone will be a minimum of 14 seconds and a maximum of 22 seconds for undersealing. After the initial introduction of a sufficient amount of water into the mixture to obtain the necessary consistency, no additional water shall be added. The grout shall be used within 90 minutes after introduction of water into the mixture.

Dry ingredients may be added to a mixed batch only in the amounts necessary to bring a too thin mixture to the required consistency. In this case the added dry ingredients shall be in the specified ratio. Grout which fails to meet the flow requirements specified above shall not be used in grouting operations.

A grout mixture shall be selected by the Contractor from the mixtures shown in Table I below. The Engineer reserves the right to specify a different mixture if the one chosen by the Contractor fails to produce the desired results.

TABLE I
GROUT MIXTURES

	Mix Proportions, Percent by Volume of Dry Ingredients					
	Grout Type					
	1	2	3	4	5	6
Fine Sand				30	50	50
Limestone Dust		50	80			30
Fly Ash	80	30		50	30	
Cement	20	20	20	20	20	20

3. CONSTRUCTION.

Selected slabs designated by the Department for pressure grouting shall be drilled as indicated on the plans or designated by the Engineer. For holes nearest the edges of the slab, the joints, or a major crack, a maximum of 3 inches {75 mm} from the precise marked location is considered to be reasonable. For other holes, a maximum 6 inch {150 mm} tolerance is considered to be reasonable. Should it become necessary or desirable to drill holes at locations other than those shown on the plans, such holes shall be drilled only as approved by the Engineer. In no instance shall holes be drilled in the wheel paths of a lane. The drills shall be rotated to avoid cracking the pavement and to provide satisfactory holes of the proper diameter for effective operations in pressure grouting. When drilling holes, the drills shall be held as nearly perpendicular to the pavement surface as possible. Holes which cannot be satisfactorily used in pressure grouting shall be filled with grout and not measured for pay; new holes shall be drilled.

After the holes are drilled, and just prior to pressure grouting, a high pressure air pipe may be required to clean the hole, if deemed necessary by the Engineer, to facilitate introduction of the grout.

After the holes are cleaned, the discharge hose on the pressure grout pump shall be connected to the hole in a manner that will provide adequate seal to maintain pressure past the

connection. The discharge end of the pipe shall not extend below the lower surface of the concrete pavement.

To fill all voids, pumping of grout will be required in holes designated by the Engineer. The maximum pressure allowed during the grouting operation will be 200 psi {1.5 Mpa}. A gage shall be located on the discharge side of the pump to measure the pumping pressure. Normally, indication that grout is flowing out of an adjacent hole or joint or the edge of the slab is sufficient evidence that all cavities or voids are filled within the range of the hole being grouted and pumping in such hole shall cease. Additional evidence that grouting should cease is a rapid rise of the slab, or indications of a rise of the adjacent shoulder. A minimal lifting of the slab will be allowed but not to exceed 0.05 of an inch {1 mm} per grouting pass. Care shall be taken not to crack slabs by differential lifting. Any slab or portion of slab or shoulder which is raised more than 0.05 of an inch {1 mm} each grouting will require corrective action, without payment, by the Contractor. Such corrective action shall consist of grinding or other methods approved by the Engineer.

After grouting has been completed in a drill hole, the discharge pipe shall be withdrawn and latent grout removed. The hole shall not be plugged unless authorized otherwise by the Construction Engineer. Patching of the hole shall begin after the grout has taken an initial set. The grout shall be removed to a minimum depth of 4 inches {100 mm} below the pavement surface. A low slump concrete mix consisting of 1-part Type I or Type III cement and 2-parts No. 100 concrete sand by volume shall then be placed in the hole, rodded and leveled with the pavement surface. Filled holes that later shrink below the finished surface, ravel out, or otherwise become damaged before project completion shall be repaired.

Corrective measures shall be taken in case stooling occurs by making proper adjustment in the stiffness of the grout being used. In case stooling does occur, additional holes shall be provided as directed and a more fluid grout shall be pumped through these new holes to fill the voids between the stools.

At least 24 hours, but no later than 5 days, after a slab has been grouted, it shall be tested for movement between the hours of 3:00 a.m. and 7:00 a.m. On cool, cloudy days, this time frame may be extended if approved by the Engineer. The test rolling equipment shall be rubber-tired and of sufficient weight {mass} to give a 20,000 pounds {90 kN} single axle load with a minimum of 10,000 pounds {45 kN} per side (a properly loaded dump truck may be used).

Each slab shall be tested by making one or more passes over it with the test roller. The rolling shall be slow enough to allow an observer to measure the movement and mark the slab if regrouting is needed. If the slab moves 0.03 of an inch {0.8 mm} or more during the test rolling, new holes shall be drilled and the slab regrouted. All slabs which have been regrouted shall be retested as outlined above for the initial testing.

After two returns for regrouting, should the slab fail the test rolling, the Engineer will make the decision to leave the slab as is, continue regrouting, or remove and replace the slab. Payment will be made under the appropriate pay items for the additional drill holes and grout used in the regrouting operation. The cost of test rolling shall be absorbed in other items of work.

The construction methods outlined above may be modified by the Engineer as field conditions indicate.

Pressure grouting operations shall cease at least three hours before sundown, except that on cloudy days pressure grouting operations shall cease earlier as necessary to permit grout to harden at least three hours prior to allowing traffic back on the grouted slab before first darkness. First darkness shall be defined as that time of day the average traveling public vehicle would first begin to use its headlights.

(c) REMOVAL AND REPLACEMENT OF PAVEMENT SLABS.

1. REMOVAL.

The extent of removal shall be as shown on the plans or directed by the Engineer. The slab section designated for removal shall be sawed as shown on the plans. The Contractor shall not oversaw the slab within 2 feet {600 mm} of another oversaw or within 2 feet {600 mm} of any type of joint. Transverse cuts for removal and the placing of new steel tie bars shall be performed as shown by plan details. The sections of pavement to be removed may be removed in any manner approved by the Engineer which does not damage the underlying base layer, adjacent concrete slabs, or the joint steel. Any damage to the underlying base or adjacent slabs shall be repaired to the satisfaction of the Engineer. Joint steel shall be cleaned and reconditioned to provide the same load transfer and/or tie as in the original pavement design. Any damaged or destroyed steel, which in the opinion of the Engineer would not function properly, shall be replaced in kind and retied to the old pavement by

drilling an appropriate size hole of the proper depth and anchoring the new bar with an approved adhesive material. This replacement also includes steel damaged or destroyed previous to the removal operation. All tie bars and dowel bars tied to the old pavement shall be anchored into place with an approved adhesive material in such a manner as to meet a 7200 pound {32 kN}, minimum, pull-out requirement. The Department will perform the pull-out tests in accordance with ALDOT-366.

Slabs shall be removed and replaced during the same day. Preparation for removal, including sawing the slab into smaller pieces, may be done the day prior to removal, but traffic shall be maintained on the slab the night before removal.

2. CONCRETE PAVEMENT REPLACEMENT.

After completion of removal operation, the joint steel and/or reinforcing steel shall be reconditioned or replaced (reconditioned means the cleaning and straightening of the steel bars and the cleaning, painting, greasing, replacement, etc. of the dowels), new tie bars placed as detailed by the plans, and the base cleaned and repaired as directed, and then the slab shall be poured.

The Contractor shall provide gang drills or templates that will provide the proper alignment for holes drilled for dowels or tie bars. The size of the drilled hole shall be 1/8 of an inch {3 mm} greater in diameter than the diameter of the dowel or tie bar being installed therein. The drill used shall not cause any spalling of the existing concrete around the face of the drill hole.

The Contractor shall provide a device that will place the adhesive in the back of the drilled hole first and then proceed toward the front. After the dowels or tie bars are anchored in place, the Contractor shall allow time for the adhesive to set and then allow sufficient time for any required pull-out tests to be preformed prior to pouring the replacement slab.

The concrete paving slab shall be poured in accordance with the provisions of Section 450 except that Structural Portland Cement Concrete meeting the requirements of Section 501 for a Class A, Type 1a mix, utilizing either Type III cement or Type I cement with a non-chloride accelerator, shall be used and a full paving train will not be required. Unless shown otherwise by the plans, the surface finish and slope of the new pavement shall be the same as the adjoining pavement slabs. If the pavement is to be covered by a bituminous overlay, a wood float finish and straight slope will be acceptable. All joints, except expansion joints, with adjacent pavement shall be butt type tied construction joints. Expansion joints shall be reconstructed so that the continuity of existing expansion joints are retained utilizing similar joint filler and sealed with the type sealer specified on the plans. Other reconstructed joints which require sealing shall be sealed with the specified type sealer. When a joint is completely removed, new materials shall be used throughout the joint. All materials necessary to repair or reconstruct the joints in or adjacent to the concrete pavement replacement is considered incidental to said replacement.

All joints shall be constructed in accordance with the provisions of Subarticle 450.03(j) except as noted herein. Due to the requirement for the use of either an accelerator or Type III cement in the concrete mix, extreme care shall be taken to see that joints are saw cut before uncontrolled shrinkage cracking begins.

Slabs that have been removed shall be replaced the same day they are removed.

The Contractor shall use such approved methods as necessary to keep all pavement surfaces adjacent to this operation reasonably clean of excess grout or other materials at all times.

(d) OPENING TO TRAFFIC.

No traffic, including construction equipment, will be permitted on the grouted slabs until at least three hours after the grouting has been completed.

No traffic, including construction equipment will be permitted on the replaced slab until at least six hours after the slab has been poured.

Traffic shall be placed on grouted slabs before first darkness of the same day that the slabs were grouted; traffic shall be placed on replaced slabs no later than the morning following the day the slabs were replaced.

453.04 Method of Measurement.

Each drill hole through the concrete paving slab ordered by the Engineer and placed in accordance with the requirements noted herein in this Section and properly filled after satisfactory use will be measured for payment.

Portland cement concrete grout will be measured for payment by the bag (94 pounds {42 kg}) of Portland cement used in the grout; all other ingredients required in the grout will not be measured for payment.

Concrete pavement removed will be measured in square yards {square meters} computed from surface measurements taken to the nearest 0.1 foot {0.1 meter}.

Concrete pavement replacement slabs will be measured by computing the theoretical cubic yards {cubic meters} of concrete necessary to replace the removed slab. The thickness used in computing the theoretical cubic yards {cubic meters} will be the average thickness necessary to replace the slab and to fill any voids, except those caused by the Contractor, underneath the slab.

453.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. DRILL HOLES.

Drill holes for stabilizing the concrete pavement, measured as noted above, will be paid for at the contract unit price bid per each which shall be full compensation for the drilling of the holes and the sealing of the holes after the satisfactory use thereof, and includes the furnishing of equipment, tools, labor, and incidentals necessary to complete this item of work.

2. PORTLAND CEMENT PRESSURE GROUT.

Portland cement pressure grout, measured as noted above, will be paid for at the contract unit price bid per bag of cement used in the grout, which shall be full compensation for furnishing the grout, including all ingredients for the type mix designated, for the mixing, for pumping of the grout, and for all equipment, tools, labor, and incidentals necessary to complete this item of work.

3. REMOVAL OF CONCRETE PAVEMENT SLABS.

Removal of concrete pavement slabs, measured as noted above, will be paid for at the contract unit price bid per square yard {square meter}, which shall be full compensation for the sawing and satisfactory removal and disposal of the old concrete, for the reconditioning or replacement of all steel and the concrete joint including all equipment, tools, labor, and other incidentals necessary to complete this item of work.

4. CONCRETE PAVEMENT REPLACEMENT SLABS.

Concrete pavement replacement slabs, measured as noted above, will be paid for at the contract unit price bid per cubic yard {cubic meter} which shall be full compensation for the furnishing of the concrete mix, the hauling of the mix, the forming, placing, including any new steel, sawing and sealing of joints, finishing and curing of the slab and for all equipment, tools, labor, and incidentals necessary to complete this item of work.

5. RIDEABILITY ACCEPTANCE.

Prior to the grouting operation, and after completion of the grouting operation, the Department will take rideability readings with a profilograph as outlined in ALDOT-335. A copy of this Procedure may be obtained from the office of the Materials and Tests Engineer. Any test section which experiences an increase in the rideability readings of 0.6 inches/mile {10 mm/km} or more shall be restored to within this range (less than 0.6 of an inch {10 mm}) by grinding at no cost to the State. Such grinding shall provide for an even pavement surface across longitudinal joints such as the centerline joint, lane joints, and shoulder joints.

Equipment used in grinding shall be a self-propelled unit specifically designed to grind Portland Cement concrete pavement using diamond grinding blades capable of grinding the designated surfaces without causing spalls at cracks or joints or at other locations. The equipment shall be of a size, shape, and dimension capable of working within the designated work limits without restricting the movement of traffic outside of the work limits.

The Contractor shall provide positive means for the removal of the grinding residue before such residue is blown by traffic action or the wind. Residue shall not be permitted to flow across lanes designated for traffic use or into gutters or other drainage structures.

The grinding process shall produce a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Said line type texture shall consist of parallel longitudinal corrugations of approximately 60 evenly spaced grooves per foot {300 mm} with the ridges approximately 1/32 of an inch {1 mm} higher than the bottom of the grooves.

The rideability specifications outlined herein above in this Item are applicable only to those lanes which do not receive grinding as specified in Section 455. Those lanes which receive grinding shall meet the rideability requirements of Subarticle 455.03(d).

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

453-A Drill Holes (Max. bid limited to $6.00 per Hole) - per each
453-B Portland Cement Pressure Grout - per bag (94 pounds {42 kg})
453-C Removal of Concrete Pavement Slab - per square yard {square meter}
453-D Concrete Pavement Replacement Slab - per cubic yard {cubic meter}

SECTION 454
CLEANING, SEALING, AND WATERPROOFING PORTLAND CEMENT CONCRETE PAVEMENT JOINTS AND CRACKS

454.01 Description.

This Section shall cover the work of repairing joints and cracks in existing concrete pavement in accordance with the following: Cleaning of all types of existing joints, the re-establishment of the joint shape or the cleaning and establishment of a sealable groove for cracks along with the sealing of the prepared joints and cracks; waterproofing of designated joints and/or cracks using a waterproofing membrane. The above work may be required individually or in combination as noted in this Article at the locations shown on the plans or as directed by the Engineer.

Cleaning and Sealing of joints and cracks will be classified by "Type" in accordance with the following:

Type I Cleaning and sealing of joints and cracks which are not to be covered by a bituminous overlay.

Type II Cleaning and sealing of joints and cracks which are to be covered by a bituminous overlay.

Waterproofing of Type II joints and cracks will be required prior to placing a bituminous overlay. Waterproofing of joints other than those joints covered under the provisions for the Cleaning and Sealing of Type II joints may be specified. The location of this treatment, when specified, will be shown by plan details or as directed by the Engineer.

454.02 Materials.

Materials, furnished for use, shall conform to the appropriate requirements of Division 800, Materials, and the following:

(a) SEALANT FOR SEALING OF TYPE I JOINTS.

The sealant for sealing Type I joints, except longitudinal edge joints, shall be a Low Modulus Silicone Type sealant meeting the requirements of Subarticle 832.02(c).

The joint configuration shown by plan details shall require a backer rod; said rod shall be compatible with the sealant and no bond or reaction shall occur between the sealant and the rod.

Unless directed otherwise by the Engineer, spalled areas adjacent to longitudinal joints will not require a concrete repair compound as specified below for transverse joints. Spalled areas adjacent to longitudinal joints will require filling with a Hot Poured Elastic Type sealant complying with the requirements of either Subarticle 832.02(b) or ASTM D 3406.

Based on the locations and sizes of the spalled areas along any given longitudinal joint, the Engineer will designate the limits of use of the Hot Poured Elastic Type sealant material within the given joint. The intent is to use the Low Modulus Silicone Sealant whenever possible but to minimize the number of changes in types of sealant within a joint.

The sealant for sealing longitudinal edge joints shall be a Hot Poured Elastic Type sealant complying with the requirements of either Subarticle 832.02(b) or ASTM D 3405.

The concrete repair compound for repairing spalls adjacent to transverse joints only, unless specified otherwise by the Engineer, shall be a high strength, quick set, job mixed compound meeting the requirements listed herein.

COMPONENT OF MIXTURE	MIXED BY WEIGHT {MASS} % of Comp. Weight/cubic foot of Batch {% of Comp. Mass/m³ Batch}		MIXED BY VOLUME % of Comp. Vol./ cubic foot Batch {% of Comp. Vol./m³ Batch}	
Type III Cement	15.7	23 pounds {368 kg}	12.7	0.9 gallons {120 L}
Water	6.8	10 pounds Max. {160 kg Max.}	16.9	1.2 gallons {160 L}
Sand	27.7	41 pounds {657 kg}	26.8	1.9 gallons {254 L}
Coarse Aggregates (ALDOT #7 or #78)	49.8	73 pounds {1170 kg}	43.6	3.1 gallons {414 L}
*Air, 5%	- -	- -	- -	2.5 cc/ft³ {88 cc/m³}
*Accelerator	- -	4 oz./cubic foot {4 kg/m³ }	- -	- -
* The air and accelerator admixtures and dosage rates shall be approved by the Engineer. Dosage rates may vary to attain desired results.				

When a job mixed concrete repair compound is used, the materials, apportioning of materials, and mixing thereof shall meet the approval of the Engineer. The apportionment of the materials shall be by using scales or appropriately marked containers.

(b) SEALANT FOR SEALING OF TYPE I CRACKS.

The sealant for sealing Type I cracks shall be a Hot Poured Elastic Type complying with the requirements of either Subarticle 832.02(b) or ASTM D 3406. Spalled areas adjacent to the cracks shall be filled with the same type sealant as used to fill the crack.

(c) SEALANT FOR SEALING OF TYPE II JOINTS.

The sealant for sealing Type II joints shall be a Hot Poured Elastic Type complying with the requirements of either Subarticle 832.02(b) or ASTM D 3406.

(d) SEALANT FOR SEALING OF TYPE II CRACKS.

The sealant for sealing Type II cracks shall be a Hot Poured Elastic Type complying with the requirements of either Subarticle 832.02(b) or ASTM D 3406.

(e) MEMBRANE FOR WATERPROOFING JOINTS AND CRACKS.

The waterproofing membrane shall incorporate a high strength, heat resistant mesh embedded in a layer of self-adhesive, rubberized asphalt with the following properties:

	REQUIREMENTS	TEST METHOD
Thickness	0.065 of an inch minimum {1.5 mm minimum}	
Permeance – Perms grains/sq.ft./hr., in. hg {57.2 ng/s•m²•Pa}	0.10 maximum {5.72 maximum}	ASTM E 96, Method B
Tensile Strength	50 pounds/inch {9 N/mm minimum}	ASTM D 882 (Modified for 1 inch {25 mm} opening)
Puncture Resistance (mesh)	200 lb. {45 N} Minimum	ASTM E 154
Pliability – 1/4 of an inch {6 mm} Mandrel, 180° bend at –15 °F {-26 °C}	No cracks in mesh or rubberized asphalt	ASTM D 146

The material may or may not have a surface coating.

454.03 Construction Requirements.

(a) CLEANING OF JOINTS AND CRACKS.

1. JOINTS.

The cleaning of existing concrete pavement joints (all types) shall cover the removal of old joint materials and any foreign matter collected in the joint (joint filler material in expansion joints is not considered foreign matter) and the re-establishment of the joint sides to receive a new sealant.

Unless specifically authorized differently by the Engineer, each existing joint shall be sawed to satisfactorily re-establish the joint sides. Such sawing shall be done using an approved

concrete saw specifically made for the intended purpose. Immediately after sawing the joint, if a saw utilizing water is used, the resulting slurry shall be completely removed from the joint and the immediate area by flushing with a jet of water under pressure, and by the use of other tools as necessary. After the sawing, and flushing if necessary, the joint shall be blown out with compressed air. The air compressor shall be equipped with a filter which will effectively limit the moisture in the air to be exhausted. When the surfaces are thoroughly clean and dry and just before the joint sealant is placed, compressed air having a pressure of at least 90 psi {600 kPA} shall be used to blow out the joint and remove all traces of dust. In the event further cleaning is necessary prior to sealing, or if sawing as outlined above is not feasible due to existing joint width, one or more of the following methods shall be required:

Wire Brush and Muriatic Acid - The joints shall be thoroughly cleaned with a mechanical wire brush and other tools as necessary. All harmful materials such as oil, asphalt, curing compound, paint, rust, and other foreign matter shall be completely removed. After brushing, a solution of 10% commercial muriatic acid shall be applied to the surfaces of the joint. After the foaming action of the acid has ceased, the joint shall be thoroughly flushed with water and thoroughly brushed again. After flushing and rebrushing, the joint shall be blown out with compressed air.

Sand Blasting - The joints shall be thoroughly cleaned with a sand blaster and other tools as necessary. All material such as oil, asphalt, curing compound, paint, rust, and other foreign matter shall be completely removed. After blasting, the joint shall be blown out with compressed air.

High Pressure Water Jet - The joints shall be thoroughly cleaned of all foreign material including old sealant if present. After cleaning, the joint shall be allowed to become thoroughly dry before the new sealant is installed.

NOTE: Air compressors used for cleaning joints shall be equipped with suitable traps and/or filters capable of removing all surplus water and oil in the compressed air. This compressed air shall be checked daily by the Engineer for contamination. No contaminated air shall be used.

2. CRACKS.

The cleaning of cracks in the concrete pavement shall cover the removal of loose concrete and foreign matter from the cracks and the establishment of an acceptable shaped groove (size and depth as shown on plan details) suitable for sealing with the designated sealant.

A rotary router, specifically designed for the intended purpose, shall be used to establish the plan detailed groove. After the crack has been routed, it shall be cleaned and dried using the same procedures as for joints.

(b) PREPARATION OF JOINTS AND CRACKS FOR SEALING.

All joints and cracks shall be reworked to the dimensions shown on the plans. In addition, the following requirements shall be met.

1. TYPE I JOINTS.

a. General.

Type I joints shall have vertical sides and reasonably true edge lines. Breakouts or raveled edges shall be reshaped by reworking the joint edges by the sawing and removal of the spalled area as indicated by plan details and specified in this Item. Individual spalled areas less than 12 inches {300 mm} apart after sawing and removal shall be joined to form one larger continuous spall. When spalled areas are adjacent to joints, the shape and integrity of the joint shall be maintained. This will require the placing of a preformed joint material for the entire depth of the spall before placing the concrete repair compound. The entire surface area of the old concrete which is to be bonded to the new concrete shall be coated with a Type II, Grade 2 epoxy meeting the requirements of Article 870.03. The equipment, mixing, placing, and curing of the compound shall be as approved by the Engineer. The concrete repair compound shall be consolidated by vibrating and/or tamping during placement.

b. Partial Depth Spalls.

These spalled areas shall be reworked by sawing a minimum of 3 inches {75 mm} beyond the edges and to a minimum depth of 4 inches {100 mm}. All old concrete shall be removed to a minimum depth of 4 inches {100 mm} and any loose material below this depth shall be removed before the area is to be repaired as specified herein.

c. Full Depth Spalls.

These spalled areas shall be reworked by sawing a minimum of 3 inches {75 mm} beyond the edges and full depth of the pavement slab. The minimum size of the area to be removed shall be 36 inches {1 m} in any direction. All old concrete shall be removed and any reworking or

replacing of the tie bars and joint steel performed before the area is to be repaired as specified herein. Areas originally thought to need only partial depth repair may be reclassified as full depth spalls by the Engineer.

2. TYPE I CRACKS

Ordinarily, Type I Cracks shall not require preparation other than that specified in the cleaning operation of Item 454.03(a)2.

3. TYPE II JOINTS AND CRACKS.

Type II joints and cracks will not require the uniformity of sides and edges noted for Type I joints; however, any adjacent popouts, breakouts, or spalls larger than 3 square inches {2000 mm^2} in area and 1/2 of an inch {13 mm} or more in depth shall be repaired, at no additional cost, by the use of a bituminous plant mix, one of the mixes utilizing fine aggregate provided in the contract. The complete surface area to be patched shall be tacked with PG 58-22 or PG 64-22 bituminous material.

The joint or crack, after having been repaired, shall then be reworked to plan dimensions before being sealed.

(c) SEALING OF JOINTS AND CRACKS.

After completion of cleaning and preparation of the joints and cracks as noted in this Article, they shall be blown out with compressed air. It is absolutely essential that the joints and cracks be clean and dry before being sealed.

To produce the plan detailed joint shape factor, a resilient rod type backup material shall be installed for Type I joints.

If a primer is recommended by the manufacturer of the sealant, it shall be used in accordance with the manufacturer's recommendations.

The sealant shall not be placed when the air temperature is less than 50 °F {10 °C} or is 50 °F {10 °C} and falling, unless permitted otherwise by the manufacturer and the Engineer.

The sealant may be applied by an approved mechanical device or by manual pouring or trowelling, unless recommended differently by the manufacturer, depending upon the consistency used. When applied mechanically or by pouring, a nozzle or pouring spout shall be shaped to fit inside the joint or crack to introduce the sealant from the inside.

Any failure of the sealing material in either adhesion or cohesion will be cause for rejection, and the joint or crack shall be repaired to the Engineer's satisfaction at the Contractor's expense.

After a joint or crack has been sealed, all surplus primer or sealant on the pavement surfaces shall be promptly removed.

Traffic shall not be permitted over sealed joints or cracks until the sealant is tack free.

In addition to the general requirements outlined above, the following requirements shall apply:

1. TYPE I JOINTS.

The joints shall be sealed in such manner as to conform to these specifications and the plan details using the sealant specified in Subarticle 454.02(a).

Since this sealant is not self-leveling and will not position properly in the joint under its own weight {mass}, the sealant shall be applied and tooled in such a manner as to wet the joint faces and to provide the required recess and shape factor shown on the plans.

2. TYPE I CRACKS.

The cracks shall be sealed in such a manner as to conform to these specifications and the plan details using one of the sealants specified in Subarticle 454.02(b). The sealant shall be placed in such a manner as to be flush with the adjacent pavement surface.

3. TYPE II JOINTS AND CRACKS.

Joints and Cracks shall be sealed in such a manner as to conform to these specifications and the plan details using one of the sealants specified in Subarticle 454.02(c).

The sealing compound shall be brought to a uniform consistency without damage to the material, and this consistency shall be suitable for completely filling joints and cracks without inclusions of air holes or discontinuities. The temperature of the sealing compound at the time of application shall be within the range specified by the manufacturer.

(d) WATERPROOFING JOINTS AND CRACKS.

The waterproofing membrane, specified in Subarticle 454.02(d), for Type II joints and cracks shall be placed in accordance with the plan details and the following:

Placement of the membrane shall be done only when the air temperature is above 40 °F {4 °C} and the pavement surfaces are dry and free of any dirt or debris.

The surface shall be primed in accordance with the manufacturer's recommendations prior to placement of the membrane. The primer shall be placed on the concrete surface at a minimum rate of 300 square feet per gallon {7.5 m^2/L} and 1 inch {25 mm} wider than the membrane, and shall be allowed to dry until tackfree before applying the membrane.

The waterproofing membrane shall be placed in such a manner as to leave no voids between the membrane and the pavement at the faulted joints.

The membrane shall be installed in widths of 11.4 inches {290 mm} minimum and shall be centered over the joint or crack within a 1 inch {25 mm} tolerance. Transverse joints and cracks shall be waterproofed first.

The longitudinal joints and cracks shall be waterproofed after the transverse joints and cracks. All laps shall be made in such a manner that the paver does not encounter the exposed edge of the lap first.

Transverse membranes shall be extended 4 inches {100 mm} to 6 inches {150 mm} beyond each pavement edge. Cracks which connect with a transverse joint shall be waterproofed first with a minimum of a 2.5 inch {65 mm} lap at the intersection with the joint. Laps will be permitted in both the transverse and longitudinal membrane with a minimum overlap of 2.5 inches {65 mm}.

The membrane shall be installed straight and wrinkle-free with no curled or uplifted edges. Any wrinkles over 3/8 of an inch {10 mm} in width shall be slit and folded down.

All membranes and the exposed paving shall be surface dry before placement of the tack coat.

If the membrane is damaged prior to placing the paving, it shall be corrected, in a manner approved by the Engineer, at no expense to the Department.

454.04 Method of Measurement.

The ordered and accepted cleaning and sealing, and the waterproofing if applicable, of concrete pavement joints and cracks will be measured in linear feet {meters}, to the nearest 0.1 foot {0.1 m}, along the surface of the pavement for the treatment ordered and acceptably placed.

The ordered and accepted repairing of Type I concrete pavement spalls will be measured in square feet {square meters} of the surface of the pavement for the type treatment, partial or full depth repair, ordered and acceptably placed.

454.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The quantity of cleaning and sealing of each type of concrete paving joints and cracks ordered and accepted, measured as noted above, will be paid for at the contract unit price bid for each type, which shall be full compensation for the furnishing of all materials, equipment, tools, labor, and incidentals necessary to clean and seal, as required, all designated concrete pavement joints and cracks.

The quantity of waterproofing, if applicable, of concrete paving joints and cracks ordered and accepted, measured as noted above, will be paid for at the contract unit price bid, which shall be full compensation for the furnishing of all materials, equipment, tools, labor, and incidentals necessary to waterproof all designated concrete pavement joints and cracks.

The quantity of repairing of Type I concrete pavement spalls ordered and accepted, measured as noted above, will be paid for at the contract unit price bid, which shall be full compensation for the furnishing of all materials, equipment, tools, labor, and incidentals necessary to repair all designated Type I concrete pavement spalled areas.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

454-A Cleaning and Sealing Concrete Pavement, Type __*__ __**__ - per linear foot {meter}

454-B Waterproofing Pavement Joints and Cracks - per linear foot {meter}

454-C Repairing Type I Concrete Pavement Spalls, Full Depth - per square foot {square meter}

454-D Repairing Type I Concrete Pavement Spalls, Partial Depth
- per square foot {square meter}

* Specify I or II

** Specify Joints or Cracks

SECTION 455
GRINDING PAVEMENT SURFACES

455.01 Description.

This Section shall cover the work of grinding Portland Cement Concrete pavement at locations shown on the plans or directed by the Engineer. The primary locations will be the right-hand lane, or truck lane, of each roadway, but may include other locations.

Said grinding is intended to substantially correct joint faulting, surface drainage, skid resistance, riding characteristics and/or removal of excessive surface material.

455.02 Materials.

N/A

455.03 Construction Requirements.

(a) GENERAL.

It is intended that areas of the pavement surface designated by the plans or Engineer to be processed shall be ground to eliminate joint or crack faults and to provide a constant pavement cross slope within the designated grinding limits in each lane. Adjacent sides of longitudinal joints or crack shall be in the same plane. Adjacent sides of transverse joints or cracks in excess of 1/16 of an inch {2 mm} shall be reground until flush.

If a progress schedule for the grinding operation is not shown on the plans, the Contractor may select his own grinding operation schedule. The grinding operation shall be expeditiously performed in a continuous operation on a traffic lane before grinding begins on a succeeding lane.

The residue created by the grinding operation shall be satisfactorily removed as the grinding operation proceeds.

(b) EQUIPMENT.

Grinding equipment shall be a self-propelled unit specifically designed to grind Portland Cement concrete pavement using diamond grinding blades capable of grinding the designated surfaces without causing spalls at cracks or joints or at other locations. The equipment shall be of a size, shape and dimension capable of working within the designated work limits without restricting the movement of traffic outside of the work limits.

The Contractor shall provide positive means for the removal of the grinding residue before such residue is blown by traffic action or wind. Residue shall not be permitted to flow across lanes designated for traffic use or into gutters or other drainage structures.

(c) OPERATIONAL REQUIREMENTS.

1. GENERAL.

It is the intent that the work of grinding of the pavement surface be performed under traffic. Traffic may be shifted to one lane on a 4-lane facility; but no consideration will be given to transferring traffic to one travelway during this operation.

The area of pavement surfaces to be ground will be designated on the plans, unless directed otherwise by the Engineer.

The construction operations shall be scheduled and prosecuted in such a manner that a uniform surface finish which eliminates the joint or crack faults while maintaining positive lateral drainage by maintaining a constant cross slope is obtained.

2. MAIN ROADWAY.

All preliminary work of stabilizing and repair on the main roadway shall be completed prior to commencing grinding operations. This preliminary work includes the stabilization of designated pavement slabs and removal and replacement of certain slab sections as noted by plan details or as directed by the Engineer.

The entire area of the travelway designated to be ground shall be ground until the adjacent sides of joints and cracks are in the same plane, the cross slope complies with typical section shown by plan details and the surface requirements of Subarticle 455.03(d). It is the intent of this specification that the faulting at joints and cracks be eliminated, the overall roughness be within the specified limits and that the pavement surface of the lane designated for treatment be textured.

(d) FINAL SURFACE FINISH.

The grinding process shall produce a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. Said line type texture shall consist of parallel longitudinal corrugations of approximately 60 evenly spaced grooves per foot {300 mm} with the ridges approximately 1/32 of an inch {1 mm} higher than the bottom of the grooves.

Joints and cracks shall be visually inspected to insure that adjacent surfaces are in the same plane. Misalignment of the surface planes of adjacent sides of joints or cracks which is in excess of 1/16 of an inch {2 mm} shall be ground until the surfaces are flush.

The transverse slope of the ground pavement shall be uniform to a degree that no depressions or misalignment of slope greater than 1/4 of an inch {6 mm} in 12 feet {3.5 m} are present when tested with a 12 foot {3.5 m} straightedge placed perpendicular to the pavement centerline. Straightedge requirements do not apply outside of the ground areas.

The grinding shall produce a mainline riding surface with a Profile Index which does not exceed 7 inches/mile {110 mm/km} per section of each vehicle lane ground when tested with the Department's Profilograph in accordance with ALDOT-335. The Department will test the riding surface immediately after completion of the grinding operation on each lane that has been ground. The Contractor shall furnish the necessary personnel to operate the profilograph under the direction of the Engineer. Auxiliary lanes, ramps and shoulders are not required to meet the Profile Index noted above provided the grinding produces a smooth riding surface acceptable to the Engineer.

455.04 Method of Measurement.

The grinding of pavement ordered and accepted will be measured in square yards {square meters} computed from surface measurements taken to the nearest 0.1 of a foot {0.1 m} on the processed pavement.

Those areas of pavement requiring corrective action due to inappropriate or unacceptable work or negligence on the part of the Contractor shall be excluded from measurement for payment.

455.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The grinding of pavement ordered and accepted, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the grinding of the pavement, the removal of grinding residue and the satisfactory disposal thereof, the cleaning of the pavement and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

455-A Grinding Concrete Pavement - per square yard {square meter}

DIVISION 500
STRUCTURES

SECTION 501
STRUCTURAL PORTLAND CEMENT CONCRETE

501.01 Description.

The work under this Section shall cover the furnishing of Portland cement concrete to be used in constructing concrete structures. Structures shall include but are not limited to bridges of all types, box culverts, headwalls, retaining walls, and other miscellaneous structures.

501.02 Materials.

(a) GENERAL.

Handling, storage, and control of materials shall comply with appropriate portions of Section 106. All materials shall conform to the requirements set forth in Division 800, Materials. Specific reference is made to applicable portions of the following Sections:

Section 801 - Coarse Aggregate
Section 802 - Fine Aggregates
Section 806 - Mineral Admixtures
Section 807 - Water
Section 808 - Air Entraining Additives
Section 809 - Chemical Admixtures for Concrete
Section 815 - Cement
Section 830 - Concrete Curing Material
Section 832 - Concrete Joint Fillers, Sealers and Waterstop Material
Section 835 - Steel Reinforcement

(b) SPECIAL REQUIREMENTS.

Aggregates from different sources, which are to be used for concrete Types 2, 3, and 4 as specified in Item 501.02(c)2, may be stockpiled together provided material from each source meets the requirements of Section 801 and the specific gravity of the aggregates from each source does not vary more than plus or minus 0.05.

In the event the coarse aggregate shows a tendency to segregate in the stockpile, the Engineer may order the coarse aggregate be furnished and batched in two fractions from two separate stockpiles.

The Contractor may be required to adjust the size of coarse aggregate for the concrete used around steel in heavily reinforced members.

(c) PROPORTIONING MATERIALS.

1. MIX DESIGN.

The Contractor's concrete producer shall establish the proportion of materials for each class and type of concrete following the guidelines described in ALDOT-170, *"Method of Controlling Concrete Operations for Structural Portland Cement Concrete"*. It shall be the responsibility of the concrete producer to request approval of concrete mix design(s) for use in Department's projects.

2. MASTER PROPORTION TABLE.

MASTER PROPORTION TABLE One Cubic Yard {Meter} Proportions							
Concrete Class - Type	A-1a	A-2a	B-3	A-1c	C-4	E-6a	S-7a
Cement Factor (lbs.) {kg}	620 {368}	620 {368)	508 {302}	620 {368}	620 {368}	658 {390}	696 {413}
Fly Ash, GGBFS, & Microsilica (lbs.) {kg}	See Note e	See Note e	See Note e	See Note e	See Note e	See Note e	See Note e
Maximum Water in Gallons {liters}	36 {178}	39 {193}	36 {178}	33 {163}	33 {163}	35 {173}	39 {193}
Fine Aggregate (lbs.) {kg}	1088 {645}	1204 {714}	1487 {882}	1097 {651}	1504 {892}	947 {562}	1096 {650}
Coarse Aggregate (lbs.) {kg}	1839 {1091}	1829 {1085}	1712 {1016}	1857 {1102}	1677 {995}	1974 {1171}	1696 {1006}
Entrained Air % by Volume	3 - 5	0 - 5	0 - 5	4 - 6	0 - 5	3 - 5	3 - 5
Maximum Consistency Slump (in.) {mm}	3 {75}	3 {75}	3 {75}	3.5 {90}	3 {75}	3.5 {90}	7 {180}
Coarse Aggregate Size No.	57 or 67	57 or 67	57 or 67	57 or 67	57 or 67	57 or 67	57 or 67
Minimum 28 Day Compressive Strength (psi) (MPa)	3000 {21}	3000 {21}	2000 {14}	4000 {28}	3000 {21}	4500 {31}	3000 {21}
Special Requirement Notes	b	b	b	a, b	b	a, b	c, d

Notes:

a. The Class A Type 1c mix and Class E mixes will require an approved Type "A", Water-reducing admixture or a Type "D" Water-reducing and retarding admixture in the mix design in order to obtain the 3.5 inch {90 mm} slump. These admixtures shall be included in the mix design.

b. Approved Type "F", Mid-Range Water-Reducing (MRWR) admixtures may be used to chemically increase the slump of the concrete if they are shown in the approved mix design. The chemical slump shall not exceed 5.5 inches {140 mm}. In no case shall the water to total cementitious material (cement plus mineral admixtures) ratio shown in the Master Proportion Table be exceeded in order to increase the slump. Concrete shall be tested for slump before and after the addition of the chemical admixture. Mid-Range water reducers are chemical admixtures that will provide a water reduction of 8 to 18 percent without extending the setting time of the concrete mix. Approved Mid-Range water reducers are listed in the "*Materials, Sources, and Devices with Special Acceptance Requirements*" manual, List II-1 "*Chemical Admixtures for Portland Cement Concrete*".

c. Seal concrete used as an integral part of a bridge support system will require the use of washed gravel coarse aggregate, Type II cement, and Class "F" fly ash, or Ground Granulated Blast Furnace Slag (GGBFS) to aid in reducing the heat of hydration. Fly ash or GGBFS use in mixes shall be as specified in Items 501.02(c)5. and 501.02(c)6. respectively. Seal concrete not used as an integral part of the bridge support system does not require the use of washed gravel coarse aggregate, Type II cement and Class "F" fly ash or GGBFS.

d. Approved Type "F", Water-reducing, high range admixtures or Type "G", Water-reducing and retarding, high range admixtures may be used to obtain a flowable concrete mix within the allowable slump range, provided they are shown in the approved mix design. In no case shall the water to total cementitious material ratio shown in the Master Proportion Table be exceeded in order to increase the slump.

e. Fly ash use in concrete mixes shall be as specified in Item 501.02(c)5. Ground granulated blast furnace slag use in concrete mixes shall be as specified in Item 501.02(c)6. Microsilica use in concrete mixes shall be as specified in item 501.01(c)7.

Explanation of Table:

The following construction code numbers identify the kind of work on which a designated mix is to be used:

Type 1 - Mix "a", bridge substructure concrete, box culverts, retaining walls, and concrete safety barriers. Mix "c", bridge superstructure concrete.

Type 2 - Mix "a", headwalls, inlets, and miscellaneous concrete units.

Type 3 - Slope paving.

Type 4 - Machine laid curbs, gutters, or combination curbs and gutters.

Type 6 - Bridge concrete for use when the structure is exposed to salt water, where shown by the plan details, or directed by the Engineer.

Type 7 - Underwater concrete.

Substitution of Type 1 mixes for Type 2 and 3 mixes or the substitution of a higher strength mix for one of a lower strength may be permitted if such is requested in writing.

The mixes shown by the Table were designed on a specific gravity of 2.65 for sand and 2.60 for coarse aggregate (bulk, saturated, surface dry). The design weights {masses} will be adjusted on the mix design to reflect the specific gravities of the actual aggregates being used. These mixes were designed to use either No. 57 or No. 67 coarse aggregate. If requested, the use of No. 7 may be permitted in Type 4 mixes and the use of No. 357 or No. 467 may be permitted in Type 7 mixes.

The basic design fineness modulus for sand is 2.60. The required gradation uniformity is given in Subarticle 802.02(g).

3. ADDITIVES.

An approved air-entraining agent shall be used when such is specified in the Master Proportion Table. The percent of air entrainment shall be maintained, at the point of delivery, within plus or minus one percentage point of the amount specified in the mix design.

The State Materials and Tests Engineer may approve the use of other chemical admixtures if requested in writing, except that calcium chloride will not be permitted.

The State Materials and Tests Engineer shall approve methods and equipment for measuring and adding additives. Equipment, which will not accurately dispense the correct amount of additive in an acceptable manner, will not be approved.

No separate payment for additives used in the concrete mix will be made.

4. SLUMP.

The consistency slump shown in the Master Proportion Table for each mix is considered the specified slump. When the specified slump is 3.0 inches {75 mm} or less, a tolerance of plus 0.5 inches {13 mm} will be acceptable for the mixture delivered at the work site; when the specified slump is greater than 3.0 inches {75 mm}, a tolerance of plus 1.0 inch {25 mm} will be acceptable. Any mix delivered with a slump less than the specified slump will be acceptable provided the mix is workable.

5. FLY ASH USE.

Fly ash may be used in any mix design except where it is specified otherwise by the plans or proposal. On some projects, fly ash will be required for certain applications. In these cases, the requirements will be shown in a special provision or as a note on the plans.

If fly ash is used, the Master Proportion Table will be used as a guide in proportioning the mix components. Fly ash may be substituted for cement up to a maximum substitution rate of twenty percent for Class "F" fly ash and thirty percent for Class "C" fly ash by weight {mass}. The minimum substitution ratio of fly ash to the cement it replaced will be one to one.

When fly ash is substituted for cement in any mix design, the letter "F" will be added in the Class designation (i.e. Class A-1a becomes Class AF-1a, Class A-1c becomes Class AF-1c). Due to the difference in the specific gravity of fly ash and cement, adjustments will be made to the aggregate weights {masses} shown in the Master Proportion Table to correct the yield of the mix back to one cubic meter. The maximum gallons {liters} of water shown in the Table for the mixes without fly ash will remain the same when fly ash is used. When water is withheld due to slump requirements, a correction of the yield will be made by replacing the volume of water withheld with an equal volume of fine aggregate. In no case shall the water to total cementitious material ratio shown in the Table be exceeded.

When fly ash use is required by the plans or proposal for the purpose of reducing the heat of hydration of a concrete mass, the class of fly ash to be used shall be Class "F".

6. GROUND GRANULATED BLAST FURNACE SLAG USE.

Ground granulated blast furnace slag may be used in any mix design except where it is specified otherwise by the plans or proposal. On some projects, ground granulated blast furnace slag will be required for certain applications. In these cases, the requirements will be shown in a special provision or as a note on the plans.

If ground granulated blast furnace slag is used, the Master Proportion Table will be used as a guide in proportioning the mix components. Ground granulated blast furnace slag may be substituted for cement up to a maximum substitution rate of fifty percent by weight {mass}; except that when the ambient air temperature is 45 °F (7 °C) or below, the maximum substitution rate will be twenty-five percent by weight {mass}. The minimum substitution ratio of ground granulated blast furnace slag to the cement it replaced will be one to one.

Ground granulated blast furnace slag shall not be substituted for a portion of Type IP cement or for Portland cement in high early strength concrete. Ground granulated blast furnace slag shall not be used in fly ash and/or microsilica mix.

When ground granulated blast furnace slag is substituted for cement in any mix design, the letter "S" will be added in the Class designation (i.e. Class A-1a becomes Class AS-1a, Class A-1c becomes Class AS-1c). Due to the difference in the specific gravity of ground granulated blast furnace slag and cement, adjustments will be made to the aggregate weights {masses} shown in the Master Proportion Table to correct the yield of the mix back to one cubic yard {meter}. The maximum gallons {liters} of water shown in the Table for the mixes without ground granulated blast furnace slag will remain the same when ground granulated blast furnace slag is used. When water is withheld due to slump requirements, a correction of the yield will be made by replacing the volume of water withheld with an equal volume of fine aggregate. In no case shall the water to total cementitious material ratio shown in the Table be exceeded.

7. MICROSILICA USE.

Microsilica may be used in any mix design except where it is specified otherwise by the plans or proposal. On some projects, microsilica will be required for certain applications. In these cases, the requirements will be shown in a special provision or as a note on the plans.

If microsilica is used, the Master Proportion Table will be used as a guide in proportioning the mix components. Microsilica may be substituted for cement up to a maximum substitution rate of ten percent by weight {mass}. The minimum substitution rate of microsilica to the cement it replaced will be one to one.

Microsilica may be used in mixes with fly ash. The substitution rate shall be fixed at twenty percent fly ash and ten percent microsilica by weight {mass}.

When microsilica is substituted for cement in any mix design, the letter "M" will be added in the Class designation (i.e. Class A-1a becomes Class AM-1a, Class A-1c becomes Class AM-1c). If fly ash is used in combination with microsilica in any Mix Design, the letters "F" and "M" will be added in the Class designation (i.e. Class A-1a becomes Class AFM-1a, Class A-1c becomes Class AFM-1c). Due to the difference in the specific gravity of microsilica and cement, adjustments will be made to the aggregate weights {masses} shown in the Master Proportion Table to correct the yield of the mix back to one cubic yard {meter}. The maximum gallons {liters} of water shown in the Table for the mixes without microsilica will remain the same when microsilica is used. When water is withheld due to slump requirements, a correction of the yield will be made by replacing the volume of water withheld with an equal volume of fine aggregate. In no case shall the water to total cementitious material ratio shown in the Table be exceeded.

8. MIX PRODUCTION.

During the progress of the work, the relative proportions between the fine and coarse aggregates, and between aggregate and water, may be varied as needed for best results, but the cement factor (weight {mass} of cement in pounds per cubic yard {kilograms per cubic meter} of concrete) and the water to total cementitious material ratio will not be changed except as noted below:

The water content may be decreased to produce concrete of the desired consistency with an appropriate increase in fine aggregate to maintain yield. If it is impossible to produce concrete having the desired consistency without exceeding the maximum allowable water content specified in the Master Proportion Table, the cement content shall be increased as directed by the Engineer so as not to exceed the maximum water to total cementitious material ratio. The total amount of cement

may be increased to achieve the desired workability provided that the maximum water to total cementitious material ratio is not exceeded and there is no additional cost to the Department.

If the Engineer finds it advisable to increase the minimum design strength of the concrete and orders the cement factor increased, the State will reimburse the Contractor for the actual amount only of the additional cement used, based on actual f.o.b. destination, with the additional quantity calculated from the theoretical cement factor determined by the Engineer and not from count of bags or weight {mass} used.

The Master Proportion Table is based on the use of Type I, II, or IP cement. The Contractor may select either of these types of cement for use, except that Type IP cement will not be permitted in fly ash or GGBFS concrete mixes. The Contractor may, for his own convenience and without additional compensation, use additional cement or substitute Type III cement, provided prior approval is given by the State Materials and Tests Engineer.

It shall be the Contractor's responsibility to furnish suitable aggregate and carry out uniform construction practices, which will produce concrete of not less than the minimum compressive strength indicated by the Master Proportion Table. Should the concrete not produce the required minimum compressive strength, the State Materials and Tests Engineer shall be notified so that additional tests and evaluations can be made prior to ordering the removal of the affected concrete. Should low breaks occur consistently, the State Materials and Tests Engineer may order such corrective action as deemed necessary, all without additional cost to the Department. Special note is made of the following: When type IP cement is used, it will be necessary to provide two additional cylinders for a 90-day break should the 28-day test show strength less than that specified by the Master Proportion Table.

Where the conditions require the use of low tricalcium aluminate cement, the plans or proposal will designate Type II cement. In such case, if requested and approved, Type I cement containing a maximum of eight percent tricalcium aluminate may be used. Should Type III cement be permitted, a maximum of eight percent tricalcium aluminate shall still apply.

(d) SAMPLING AND INSPECTION.

Aggregates from approved sources will be accepted in stockpiles provided there is no segregation, but production of required gradation in the mix shall be the Contractor's responsibility.

Cement, aggregates, water, and all additives shall be accepted on the basis of requirements currently listed in the Department's Testing Manual.

The Department reserves the right to take samples of aggregates from stockpiles and cement from storage bins at the mixing or batching plant and to make further tests as needed as a basis for continued acceptance of the materials.

The Contractor shall furnish, without extra compensation, samples of the materials and the concrete mix for making tests and test specimens as required to comply with the Department's Testing Manual. Additional testing may be required if deemed necessary by the Engineer.

The Contractor shall furnish, without extra compensation, a protected environment for all concrete test cylinders produced incidental to any placement of concrete. This shall be accomplished by supplying a cylinder curing box with a minimum capacity of 24 test cylinders 6" X 12" {150 mm X 300 mm} in size, equipped with heating/cooling capabilities, automatic temperature control, and a maximum/minimum (high/low) temperature readout. The protective environment shall be capable of protecting all specimens within the following specification requirements and it shall be available at each site when concrete is placed and then maintained until such time that all specimens have been transported from the project to the testing facility. The Engineer, prior to beginning of any concrete placement, shall approve each protective environment.

Immediately after being struck off, the concrete test specimens shall be moved to the protective environment where they shall remain for an initial curing period of not less than 24 hours nor more than 48 hours. During the initial curing period, the specimens shall be stored in a temperature range between 60 ºF to 80 ºF {15 ºC to 25 ºC}, and in a moist environment preventing any loss of moisture up to 48 hours. At all times the temperature in and between specimens shall be controlled by shielding from cooling/heating devices and direct rays of the sun.

A temperature record of the specimens shall be established by means of maximum/minimum (high/low) thermometers supplied by the Contractor. Only plastic molds shall be used for specimens to be immersed in water.

Specimens that are to be transported to the laboratory for standard curing within 48 hours shall remain in the molds in a moist environment, until they are received in the laboratory, demolded

and placed in standard curing. If specimens are not transported within 48 hours, the mold shall be removed within 24 ± 8 hours and standard curing used until transported. During the standard curing period, the specimens shall be stored at a temperature of 73.4 ± 3 ºF {23 ± 1.7 ºC} using the cylinder curing box defined above. Standard curing shall comply with AASHTO T 23 *"Making and Curing Concrete Test Specimens in the Field"*, Standard Curing section.

501.03 Construction Requirements.

(a) GENERAL.

All materials, labor, equipment, tools, and machinery necessary for forming, mixing, placing, finishing, and curing shall be available as required and all necessary equipment for the proper construction and completion of any section of the work shall be in satisfactory working condition before the Contractor will be permitted to start placing concrete.

All concrete batching plants shall be certified by the National Ready Mix Concrete Association (NRMCA) to be in conformance with the NRMCA Plant Certification Checklist. The concrete producer shall submit proof of NRMCA certification to the State Materials and Tests Engineer prior to any batching of concrete.

All batching plants shall meet the requirements of the Specifications and ALDOT-352. Producers who request that their batching plants be placed on the LIST OF EVALUATED READY-MIX CONCRETE PLANTS will be charged a fee as specified by ALDOT-355, *"General Information Concerning Materials, Sources, and Devices With Special Acceptance Requirements"*.

(b) EQUIPMENT.

1. GENERAL.

The Contractor shall furnish equipment capable of producing concrete meeting the requirements noted in this Section in sufficient quantities to provide for orderly construction of the project. All equipment must be in good working order and so maintained throughout the requirement for its use.

Specific requirements for certain types of equipment are designated in subsequent items of this Subarticle.

2. MIXING AND TRANSPORTING EQUIPMENT.

Concrete for all major structure work (bridges, culverts, retaining walls, etc.) shall be "ready-mixed" concrete. Ready-mixed concrete is defined as Portland cement concrete manufactured for delivery and delivered to the work site in accordance with AASHTO M 157 *"Ready-Mixed Concrete"* Modified* and the requirements written herein in other parts of these specifications. In case of discrepancy these specifications shall govern.

*Modification of AASHTO M 157 is as follows:

The requirements of Paragraph 8.1 shall include the following: Should this method of measuring fly ash cumulatively with cement produce unsatisfactory results, it shall be discontinued and separate scales and hoppers provided for these ingredients.

Concrete for minor structure work (headwalls, inlets, junction boxes, and other miscellaneous individual concrete units requiring three cubic yards {3 m^3} or less of concrete, along with such items as slope paving, sidewalks, curbs, gutters, and combinations thereof) may be mixed in mixers as noted above or an approved type of mobile mixing plant designed with separate bins for fine aggregate, coarse aggregate, cement, water, additives, etc. that will automatically proportion all concrete aggregates either by weight {mass} or volume and be capable of combining the ingredients into a uniform mass and discharging such without segregation. It shall have approved equipment that will determine the volume of concrete dispatched. Said alternate type mobile mixing plant shall be capable of providing concrete complying with the designated mix design noted in Article 501.02. Prior written approval of such alternate equipment shall be obtained before it is allowed on the project. Basis for this approval will be upon the satisfactory performance of the equipment when checked in accordance with the provisions of AASHTO M 241 *"Concrete Made by Volumetric Batching and Continuous Mixing"*. The costs of all materials and labor furnished to perform the above mentioned test shall be absorbed by the Contractor,

If the Contractor requests to use portable mixers, the State Materials and Tests Engineer may approve their use and will furnish written requirements covering such mixers.

All mixing and transporting equipment shall be supplied in sufficient amounts to provide continuous delivery of the concrete as needed for an acceptable, satisfactory operation. The volume of

concrete mixed or transported in a concrete truck mixer shall not be less than 15% of the gross volume of the drum.

Concrete transit mixers shall be equipped with an approved in line water-metering device capable of accurately measuring the amount of water discharged into the load to within ±1% of the reading indicated. The metering device shall be approved by the State Materials and Tests Engineer as part of the NRMCA certification. The precision of the water-metering device shall be verified as per ALDOT-407, "*Calibration Verification of Truck Mounted Water Meters*". An alternate method, such as a calibrated 5 gallon {20 liter} bucket, may be used to measure the amount of water discharged into the concrete in lieu of the in-line water meter, provided the alternate method has been approved in writing by the State Materials and Tests Engineer. Metering devices not meeting the stated accuracy shall not be used. Concrete transit mixers without approved water-metering devices shall not be used on Department projects.

Each transit mixer shall be equipped with an approved automatic counter that will record the number of drum revolutions regardless of the drum speed.

3. VIBRATORS.

Vibrators shall be of an approved internal vibrating type and design, unless the Engineer gives special authorization for other types. Vibrators shall be capable of transmitting vibrations to the concrete at frequencies of not less than 4500 impulses per minute. The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms. At least one standby vibrating unit in workable order shall be available before the start of any placement of concrete.

(c) RETEMPERING.

Retempering, defined as the addition of water and remixing of concrete that has lost enough workability to become unplaceable or unusable, will not be allowed.

(d) ADDITION OF WATER AT JOBSITE.

Water may be added to the concrete to bring a dry concrete batch to a workable slump. The addition of water to the concrete at the jobsite is allowed only for the following two cases:

1. ON ARRIVAL OF THE TRUCK TO THE JOBSITE.

After sampling the fresh concrete as per ALDOT-328, "*Rapid Method of Sampling Fresh Concrete from Revolving Drum Truck Mixers or Agitators*", and testing its consistency if the slump test shows that the concrete mix is too dry, water may be added prior to discharging any more concrete from the truck mixer and without exceeding the water-cementitious ratio and the specified slump.

2. AFTER PART OF THE LOAD HAS BEEN DISCHARGED.

The water shall be added only if the following three conditions are met. (1) A bucket holding a known volume of concrete is used during the placement operation. (2) The amount of water available can be prorated to the known amount of concrete in the truck mixer. (3) The water-cementitious ratio is not exceeded.

Tests for slump, air content, temperature, and compressive strength shall be run after the addition of water at the jobsite regardless of any previous testing.

The addition of water at the jobsite shall not extend the time limitations for delivery and placement of concrete as stated in ALDOT-170.

(e) TIME, LIGHT AND WEATHER LIMITATIONS.

1. TIME OF HAULING AND PLACING CONCRETE.

Ready-mix concrete shall be transported and delivered as outlined in ALDOT-170 except that the time limits shall be 15 minutes less when Type III cement is used. If the State Materials and Tests Engineer authorizes the use of retarders, in writing, the time limit for delivery of the mixed concrete may be extended by an amount specified in ALDOT-170. If requested, and approved in writing by the State Materials and Tests Engineer, a hydration stabilizer can be used to extend the retardation of set time of concrete. The State Materials and Tests Engineer may permit mixing and the adding of the cement and additives at the work site in truck mixers, in order to meet the time limitation requirements.

Type IP cement is classified as producing a retarded concrete; therefore, the delivery time thereof in excess of that allowed by paragraph one above shall be set by the State Materials and Tests Engineer.

2. LIGHT.

All concrete shall be placed and finished during daylight hours, unless written permission to the contrary is given. Such permission will not be given unless an adequate approved lighting system is available for all operations after sundown.

3. WEATHER.

a. General.

The temperature of the concrete, at the time of placing in the forms shall not be less than 50 °F {10 °C} nor more than 95 °F {35 °C}, except that for bridge deck slabs the temperature of the concrete at the time of placing shall not be more than 90 ºF {32 ºC }, unless otherwise provided or directed.

b. Cold Weather Operations.

No concrete shall be placed when the ambient air temperature is below 40 °F {5 °C} without written permission of the Engineer. If the Contractor proposes to place concrete during seasons when there is a probability of temperatures lower than 40 °F {5 °C}, the Contractor shall have available on the project such suitable approved equipment and materials as necessary to enclose the uncured concrete and keep the air temperature inside the enclosure within the following ranges and for the minimum times noted hereinafter.

If there are indications there will be temperatures below 40 °F {5 °C} during the first three days after placement of concrete, it shall be protected from cold temperatures by keeping the surface at a temperature above 50 °F {10 °C} for the first 72 hours after placement and above 32 °F {0 °C} an additional 72 hours. However, the protective covering shall be retained in place until the temperature inside the protective covering reaches that of the surrounding atmosphere.

When the Contractor is permitted to place concrete at temperatures below 40 °F {5 °C}, the aggregates and/or mixing water shall be heated as necessary to keep the temperature of the plastic concrete above 50 °F {10 °C} from the time of placement to the time of initial set; however, in no case shall the materials be heated in excess of 150 °F {65 °C}, nor shall aggregates from frozen stockpiles be incorporated into the mix. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salts, chemicals, or other materials shall not be incorporated in the concrete to prevent freezing. Care shall be taken to heat all materials uniformly and avoid hot spots that will burn or overheat the materials.

The Contractor shall assume all risk and added cost connected with mixing, placing and protecting of concrete during cold weather. Permission given by the Engineer to place concrete during such time will in no way relieve the Contractor of responsibility for satisfactory results. Should it be determined at any time that concrete placed under such conditions is found to be unsatisfactory, it shall be removed and replaced with satisfactory concrete by the Contractor without extra compensation.

c. Hot Weather Operations.

The following hot weather operations practices shall be followed for all concreting done between June 1 and September 15 of each year, and any other time when the temperature of the concrete may be above 95 ºF {35 ºC} or 90 ºF {32 ºC} for bridge deck slabs.

The Contractor shall submit in writing a proposed plan for controlling the concrete mixture temperature during hot weather operations. The hot weather concrete plan shall outline the Contractor's procedures to maintain the temperature of the concrete at or below the temperature requirements noted above, and the Contractor's procedures for transporting, handling, placing, finishing, and curing concrete during hot weather. The hot weather concrete plan shall be submitted at the pre-construction conference to the Division Materials Engineer for approval before any concrete placement is allowed.

During hot weather operations an approved retarder admixture shall be used in the concrete mix, and the concrete shall be properly placed and finished with the procedures previously submitted by the Contractor. Cooling of the mixing water and/or aggregates or placement during the cooler part of the day may be required to meet the above maximum temperature requirements. In no instance shall a concrete bridge deck slab mix be placed when the temperature of the plastic concrete is above 90 °F {32 °C}. When the temperature of the steel is greater than 120 ºF {50 ºC}, the steel forms and reinforcement steel shall be cooled prior to concrete placement. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete placing temperature.

(f) HANDLING AND PLACING CONCRETE.

1. GENERAL.

In preparation for the placing of concrete, all sawdust, chips, and other construction debris and extraneous matter shall be removed from the interior of forms. Temporary struts, stays, or braces serving to hold the forms in place until the concrete is placed shall be removed prior to being encased in the concrete. All permanent struts, stays, or braces shall be precast concrete struts or, at the Contractor's option, approved steel struts; no wooden struts shall be permitted.

During the placing of concrete, the Contractor shall continuously check the alignment of forms and immediately correct any yielding of the forms or falsework.

Concrete shall be deposited continuously for each monolithic section of the work by placing the fresh concrete in horizontal layers of approximately 12 inches {300 mm} in thickness. Each additional layer shall be placed and compacted before the preceding layer has taken its initial set, 45 minutes for mixes without retarder and 60 minutes for mixes with retarder.

For vertical members the maximum height of concrete placement shall not exceed 20 feet {6 m}, except for underwater concrete or when steel forms are used. When structurally sound steel forms are used, concrete placement may be made up to 30 feet {9 m} in height provided that an approved mortar tight downspout of sufficient length to reach within 5 feet {1.5 m} of the bottom of the placed concrete and a vibrator of sufficient length to provide good consolidation throughout the concrete placement are used. Any vertical member exceeding 20 feet {6 m} in height shall be broken into two or more approximately equal concrete placements unless the preceding requirements are met.

When succeeding concrete placements are necessary, the next concrete placement will not be permitted until the concrete in the underlying placed concrete has aged at least 12 hours or attained a minimum compressive strength of 2400 psi {17 MPa} from cylinders prepared in conformity with AASHTO T 23. When a set retarding admixture is used in the preceding concrete placement, the next concrete placement shall not be permitted until a 2400 psi {17 MPa} cylinder strength is attained.

The forms shall not be jarred nor shall any strain be placed on reinforcing bars partially encased in concrete that will cause damage to bond. All accumulations of mortar splashed on the reinforcing steel and surfaces of forms shall be removed before the next concrete placement.

When it is necessary to pump water from the excavation during placing of concrete to deposit the concrete in the dry, the sump for the intake hose shall be located outside the forms.

The use of aluminum pipes, chutes, or other devices made of aluminum that come into direct contact with the concrete shall not be utilized in the handling and placing operations.

a. Use of Chutes, Pipes or Belts.

Concrete shall not be dropped a distance of more than 5 feet {1.5 m} unless confined in an approved mortar tight downspout of not less than 4 inches {100 mm} in diameter. Downspouts shall be equipped with suitable hoppers at their inlet end and shall be provided in sectional lengths that will permit adjustment of the level of the outlet during placement.

The number of downspouts furnished shall be sufficient to insure the concrete placement in horizontal layers. Depositing large quantities of concrete at one point in the form and running, flowing, or working the concrete along the forms will not be permitted.

In wall sections where a 4 inch {100 mm} downspout cannot be utilized without displacing the reinforcing steel, the concrete may be dropped in excess of the 5 feet {1.5 m} previously noted, provided such does not displace the reinforcing steel nor produce segregation of the concrete.

(1) Chutes, pipes, or power belts may be used to convey concrete from the concrete mixer or transporting vehicle to the forms, and they shall convey it to its final position without segregation and without displacing the reinforcing steel. If the use of this equipment results in honeycombed or otherwise inferior concrete, the Engineer will require it to be changed or its use discontinued.

(2) Chutes, pipes, and power belts shall be flushed with water after each run and this water shall be discharged free of the freshly placed concrete. All hardened concrete shall be promptly removed.

b. Pumping.

Direct placement of concrete by an approved pumping device will be permitted. The equipment shall be so arranged that no vibration result that might damage freshly placed concrete. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipeline, if it is to be

used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. After each placement the equipment shall be cleaned to prevent improper results on subsequent operations.

c. Compacting and Vibrating.

Concrete, except underwater concrete, shall be thoroughly compacted by mechanical vibration applied internally, during, and immediately after depositing.

The application of a vibrator or vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective. Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms. Vibration shall be supplemented by as much spading as is necessary to insure smooth surfaces and dense concrete.

The vibrators shall be methodically inserted and withdrawn from the concrete. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but vibrators shall be withdrawn before segregation and localized areas of grout result.

Vibration shall not be applied directly or through reinforcement to sections or layers of concrete that have hardened to the degree that the concrete ceases to be plastic under vibration. Vibrators shall not be used to make concrete flow in the forms over distances so great as to cause segregation.

2. CULVERTS.

See Section 524 for specific details not covered in this Section.

3. RETAINING WALLS.

See Section 525 for specific details not covered in this Section.

4. BRIDGES.

See Section 510 for specific details not covered in this Section.

5. DEPOSITING CONCRETE UNDER WATER.

a. General.

Concrete shall not be deposited in water unless provided for on the plans, or authorized as provided in Subarticle 503.03(g). Concrete placed under water shall be placed as hereinafter provided.

b. Control.

Seal concrete shall be placed continuously from start to finish to insure the concrete placement being monolithic. The surface of the concrete shall be kept as nearly horizontal as practicable at all times. To insure bonding, each succeeding layer of seal or foundation concrete shall be placed before the preceding layer has initially hardened. All laitance or other foreign matter shall be removed from the top surface of the concrete, and bonding of construction joints performed as provided by Item 501.03(g)4.

c. Placing Methods.

Concrete specified to be deposited in water shall be seal concrete as provided in Article 501.02. To prevent segregation, it shall be carefully placed in a compact mass in its final position by means of a tremie, a bottom dump bucket, pumping, or other approved method. Concrete shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit as nearly as practical.

(1) Use of Tremie.

A tremie shall consist of a rigid, watertight tube of sufficient strength to withstand the stress to which it is subjected and be at least 8 inches {200 mm} in diameter. The tremie shall be supported so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The tremie shall be plugged at the start of work with an approved device capable of separating the concrete from the water until the tube is filled with concrete. The tremie tube shall be kept partially filled with concrete at all times during the concrete placement. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the tremie, always keeping the discharge end in the deposited concrete. The flow shall be as nearly continuous as possible and in no case shall it be intentionally interrupted until the entire seal concrete foundation work is completed.

(2) Use of Bottom Dump Bucket.

The bottom dump bucket shall have a capacity of not less than 0.5 cubic yards {0.5 m^3} and be mechanically equipped to prevent dumping until it rests on the foundation or previously placed concrete. The bucket shall be completely filled and lowered very carefully until it

rests upon the foundation or concrete already placed so as not to get a wash over the bucket top. It shall then be raised very slowly during the discharge travel, the intent being to maintain as nearly as possible, still water at the point of discharge and to avoid agitating the mixture; also to allow the concrete to be deposited by the time the bucket emerges from the concrete already on the foundation.

(3) Pumping.

In addition to the requirements of Subitem 501.03(f)1.b, the following shall also apply for placing concrete under water by pumping. Concrete may be pumped into a tremie, or directly to the point of placement. If the concrete is pumped directly to the point of placement, a rigid pipe shall be provided that must extend a minimum of 5 feet {1.5 m} above the water level when resting on the bottom of the excavation. A flexible hose suitable for pumping concrete may be used from the top of the rigid pipe to the concrete pump. The method of placing and handling the concrete shall be as specified in Subitem 501.03(f)5.c.

(g) CONSTRUCTION JOINTS.

1. GENERAL.

Construction joints shall be placed only at the locations shown on the plans or as directed. In case of an emergency, if a construction joint is permitted, it shall be placed as approved by the Engineer.

2. HORIZONTAL JOINTS.

Generally, horizontal joints shall be made by placing the concrete slightly above the grade of the construction joint, and after the surface has reached its final set, the surface shall be prepared as outlined in Item 4 below. Insert formwork shall be used to obtain neat, horizontal lines.

3. VERTICAL JOINTS.

Vertical joints shall be formed with substantial bulkheads or headers as required. Feather-edged joints will not be permitted.

4. BONDING.

Before placing concrete against any construction joint, the surface of the hardened concrete shall be scarified in such a manner that all foreign matter, laitance, and loose material is removed to expose sound concrete. The prepared concrete at the construction joint shall be kept wet for a minimum of one hour prior to placing concrete against it. Keyways and dowels shall be placed as shown on the plans or directed.

5. WATER STOPS.

Water stops shall be furnished and placed as required by the plans. They shall form continuous watertight joints.

(h) EXPANSION JOINTS.

All joints shall be constructed according to details shown on the plans, providing the design width designated for the expansion joint. The insertion and removal of joint forming material shall be accomplished without chipping or breaking the corners of the concrete. Expansion material, when required, shall be placed as shown on the plans.

(i) FORMS.

1. GENERAL.

Reference is made to Article 105.02 concerning working drawings and other details that require submission.

Forms shall be substantial and unyielding and so designed and constructed that the finished concrete will conform to the plan dimensions and contours within tolerances listed in other portions of these Specifications.

Basic bridge plan design is for removable forms and plan concrete quantities computed accordingly. Hence, removable forms are to be used unless stay-in-place forms are allowed by contract plan notes and details. When shown by contract plan details, the Contractor will be allowed the option of using permanent steel forms under deck slabs between girders, beams or stringers provided the cost of extra concrete and materials required by this type of form is at the Contractor's expense.

2. DESIGN.

a. Removable Forms.

All removable forms shall be designed so that they may be removed without damage to the concrete. Forms shall be so constructed that portions where finishing is required can be removed

for that purpose without loosening supports or disturbing portions of forms that must still remain in place.

b. Permanent Steel Bridge Deck Forms.

The forms and supports shall be zinc coated (Galvanized) steel conforming to ASTM A 446 (Grade A through E) with coating Class of G165 according to ASTM A 525 and shall otherwise meet all requirements relevant to permanent steel forms and the placing of concrete as specified herein and as noted on the plans. Miscellaneous fastener hardware (bolts, nuts, metal screws, and washers) shall be common stock hardware items galvanized to provide a zinc coating equal to or better than that required by ASTM B 633.

The following criteria shall govern the design of permanent steel bridge deck forms:

(1) The steel forms shall be designed on the basis of dead load of form, reinforcement, and plastic concrete plus 50 pounds per square foot {2.4 kN/m^2} for construction loads. The unit working stress in the steel shall not be more than 0.725 of the specified minimum yield strength of the material furnished, but not to exceed 36,000 pounds per square inch {250 MPa}. The uncoated thickness of the forms shall not be thinner than 0.0359 inch {0.9 mm}.

(2) Deflection under the weight {mass} of the forms, the plastic concrete, and reinforcement shall not exceed 1/180 of the form span or 0.5 inches {13 mm}, whichever is less, but in no case shall this loading be less than 120 pounds per square foot {5.7 kN/m^2} total.

The permissible form camber shall be based on the actual dead load condition. Camber shall not be used to compensate for deflection in excess of the foregoing limits.

(3) The design span of the form sheets shall be the clear span of the form plus 2 inches {50 mm} measured parallel to the form flutes.

(4) Physical design properties shall be computed in accordance with requirements of the American Iron and Steel Institute Specification for the Design of Cold Formed Steel Structural Members, latest published edition.

(5) The plan dimensions of both layers of primary deck reinforcement from the top surface of the concrete deck shall be maintained. A minimum concrete cover of 1 inch {25 mm} shall be maintained for the bottom slab steel.

(6) Welding of the forms to bridge elements fabricated from non-weldable grades of steel or to flanges in tension will not be permitted. Plan details will indicate stringer and girder top flange tension limits. Attaching Stay-In-Place bridge deck forms in tension areas of stringers and girders may be done by the welding together of attachment straps if backing plates of galvanized steel are installed under the attachment straps. The attachment straps may be furnished without galvanization. The backing plates shall be thick enough to prevent burn-through. The width of the backing plates shall be at least one inch wider than the width of the welded attachment straps so that the backing plates extend out at least one half inch beyond each edge of the welded straps.

3. CONSTRUCTION.

a. Removable Forms.

(1) Forms shall be mortar tight and placed and maintained true to designated lines and grades until the concrete has been placed and hardened. Forms found unsatisfactory in any respect shall not be used and, if rejected, shall be removed from the immediate work site.

(2) All moldings, panel work, and bevel strips shall be straight and true with neatly mitered joints and all corners in the finished work shall be true, sharp, and clean cut and of good workmanship. Forms shall be filleted and chamfered at all sharp corners except where angles exceed 90°, such as at the face of bridge curbs and deck overhangs. Unless otherwise shown on the plans, the equal sides on triangular molding or chamfer shall be 0.75 inches {19 mm}, except that for small members the width shall be 0.5 inches {13 mm}.

(3) For narrow walls, columns, et cetera, the Engineer may require daylight and inspection holes at vertical intervals as directed.

(4) Bolts or ties shall be used to prevent forms from spreading. All such bolts or ties shall be arranged so that at least 1 inch {25 mm} of that part adjacent to the concrete surface can be removed or broken off.

(5) Anchor devices may be cast in the concrete for later use in supporting forms only if they are detailed on approved formwork or falsework plans.

(6) The inside of all forms shall be coated with a non-staining oil or other approved material to prevent the concrete adhering to them. Extreme care shall be exercised to insure that form oil does not come in contact with structural or reinforcing steel.

(7) The forms shall be inspected before placing the concrete and the interior dimensions carefully checked to insure that the concrete will be of the form and dimensions shown on the plans. The inside faces of the form shall be thoroughly examined and any projections, ridges, depressions, offsets, spaces or other unevenness corrected so that the surface of the concrete will be smooth, even and true, and mortar tight. All forms shall be wetted immediately prior to placing the concrete, but no excess water shall remain in the forms.

(8) To permit proper surface finishing, forms shall be removed as soon after the concrete has set as is practicable and safe. In the determination of the time for the removal of forms, except those listed in Item 501.03(j)2, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete, and the material used in the mix. Methods of form removal likely to cause over-stressing of the concrete shall not be used. Forms shall not be removed without the approval of the Engineer.

b. Permanent Steel Bridge Deck Forms.

(1) All forms shall be installed in a manner acceptable to the Engineer.

(2) On steel members, form sheets will not be permitted to rest directly on the top of the stringer or floor beam flanges. Sheets shall be securely fastened to form supports and shall have a minimum bearing length of 1 inch {25 mm} at each end. Form supports shall be placed in direct contact with the flange of stringer or floor beam. All attachments shall be made by permissible welds, bolts, clips, or other approved means. However, there shall be no welding of form supports to flanges of steels not considered weldable or to portions of flanges excluded in Paragraph 501.03(i)2.b(6). The installation of attachment straps, shelf angles, and forms shall be carefully monitored to make sure that no welding (weld, arc strike, etc.) is done to the structural steel. Welding and welds shall be in accordance with the provisions of Article 836.46 pertaining to fillet welds except that 1/8 inch {3 mm} fillet welds will be permitted. Welders shall be ALDOT qualified welders when welds are being made to steel beams or girders.

On concrete girders, form supports to be cast into the girders shall be shown on the shop drawings. All attachments to form supports shall be made by permissible welds, bolts, clips, or other approved means. Attachment by welding to form supports may be performed by non-ALDOT qualified welders with welding electrodes recommended by the form manufacturer.

All form welds shall be cleaned of slag and wire brushed just prior to placing of the deck concrete.

(3) Any permanently exposed form metal where the galvanized coating has been damaged shall be thoroughly cleaned, wire brushed, and painted with two coats zinc oxide-zinc dust primer, Federal Specification TT-P-641, Type II, no color added, to the satisfaction of the Engineer. Minor heat discoloration in areas of welds need not be touched up.

(4) Transverse construction joints shall be located at the bottom of a flute and 0.375 inch {10 mm} weep holes shall be field drilled at not more than 12 inches {300 mm} apart along the line of the joint. If a bridge is on a skew, or in a curve, a weep hole shall be drilled in the bottom of each flute the joint crosses.

(j) FALSEWORK.

1. DESIGN AND CONSTRUCTION.

a. General.

For the purpose of this specification, falsework shall be divided into two classes as follows:

Class 1 - Common or simple falsework such as permanent steel bridge deck forms, deck overhang supports, screed rail support systems, or substructure supports attached to permanent parts of the structure (i.e. drilled shafts, columns, caps, etc.).

Class 2 - Unique or complex falsework such as that required for box girder construction, RCDG construction, or any falsework used in connection with steel erection.

The Contractor shall be responsible for designing and constructing safe and adequate falsework which provides the necessary strength and rigidity, supports all loads imposed, and produces a finished structure with lines and grades shown on the plans. Falsework shall be designed and constructed to withstand all imposed loads during erection, construction, usage, and removal.

The Contractor shall submit to the State Construction Engineer working drawings and design calculations for falsework in accordance with Article 105.02.

For both classes of falsework drawings, the State Construction Engineer will verify that the Registered Professional Engineer signature and stamp requirements of Subarticle 105.02(d) are

met. Class 1 drawings will be stamped for distribution and then distributed. Class 2 drawings will be forwarded to the State Bridge Engineer for review to determine if the results of the Registered Professional Engineer's calculations are in compliance with design criteria. If the design criteria is met, the submittal will be returned to the State Construction Engineer to be stamped for distribution and then distributed.

Except where noted in this paragraph, the formal submittal procedure may be omitted for proposed Class 1 falsework details which have been previously submitted and distributed for use on a project in Alabama. In this case the Contractor shall submit a copy of the originally distributed plans to the Project Engineer for confirmation. The formal submittal procedure will always be required for permanent steel bridge deck forms for continuous steel plate girders. The formal submittal procedure will always be required where screed rail support spacing and bridge deck overhang support bracket spacing is proposed to exceed the maximum allowable values given in Subitem 510.03(c)6.c.

All falsework will be inspected by the Project Engineer using the distributed drawings. For all Class 2 falsework, the Registered Professional Engineer who signed the falsework submittal shall verify that the falsework as constructed meets all design criteria prior to any load being placed thereon. A signed statement from the Registered Professional Engineer covering the verification shall be furnished to the Project Engineer by the Contractor.

When falsework of either class is to be used over highway, pedestrian, or railroad traffic, additional details will be required to provide for special protection to prevent debris from falling on the traffic below. These additional details will be required for both removal and construction work.

All falsework drawings shall include a description and size of all members, connections, and miscellaneous hardware. When pre-manufactured assemblies are used, all parts shall be easily identified as those shown on the drawings.

All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. Screw jacks and/or hardwood wedges shall be used to take up any settlement in the formwork either before or during the placing of concrete.

Any part of the permanent structure to which falsework will be attached shall attain a minimum compressive strength of 2400 psi {17 MPa} from cylinders prepared in conformity with AASHTO T 23 prior to the attachment.

Falsework that cannot be founded on a satisfactory footing shall be supported on piling, which shall be spaced, driven, and removed in an approved manner.

All spans shall be given a temporary camber to allow for deflection, shrinkage, and settlement. Bridges shall have a permanent camber only where so shown on the plans or directed.

b. Design Criteria.

Falsework shall be designed to withstand all imposed loads during erection, construction, usage, and removal. Designs shall be based on minimum loads, maximum stresses and deflections, and conditions in the following paragraphs. Allowable stresses are based on use of undamaged, high quality materials. The contractor shall reduce stresses if lesser quality materials are used.

Design Loads for falsework shall consist of the sum of dead and live vertical loads and assumed horizontal loads. Minimum total design load for any falsework shall not be less than 100 pounds per square foot {4.8 kN/m^2} for the combined live and dead load regardless of slab thickness.

Dead Loads shall include weight {mass} of concrete, reinforcing steel, forms, and falsework. Weight {mass} of concrete, reinforcing steel, and forms shall not be assumed to be less than 160 pounds per cubic foot {25 kN/m^3}.

Live Loads shall consist of the actual weight {mass} of any equipment to be supported by falsework applied as concentrated loads at the points of contact and a uniform load of not less than 20 pounds per square foot {0.960 kN/m^2} applied over the area supported plus 75 pounds per linear foot {1.1 kN/m} applied at the outside edge of deck overhangs.

Horizontal Loads applied shall be the sum of the actual horizontal loads due to equipment, construction sequence, or other causes and an allowance for wind, but in no case shall the design horizontal load to be resisted in any direction be less than two percent of the total dead load. Falsework shall be designed of sufficient rigidity to resist the design horizontal load prior to placement of concrete.

Falsework Foundations shall be designed to carry the loads imposed on them without exceeding allowable soil bearing values and anticipated settlements.

Maximum allowable stresses, loadings, and deflections used in design of falsework shall be as follows:

TIMBER	
Compression perpendicular to the grain (Dense Select Structural Grade Southern Pine)	450 psi {3 MPa}
Compression parallel to the grain but not to exceed 1600 psi {11 MPa}	480,000/$(L/D)^2$ psi {3300/$(L/D)^2$ MPa}
Flexural stress reduced to 1500 psi {10 MPa} for members with a nominal depth of 8 inches {200 mm} or less.	1800 psi {12 MPa}
Horizontal shear (Dense Select Structural Grade Southern Pine)	90 psi {0.620 MPa}
Deflection due to weight {mass} of concrete.	1/240 of clear span irrespective of the fact that the deflection may be compensated for by camber strips.
Timber piles, maximum loading (12 inch {300 mm} Butt Diameter)	24 tons {213 kN}

STEEL	
Deflection due to weight {mass} of concrete irrespective of the fact that the deflection may be compensated for by camber strips.	1/240 of clear span
Stresses shall not exceed those specified in the Manual of Steel Construction as published by the AISC. When the grade of the steel cannot be positively identified, design stresses shall conform to either those specified in said AISC Manual for ASTM A 36 steel or the following:	
Tension, axial and flexural.	22,000 psi {152 MPa}
Compression, flexural (But not to exceed 22,000 psi {152 MPa})	12,000,000 / (LD/bt) psi {83 000/ (LD/bt) MPa}
Compression, axial .(Except L/r shall not exceed 120.)	16,000 - 0.38$(L/r)^2$ psi {110 - 0.38$(L/r)^2$ MPa}
Shear on gross section of the web of rolled shapes.	14,500 psi {100 MPa}
Web crippling for rolled shapes	27,000 psi {186 MPa}

In the foregoing formulas, L is the unsupported member length, D is the least dimension of rectangular columns, or the width of a square of equivalent cross sectional area for round columns, or the depth of beam, b is the width of member, t is the thickness of the compression flange and r is the radius of gyration of the member. E, modulus of elasticity, used for timber shall be 1.6×10^6 psi {11 GPa} and for steel shall be 30×10^6 psi {200 GPa}.

Any additional design criteria, which may be needed, shall be developed by the Contractor's Registered Professional Engineer designer and included with the calculations of the falsework submittal.

Falsework over or adjacent to roadways or railroads which are open to traffic during construction shall be designed and constructed such that it is stable if subjected to vehicular impact or features shall be provided to protect falsework supports from vehicular impact. Protection shall be designed such that it does not present a hazard to vehicular traffic.

Design criteria for permanent steel bridge deck forms shall be as shown in Subitem 501.03(i)2.b.

2. REMOVAL OF FALSEWORK.

No falsework supporting concrete shall be removed or wedges loosened without the consent of the Engineer.

If adequate test cylinders have been made, falsework may be removed when the cylinders indicate that the concrete has developed a minimum compressive strength of 2400 psi {17 MPa}, otherwise falsework shall be removed according to the following time limitations.

Falsework may be removed after expiration of 14 days exclusive of days when for four hours or more the temperature is below 40 °F {5 °C}. Falsework under slabs of less than 6 foot {2 m} span may be removed after seven days with the same temperature limitations.

Falsework shall be gradually and uniformly released in such a manner as to avoid injurious stresses in any part of the structure. Wedges shall be removed first under slabs and transverse beams, starting at the center of the span and working both ways; then wedges under longitudinal girders and beams shall be removed also starting at the center of the span and working both ways simultaneously.

All falsework piles, at the time of removal or cleanup, shall be pulled out or cut off at an elevation not more than 6 inches {150 mm} above the bed of the stream. Piles not in water shall be removed or cut off flush with or below the ground surface of stream bed. Piles within roadbed limits shall be cut off at least 3 feet {1 m} below subgrade elevation. Other piles within roadway limits shall be cut off at least 12 inches {300 mm} below the finished surface of the front slope, ditch, or backslope.

(k) CURING CONCRETE.

1. EXPOSED SURFACES.

Whenever the Engineer determines that weather conditions are such that evaporation from the surface may cause shrinkage cracking, a fog or mist spray may be required at intervals as needed during and after finishing until curing material can be applied so that the surface will be at all times damp but not excessively wet.

The Contractor shall give careful attention to the proper curing of the concrete. All surfaces not covered by forms shall be protected with membrane curing compound, dampened burlap, Polyethylene Film* (White Opaque), White Burlap - Polyethylene Sheet*, cotton mats, or wetted sand, as soon after placing the concrete as possible without marring the surface, except for bridge deck slabs which shall be treated as noted in Item 2 below. Immediately upon removal of forms, other surfaces shall be treated by one of the approved curing methods.

Unless membrane curing compound is used, all curing materials shall be kept wet and shall remain in place for seven days, except that small portions may be temporarily removed during actual finishing operations.

*NOTE: When polyethylene film or white burlap-polyethylene sheeting is used, it shall be installed and maintained in such a manner that a complete, moisture-tight enclosure over the surface to be cured will be provided. These materials shall meet the requirements noted in Section 830.

2. BRIDGE DECK SLABS.

a. General.

Prior to placing a bridge deck slab, the evaporation rate shall be determined by use of the graph in Figure 1, "Evaporation Rate of Surface Moisture", and recorded on form BMT-171, *"Evaporation Rate Record"*. The Contractor shall furnish the equipment necessary to measure the air temperature (ambient), wind velocity, and humidity. The equipment or a manufacturer's certificate of calibration showing the equipment's model number and serial number shall be submitted to the Materials and Tests Engineer no less than 14 days prior to their use. The equipment shall consist of the following instruments with the following specifications.

1. Anemometer:	Range – 0-25mph {0-40 km/hr}. Accuracy – plus or minus 1.5%. Units – U.S. Customary and Metric.
2. Hygrometer:	Range – 10-95% relative humidity. Accuracy – plus or minus 1.5%. Units - U.S. Customary and Metric. Certified and traceable to N.I.S.T.
3. Thermometer:	range – 0-140 °F {0-60 °C}. Accuracy – plus or minus 2 °F {plus or minus 1 °C} Units - U.S. Customary and Metric.

Combination instruments such as anemometer and thermometer or hygrometer and thermometer will be accepted provided they meet the above requirements.

If the placement is expected to last more than two hours, the evaporation rate shall be checked and recorded on form BMT-171 at two-hour intervals or less. To prevent plastic shrinkage cracking, the expected evaporation rate shall not exceed 0.2 pounds per square foot per hour {1.0 kg/m^2/hour}. When the evaporation rate exceeds this amount, the Contractor shall be required to

effectively reduce the rate to within the allowable limits by taking one or more of the following actions:

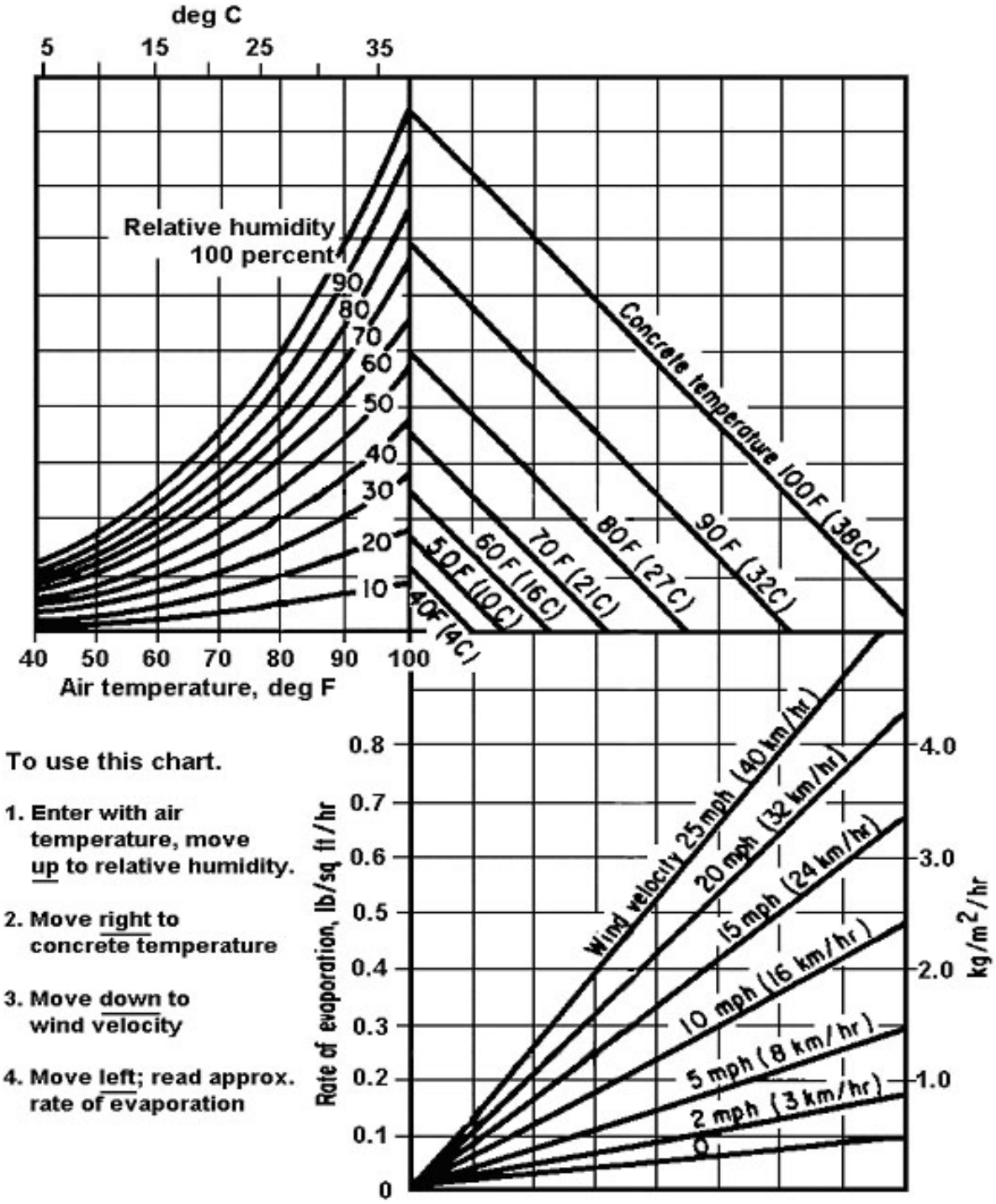
(1) Construct windbreaks or enclosures to effectively reduce the wind velocity throughout the area of placement.

(2) Use fog sprayers or sprinklers upwind of the placement operation to effectively increase the relative humidity.

(3) Reduce the temperature of the concrete.

The Department will evaluate plastic shrinkage cracks that occur. Remedial measures shall be performed as directed by the Engineer. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

FIGURE 1. Evaporation Rate of Surface Moisture



b. Evaporation Control After Screeding.

Continuous fogging or an evaporation barrier (monomolecular) material shall be used for all bridge deck curing beginning immediately after the screeding operations have been completed for sections of the deck not to exceed five feet from the starting location.

If fogging is to be used, a continuous fog or mist spray shall be maintained until the moist curing procedures of Subitem 501.03(k)2.c begin. Intermittent fogging is not acceptable if there is drying of the concrete surface. If water begins to pond on the deck, the Contractor shall adjust the rate of fogging to minimize the ponding of water.

If an evaporation barrier material is to be used, it shall be applied immediately behind the screeding operation and in accordance with the manufacturer's recommendations. The entire top portion of the concrete slab shall be covered with the barrier material applied under pressure at a rate of one gallon {liter} to not more than 200 square feet {5 m^2} of fresh concrete. Application shall be done with an industrial type sprayer in such a manner as to cover the surface being treated with a uniform film.

c. Moist Curing After Finishing.

Immediately after the finishing operation, concrete bridge decks shall be moist cured for seven days by maintaining a moist condition for the entire curing period. This may be accomplished by one of the following methods:

(1) Fog spraying or sprinkling with nozzles or sprinklers. When using this method, the Contractor shall maintain a complete and continuous moist condition of the concrete surface. Intermittent sprinkling is not acceptable. Care shall be taken that erosion of the surface does not occur.

(2) Saturated burlap, saturated plastic coated burlap, or cotton mats. These curing materials shall be clean and free from any injurious substances that can cause deleterious effects to the concrete or cause discoloration. The burlap or cotton shall be completely saturated before being placed on the concrete and shall be maintained in that condition for the entire curing period. Should tears or holes appear in the mat sheets, they shall be repaired immediately. All edges of burlaps and mats shall extend at least 18 inches {450 mm} beyond the concrete surface. Where two individual sheets join, their edges shall overlap at least 12 inches {300 mm}. All edges and overlaps shall be secured to ensure that the concrete surface is completely covered during the entire curing period. These curing materials shall be kept in contact with the concrete surface at all times. Alternate cycles of wetting and drying shall be avoided because this may result in pattern cracking.

Prior to the start of the curing operation, the contractor shall have an approved curing system that ensures continuous moist curing of the concrete for 24 hours per day.

If water or the chosen curing material stains or discolors concrete surfaces, which are permanently exposed, the contractor shall be responsible for cleaning the surfaces. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, non-supporting vertical forms shall be broken loose from the concrete and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces.

3. PROTECTION OF CONCRETE DURING CURING.

Green concrete shall be protected against jarring or other movement that might cause damage. No traffic or other superimposed load will be permitted over bridges or culverts until the following criteria have been met:

(1) Bridges - The deck concrete shall have reached a minimum 4000 psi {28 MPa} compressive strength as determined from test cylinders.

(2) Culverts - The culvert concrete shall have reached a minimum of 3000 psi {21 MPa} compressive strength as determined from test cylinders or 28 days have passed since the last concrete was placed exclusive of days when for 4 hours or more the temperature is below 40 °F {5 °C}.

(l) FINISHING CONCRETE.

1. GENERAL.

The details set forth hereinafter in this Subarticle cover the requirements for the several classes of surface finishes which shall be applied to the various parts of concrete structures.

These various classes of surface finishing will be used in accordance with the following:

Class 1 - required on all concrete surfaces except wearing surfaces and surfaces placed in direct contact with natural ground or embankment.

Class 2 - required on all exposed concrete surfaces within the requirements noted in Subitem 501.03(l)3.d. unless another class is specified.

Class 3 - may be used on designated bridge structures when specified by plan details.

Wearing surface finish for bridge deck travelway shall be as specified in Subitem 510.03(c)6.c. and for sidewalks as specified in Item 510.03(c)7.

Exposed surfaces or sidewalks, driveways, curbs, and gutters shall have a textured finish obtained by the use of a burlap or cotton drag, brush, or broom so that a uniform gritty texture is obtained. Exposed surfaces of concrete flumes and slope paving shall have a float finish.

2. CLASS 1 FINISH (ORDINARY SURFACE FINISH).

This class finish will require the concrete surface to be free from objectionable projections, swells, fins, ridges, depressions, waves, holes, and other defects. This will require that immediately after the forms are removed, metal ties shall be removed for a minimum depth of 1 inch {25 mm} from the face of the concrete. All cavities or depressions resulting from this removal, or from other causes, shall be carefully filled and pointed with a mortar of sand and cement, and the surface left smooth and even. The proportion of cement to sand, measured by volume, shall be one to two unless otherwise specified. The surface film of all pointed areas shall be carefully removed before setting occurs. Any fins, ridges, or projections shall be struck off smooth with the surface of the concrete. Particular care shall be taken throughout the progress of this operation to use one of the curing methods covered in Subarticle 501.03(k).

If a Coated Surface Finish is to be applied in a later finishing operation, the coating material may be used in lieu of mortar to fill small air holes in the concrete surface; however, this must be given time to take a set prior to applying the Coated Surface Finish.

3. CLASS 2 SURFACE FINISH.

a. General.

This class surface finish requires that, in addition to a Class 1 finish, the exposed surfaces of bridges, culverts, headwalls, inlets, etc. as defined in the Subitem d. below, receive an additional surface finish in accordance with the following:

If only one brand and type of cement from the same mill is used in a structure or unit (substructure or superstructure), the Contractor may elect to either apply a Rubbed Surface Finish or apply an approved coated Surface Finish.

If more than one brand of cement is used in a structure, the Contractor shall apply a Coated Surface Finish.

The same type of surface finish shall be used throughout the entire structure unless otherwise authorized in writing by the Engineer.

b. Rubbed Surface Finish.

As soon as the Class 1 surface finish has been completed and the pointing has set sufficiently to permit it, the entire surface except chamfers shall be wetted with a brush and rubbed with a No. 16 carborundum stone or an abrasive of equal quality, bringing the surface to a paste. The rubbing shall be continued sufficiently to remove all form marks and projections, producing a smooth dense surface without pits or irregularities. The material, which in the above process has been ground to a paste, shall then be carefully spread or brushed uniformly over the entire surface and allowed to take a reset. Curing shall continue on this surface as required in Subarticle 501.03(k).

The final finish shall be obtained by a complete rubbing with a No. 30 carborundum stone or an abrasive of equal quality. This rubbing shall continue until the entire surface is of a smooth texture and uniform in color.

c. Coated Surface Finish.

Only Departmental approved coated finishing materials may be used. A list of these coating materials may be obtained from the State Materials and Tests Engineer. The "Product Evaluation Board Committee" must approve any coating finishes not on the approved list before they will be considered for use.

The application of the coating shall be in an approved manner (normally in accordance with the manufacturer's recommendations) by competent and experienced personnel. The overall coated finish shall be uniform in coverage, texture, and color after the coating material has taken set and cured. Failure to obtain uniformity of coverage, texture, and color shall be cause for the Engineer to require such remedial action as deemed necessary to obtain the desired results.

The following actions shall be taken before the application of any coated finish:

A Class 1 surface finish applied and all pointing completely set.

Surface clean and free from foreign matter.

If membrane curing compound was used to cure the concrete, the curing compound shall have weathered for a minimum time period of six weeks. Special care shall be taken to insure that areas not to be treated are protected to prevent treatment from overlapping onto these designated areas.

d. Exposed Surfaces.

Exposed surfaces for this class finish is defined as all surfaces, including bottom chamfers and fillets except (1) the wearing surface of roadway slabs and sidewalks, (2) those surfaces having immediate contact with embankment or excavation, (3) those surfaces below low water level and/or below newly established ground line after backfilling excavation or excavated channels, (4) underside and interior faces of girders, beams, and slabs, and underside of sidewalks where the edge beam extends 3 inches {75 mm} or more below the bottom of the sidewalks, (5) top and bottom surfaces of all type caps, and (6) those parts of minor structures, box culverts, and bridge culverts that are not readily visible from a travelway.

4. CLASS 3 SURFACE FINISH.

This class surface finish requires that, in addition to the Class 1 surface finish, only the designated exposed surfaces of a bridge structure noted below be given an additional finish of either a rubbed or coated finish in accordance with the provisions for such noted in Item 501.03(l)3.

Exposed surfaces shall be defined as the inside, top, and outside surfaces of barrier rail to bottom of slab overhang, and all portions of the bridge abutments outside the edge of the exterior girders that are not in immediate contact with embankment or excavation. All other structure surfaces, exposed and unexposed, shall receive a Class 1 finish immediately after the forms are removed.

(m) PRECAST NON-PRESTRESSED CONCRETE UNITS.

1. GENERAL.

All concrete furnished for use in any precast non-prestressed Portland cement concrete items shall comply with the requirements of the preceding Articles of this Section except for modifications provided hereinafter in this Subarticle, the detailed plans, or special provisions.

2. CONSTRUCTION DETAILS AND MANUFACTURE.

The method of construction of precast non-prestressed concrete units shall be that of the fabricator provided such conforms to the following requirements:

(1) Units shall be of the size and shape shown on the plans.

(2) The reinforcing system shall be rigidly wired or fastened at all intersections and held to true position in the form by approved devices.

(3) Units shall be cast on level, tight platforms that will not settle during the casting or curing. Forms shall conform to the general requirements of this Section for concrete formwork. The casting location shall be accessible for vibrating and consolidation of the concrete. Under normal curing methods, side forms may be removed at any time after the concrete has taken its initial set (not less than four hours after casting of the concrete); however, the entire unit shall not be subjected to any handling stress until the concrete has reached a strength of 2400 psi {17 MPa}.

(4) Mixing and placing of concrete shall conform to the preceding requirements of this Section. Piling shall be cast in a horizontal position. Casting in tiers will not be permitted. Special care shall be exercised to vibrate and consolidate the concrete around the reinforcement and along and against the forms. Concrete shall be placed continuously in each unit with special care being exercised to avoid horizontal or diagonal cleavage planes. All reinforcement shall be accurately placed and rigidly secured at the location shown by the plans or approved drawings and special care shall be exercised that the reinforcement is properly imbedded in the concrete in the completed unit in accordance with the position indicated on the plans.

(5) As soon as the forms are removed, the unit shall receive an ordinary surface finish. No other finish will be required on foundation piling and that portion of trestle piling which will be below the ground surface, or piles to be used in seawater or alkali soils. The completed unit shall be free from honeycomb, porous areas, or other defects. Exposed portions of piling and other exposed surfaces as defined in Item 501.03(l)1, shall have a Class 2 Surface Finish unless otherwise specified.

3. CURING PRECAST CONCRETE UNITS.

After casting, all exposed concrete shall be protected by wet burlap or other approved material to prevent excessive loss of moisture during the initial set period. After the concrete has obtained its initial set (not less than four hours after casting), the side forms may be removed and the curing continued by one of the following methods. As an exception to the following curing methods, when a compressive strength of 4000 psi {28 MPa} is obtained no further curing will be required. All strength determinations will be made by concrete cylinder tests.

Standard Curing Method.

After removal of the side forms, the units shall remain on the pallets and not moved for a minimum period of three days during which they shall be kept covered with saturated burlap, double thickness, or tarpaulin. If the unit has not reached a strength of 2400 psi {17 MPa} at the end of this minimum three day period, curing shall be continued for a period of seven additional days by use of membrane curing compound, covering with polyethylene sheeting, immersion in water, or by covering with a heavy layer of sand which is kept wet. Anytime after the first three days if the concrete reaches 2400 psi {17 MPa} strength, curing may be discontinued and the units moved.

Steam Curing Method.

After precast concrete has obtained its initial set, steam shall be applied in such a manner as to raise the temperature of the air surrounding the units at a rate not to exceed 40 °F {22 °C} per hour to a temperature not to exceed 160 °F {71 °C}. This raised temperature shall be maintained for a period of 24 hours; however, if a compressive strength of 2400 psi {17 MPa} has not been obtained at the end of 24 hours, the steam curing shall be continued until the required strength is obtained. If a compressive strength of 2400 psi {17 MPa} is obtained before the end of the 24 hours noted, the steam curing procedure may be stopped if the units are covered with polyethylene sheeting for an additional 24 hour period to compensate for the shorter period of steaming.

The steam curing of prestressed concrete items shall be as outlined in ALDOT-367 *"Guidelines for Inspection of Prestressed and Post Tensioned Concrete Items"* or on the plans.

4. HANDLING AND STORAGE.

The method of handling and storage shall be such as to preserve true and even edges and corners. Any cast unit that becomes chipped, cracked, or marred before or during the process of installation shall be rejected and ordered removed from the work or if the damage does not affect the structural integrity of the unit, it may be repaired by approved methods.

No precast unit shall be transported or installed in the work until the required strength has been obtained, verified by cylinder test.

501.04 Inspection.

(a) GENERAL.

The Contractor shall give the Engineer sufficient advance notice before starting to place concrete in any section of a structure to permit the inspection of forms, placing of steel reinforcements, and of preparation for placing. Any defective falsework or forming shall be corrected, or removed and replaced as necessary to the satisfaction of the Engineer, all at the expense of the Contractor.

Authorization of the Engineer shall be secured before concrete is placed in any portion of a structure. Any concrete placed in violation of this provision, or in the absence of the Inspector, shall be removed and replaced at no additional cost to the State.

(b) REMOVABLE FORMS.

After the forms have been removed, any defective work discovered shall be removed and replaced in a satisfactory manner. If the surface of the concrete is bulged, sagged, uneven, or honeycombed to such an extent that it cannot be satisfactorily repaired, the entire section shall be removed and replaced, at no additional cost to the State.

(c) STAY IN PLACE STEEL FORMS.

After the deck concrete has been in place for a minimum period of two days, the concrete, if deemed necessary by the Engineer, shall be tested for soundness and bonding of the forms by sounding with a hammer as directed by the Engineer. The number and locations of the forms to be tested shall be as selected by the Engineer. If areas of doubtful soundness are disclosed by this procedure, the Contractor will be required to remove the forms from such areas for visual inspection after the concrete has attained a minimum compressive strength of 2400 psi {17 MPa}. Care shall be exercised to distinguish the sound of broken bond from the sound of defective concrete.

At locations where sections of the forms are removed, the Contractor will not be required to replace the forms, but the adjacent metal forms and supports shall be repaired to present a neat appearance and assure their satisfactory retention. As soon as the forms are removed, the concrete surfaces will be examined for cavities, honeycombing, and other defects. If irregularities are found, and in the opinion of the Engineer these irregularities do not justify rejection of the work, the concrete shall be repaired as the Engineer may direct. If the concrete where the forms are removed is unsatisfactory, additional forms, as necessary, shall be removed to inspect and repair the slab, and the Contractor's methods of construction shall be modified as required to obtain satisfactory concrete in the slabs. All unsatisfactory concrete shall be removed or repaired as directed by the Engineer.

The Contractor shall provide all facilities as are reasonably required for the safe and convenient conduct of the Engineer's inspection procedures. No additional compensation will be allowed the Contractor for compliance with the above inspection procedures.

501.05 Acceptance of Concrete.

(a) GENERAL.

Concrete Technicians certified by ALDOT shall do all concrete inspections and testing. Procedures for technician certifications and laboratory qualifications are described in ALDOT-405, "*Certification and Qualification Program for Concrete Technicians and Concrete Laboratories*".

Fresh concrete will be accepted on the basis of slump, air content, and temperature meeting the requirements specified for the Class and Type of concrete.

Hardened concrete shall be accepted on the basis of compressive strength meeting the requirements specified in Item 501.02(c)2 for that Class and Type of concrete.

Compressive strength from concrete cylinders will be accepted when the average of two consecutive cylinder test results, obtained at the same age, equals or exceeds the specified 28-day compressive strength, and neither cylinder test result is below 95% of the specified 28-day compressive strength.

(b) SUBSTANDARD CONCRETE.

1. GENERAL.

The Department will investigate any concrete not meeting the acceptance requirements outlined in Subarticle 501.05(a). Concrete investigations will be used to determine the suitability of potentially substandard concrete. This investigation may include any or all of the procedures outlined in ALDOT-170.

The combined results of the Department's investigations will be used to assess the acceptability or rejection of potentially substandard concrete.

2. IN-PLACE COMPRESSIVE STRENGTH.

If the Department deems it necessary to evaluate only the in-place compressive strength of substandard concrete, a core investigation as described in ALDOT-170 will be performed.

Price adjustments will be applied to the applicable pay item for the number of cubic yards represented by the low cylinder breaks and will be determined as follows.

If the average compressive strength of the cores is equal to or greater than 100% of the specified 28-day compressive strength, the concrete will be accepted with no price adjustment.

If the average compressive strength of the cores is 85% or greater but less than 100% of the specified 28-day compressive strength, and the State Bridge Engineer deems the concrete to be structurally acceptable, the concrete will be accepted with a price adjustment. The price adjustment will be applied to the applicable pay item for the number of cubic yards represented by the low breaks. The price adjustment shall be determined from the following formula:

$$\text{Price Adjustment (In Percent)} = 100 \times (1.0 - [(f'c - fc\ AVG) / (0.30\ f'c)])$$

f'c = Required 28-day Compressive Strength (psi) {MPa};

fc AVG = Average Compressive Strength of Test Cores (psi) {MPa};

The price adjustment shall be rounded to the nearest tenth of a percent;

The price adjustment is valid where: $50\% \geq$ Price Adjustment $< 100\%$.

SECTION 502
STEEL REINFORCEMENT

502.01 Description.

This Section shall cover the work of furnishing and installing reinforcement steel for concrete structures in accordance with detailed plans and these Specifications.

502.02 Materials.

(a) GENERAL REQUIREMENTS.

All materials shall conform to applicable portions of Division 800, Materials. Specific reference is made to Section 835, Steel Reinforcement.

Steel mesh shall be used only when and as shown on the plans.

Special attention is directed to Article 835.01 for the use of rail steel reinforcing bars in structures.

All reinforcing bars when shipped from the fabricator or supplier to the project site shall conform to the following bundling and tagging practice:

1. Bundling: All bundles shall consist of the same size bars and the same heat number.
2. Tags: Tags shall be made of durable material and marked in a legible manner with waterproof markings, not less than one tag per bundle. The tags shall show the grade, number of pieces, size, marks or length of bar, and heat number of steel.

The supplier of the reinforcing steel shall furnish to the Engineer three copies of an itemized list of all steel included in each shipment. Such list shall show the mark of the bar, bar number, heat number, grade, length, and weight {mass} of all steel for each structure requiring reinforcing steel.

(b) BAR BENDING DIAGRAMS.

When bar lists and bending diagrams are shown on the plans, the Contractor shall verify their accuracy from the drawings. Errors in the bar bending schedules and bar list shall not be cause for adjustment of contract unit prices.

502.03 Construction Requirements.

(a) GENERAL.

All reinforcement received on the project shall be placed in approved storage and shall be maintained clean, intact, and free from distortion. Reinforcement shall be free from loose or thick rust which would impair bond of the steel with the concrete. Rust that produces only discoloration without reducing the cross section of the steel will not be considered objectionable. Only such reinforcement shall be distributed along the construction as is needed for immediate use.

(b) EQUIPMENT.

All equipment necessary for the proper fabrication, bending, handling, and installation of reinforcement must be available when required, in first class working condition, and shall be approved before fabrication and construction will be permitted to begin.

(c) HANDLING AND PLACING REINFORCEMENT.

1. BENDING.

Reinforcement shall be bent in accordance with CRSI Manual of Standard Practice MSP-1-97, accurately to the form and dimensions shown on the plans without heating. In bending, care shall be taken not to injure the steel and only proper appliances and competent workmen shall be employed on the work. The radius of bends shall be three or more times the diameter of the bar unless shown otherwise on the plans. Abrupt bends shall be avoided. Any reinforcement bent during shipment or handling shall be properly reshaped, without heating to a higher temperature than that producing a dark cherry-red color, before being placed in the work. Bars with kinks or bends and bars appreciably reduced in cross sectional areas shall be rejected.

2. CLEANING.

Metal reinforcement before being placed shall be cleaned of loose mill scale and of coatings of dirt, paint, oil, grease, or any other foreign substance.

3. PLACING.

All reinforcing steel shall be accurately placed and firmly held in the position shown on the plans during the placing and hardening of the concrete.

A ± 1/4 inch { ± 6 mm} vertical placement tolerance will be allowed on the top mat of reinforcing steel in the bridge decks.

4. WIRING AND SUPPORTING.

a. All reinforcement shall, as elected by the Contractor, be (1) rigidly wired, or (2) if approved by the Engineer, spot welded. Suitable provision shall be made for supporting reinforcement in position during the placing of concrete. No construction operation shall be permitted which tends to bend or displace the reinforcement from its correct position. All reinforcement shall be placed and securely wired, spaced, and blocked before placing concrete in any section. Railing post reinforcement shall be installed before placing the curb concrete. In no case shall reinforcing steel be driven or forced into concrete after it has set.

b. All reinforcing metal shall be maintained at the proper distance from the forms or in the case of layers, from each layer by means of approved stays, mortar blocks, metal chairs, ties, hangers, or other approved supports.

Mortar blocks shall be precast from a mortar mix composed of one part Portland cement and two parts concrete sand with wires cast into them for fastening to the steel. Blocks shall be moist-cured (other curing methods may be accepted) for at least three days before use. Block basic shape shall be a square (2 inch {50 mm} x 2 inch {50 mm} Min.) with appropriate height as required to hold the steel in its designated position (+ 1/8 inch , - 0 inch {+ 3 mm, - 0 mm}). The size and shape shall be approved before use. Tie wires shall be 0.064 inch {1.6 mm} minimum diameter.

Metal supports shall be in accordance with CRSI Manual of Standard practice MSP-1-97 for Class 3 bar supports except that supports which are to be in direct contact with removable forms shall be Class 1 supports. Any premolded Class 1 support tips that do not provide a tight snug fit shall be rejected and removed from the work.

The use of pebbles, pieces of broken concrete, stone or brick, metal pipe, and wooden blocks will not be permitted.

5. INSPECTION.

a. Reinforcement in any member shall be placed, and then inspected and approved before the placing of concrete begins. Concrete placed in violation of this provision shall be rejected and removed at no additional cost to the State.

b. Extreme care shall be taken to insure that the final location of bars in the top of floor slabs, sidewalks, curbs, and beams are not lower than the clear distance from the top of the finished slab as shown on the plans.

(d) SPLICING, LAPPING, AND BUTT WELDING REINFORCEMENT.

1. SPLICING.

Whenever it is necessary to splice reinforcement at points other than those shown on the plans, drawings showing the locations and details of each splice shall be submitted by the Contractor and approved before the reinforcing steel is ordered by the Contractor. Splices shall be avoided at points of maximum stress; they shall, where possible, be staggered, and shall be designed to develop the strength of the steel without exceeding the allowable unit bond stress.

Unless otherwise shown on the plans, bars shall be lapped 24 diameters to make the splice in the slab and in the bottom of beams and girders, and not less than 35 diameters in walls, columns, haunches, and near the tops of beams and girders having more than 12 inches {300 mm} of fluid concrete under the bars.

In lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the minimum clearance distance to the surface of the concrete. Welding of reinforcing steel shall be done only if detailed on the plans or if authorized in writing. Welding shall conform to the current specifications for welded highway and railway bridges of the American Welding Society.

2. LAPPING.

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width.

3. BUTT WELDING.

Reinforcing bars shall be butt welded only when specifically shown by the detailed plans.

This type welding, when allowed, shall be limited to Shielded Metal Arc Welding (SMAW) and shall be in accordance with the plan details and the "AWS Structural Welding Code - Reinforcing Steel" required by the Special Provision on welding.

502.04 Method of Measurement.

(a) LUMP SUM UNIT MEASUREMENT.

The steel reinforcement required for a bridge superstructure will be measured for payment as a lump sum unit.

(b) THEORETICAL UNIT WEIGHT {MASS} MEASUREMENT.

The theoretical unit weight {mass} in pounds {kilograms} shall be used as the method of measurement for steel reinforcement where no other method of measurement is given for payment purposes. The weight {mass} of steel paid for shall be the number of pounds {kilograms} of steel, acceptably placed as shown to be required on the plans or as directed by the Engineer. The unit weight {mass} used for deformed bars shall be the weight {mass} of plain, square, or round bars, as the case may be, of equal nominal size. If steel mesh or expanded metal is required, the weight per square foot {mass per square meter} will be shown on the plans.

The actual quantity measured for payment will be that shown on the itemized list specified in Subarticle 502.02(a) with deductions made for:

- errors in number, size, or length of bars shipped;
- steel reinforcement used in a structure where the cost of the steel is included in the cost of the structure;
- steel reinforcement in bridge concrete superstructure units;
- discrepancies or errors in the list itself.

(c) AREAS, DIMENSIONS, AND WEIGHTS {MASSES}.

Area dimensions and weights {masses} to be used in calculations for the various size bars shall be as follows:

Bar Designation Number	Weight {Mass} Pounds per foot {kg / m}	Diameter inches {mm}	Cross-Sectional Area square inches {mm^2}
2	0.167	0.250	0.05
3 {10}	0.376 {0.560}	0.375 {9.5}	0.11 {71}
4 {13}	0.668 {0.994}	0.500 {12.7}	0.20 {129}
5 {16}	1.043 {1.552}	0.625 {15.9}	0.31 {199}
6 {19}	1.502 {2.235}	0.750 {19.1}	0.44 {284}
7 {22}	2.044 {3.042}	0.875 {22.2}	0.60 {387}
8 {25}	2.670 {3.973}	1.000 {25.4}	0.79 {510}
9 {29}	3.400 {5.060}	1.128 {28.7}	1.00 {645}
10 {32}	4.303 {6.404}	1.270 {32.3}	1.27 {819}
11 {36}	5.313 {7.907}	1.410 {35.8}	1.56 {1006}

(d) SPLICING.

Weight {mass} allowance will be made for only those splices shown on the plans. No weight {mass} allowance will be made for splices for the Contractor's convenience.

(e) MISCELLANEOUS METAL PARTS.

1. No allowance will be made for any device, material, or method which may be used for splicing, clamping, tying, butt welding, and keeping reinforcement in proper position.

2. When the proposal form omits pay items for other metal parts indicated and required in connection with the construction of concrete structures, and compensation for such parts is not elsewhere provided in these specifications or on the plans, the weight {mass} of such other metal parts will be included in the weight {mass} computed for steel reinforcement.

502.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Where the unit of measurement for steel reinforcement is pounds {kilograms}, the weight {mass} of steel reinforcement determined as provided above shall be paid for at the contract unit price per pound {kilogram}, which price and payment shall be full compensation for fabricating, furnishing,

placing, and butt welding all materials, and for all labor, equipment, tools, and incidentals necessary to complete the Item in accordance with plan details.

The reinforcement required for a bridge superstructure shall be paid for at the contract unit price bid per lump sum for steel reinforcement for bridge superstructure which shall be full compensation for fabricating, furnishing, and placing all materials in accordance with plan details. The contract unit bid price shall also be full compensation for all labor, equipment, tools, and incidentals necessary to complete this item of work. An increase, or decrease, in the quantity of steel reinforcement for a bridge superstructure from that shown on the plans, which is caused by a change in the plans after the contract has been let, will result in an increase, or decrease, in the compensation due the Contractor. Changes to the compensation for the superstructure reinforcing steel will be made by applying the percentage of the increase or decrease to the contract lump sum price for Pay Item 502-B, Steel Reinforcement For Bridge Superstructure.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

502-A Steel Reinforcement - per pound {kilogram}

502-B Steel Reinforcement For Bridge Superstructure, __*, __**, ___*** - per lump sum

* Station Number, Bridge Number, Ramp Number, etc.

** Lane, if applicable

*** Approximate quantity of reinforcing steel in pounds {kilograms}

SECTION 503
STRUCTURE FOUNDATIONS

503.01 Description.

The work under this Section shall cover preparing foundations for bridges, box culverts and other miscellaneous structures.

These foundations shall be built in accordance with the details shown on the plans and the provisions provided in this Section.

503.02 Materials.

Materials used in the work required under this Section shall conform to the applicable requirements provided elsewhere in these Specifications.

503.03 Construction Requirements.

(a) GENERAL.

In the construction of foundations, it is the intent that the foundations be constructed in the dry insofar as practical. Excavation shall be in accordance with Section 214 or 215, whichever is applicable.

Where excavation is near a railroad track, the Contractor shall install such shoring and sheeting as deemed necessary by the Engineer and the Chief Engineer of the railroad company involved. Provisions of Article 107.08 shall govern.

Where the excavation is near a building, utility or other property, the Contractor shall install shoring and sheeting and perform such other work as shown on the plans for proper protection of the property, and, in addition, shall comply fully with the requirements of Article 107.12 regarding protection of property.

(b) DEPTH AND SIZE OF FOOTINGS.

The elevation of the bottoms of footings, as shown on the plans, shall be considered as approximate only and the Engineer may order, in writing, such changes in dimensions or elevations of footings as may be necessary to secure a satisfactory foundation.

(c) PREPARATION OF FOUNDATIONS FOR FOOTINGS.

1. GENERAL.

All rock or other hard foundation material shall be freed from all loose material, cleaned and cut to a firm surface, either level, stepped, or roughened, as may be directed by the Engineer.

Where seams, voids, cracks, or crevices exist, they shall be cleaned out and filled as directed by the Engineer. In rock, the openings shall be filled with subfooting concrete (Class A, Type 1a) if the concrete can be placed in the dry. (Refer to Articles 503.04 and 503.05 concerning

measurement and payment.) If the concrete cannot be placed in the dry, the Contractor shall propose a method for filling the openings for review and approval by the Engineer. In hard, dry material other than rock, the Engineer may allow the use of Item 214-B, Foundation Backfill, or direct the use of subfooting concrete.

When the footing is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final removal of the foundation material to grade shall not be made until just before the footing is to be placed.

2. STABLE MATERIAL.

Where rock or hard foundation material is available, excavation for the footing shall be to neat lines and the concrete poured against the excavated walls without forms, unless otherwise approved by the Engineer. Concrete used to replace rock or hard foundation material excavated outside of the neat lines will not be measured for payment.

3. UNSTABLE MATERIAL.

If the material encountered at the elevation shown on the plans for the bottom of footing is of a soft and unstable nature lacking in the required bearing value, and tests show the existence of satisfactory material of sufficient thickness and bearing value at a depth of less than 10 feet {3 m} below the elevation shown on the plans for such footing, the Engineer may order that the footing be lowered into the satisfactory material and/or that the dimensions of the footing be increased.

4. PILE FOOTING.

If, in the opinion of the Engineer, footings cannot be founded at a reasonable depth on rock or other satisfactory foundation material, piling shall be driven. If satisfactory foundation is more than 10 feet {3 m} below the bottom of the footing shown, pile footings shall be used unless otherwise directed. In streams where excessive erosion is probable, piling may be ordered as protection against scour even though the soil in its natural state has adequate bearing value. Where foundation piles are used, the excavation of each pit shall be completed before the piles are driven. After driving is completed, all loose and displaced material shall be so removed as to leave a smooth solid bed to receive the footing.

5. FOUNDATION BACKFILL.

Foundation backfill shall be used as directed by the Engineer. Attention is directed to Section 214 or 215, whichever is applicable.

6. ADJUSTMENT IN FOOTINGS.

The construction adjustments permitted above shall not be considered as materially altering the original plans and shall not be a waiver of any condition of the contract nor invalidate any of the provisions thereof.

(d) COFFERDAM AND PUMPING.

1. GENERAL.

In the construction of footings and substructures, the item of Cofferdam and Pumping shall be used on all piers or bents where so designated on the plans. Working drawings and computations shall be submitted in accordance with Article 105.02. Attention is directed to Section 215 for piers and bents not designated to receive the item of Cofferdam and Pumping.

2. DETAILS.

Interlocking, steel sheet piling of 3/8 inch {9.5 mm} minimum web thickness shall be used in all cofferdam work. The tops of the cofferdams shall be well above the normal water stages and their bottoms shall be carried to a depth that will prevent flow of materials into the excavation. They shall be constructed in a substantial manner, capable of resisting earth, water or concrete without appreciable displacement, distortion or leakage. Interior clear dimensions of cofferdams shall be such as will provide sufficient clearance for construction and removal of forms and for a sump outside the footing where footings are to be poured in the dry. No excess excavation and seal concrete will be paid for where the Contractor elects to use an oversized cofferdam for his convenience.

(e) REMOVAL OF COFFERDAMS.

Cofferdams shall not be removed until after the substructure has been constructed above normal water elevation or above the ground lines, whichever is applicable, and after the Engineer has inspected the work. Care shall be taken in removing the temporary construction so as not to damage the footings and columns. Any damage as a result of the cofferdam removal shall be replaced or

repaired without additional compensation from the Department. Cofferdam sheet piling shall remain permanently in-place and undisturbed if this is shown to be required on the plans.

(f) PUMPING.

All substructure concrete shall be placed in the dry unless otherwise provided on the plans. Pumping during the placing of foundation concrete shall be done from a suitable sump separated from the concrete work and shall be so conducted that there will be no water currents inside the forms or inside the excavation if no forms are required. Pumping equipment shall in all cases be of ample capacity to keep the excavation practically free of water until all the concrete is in place. Water that originates in the footing area or that is necessary to come through or across the footing area shall be handled in approved pipes or conduits to the pump sump. Cofferdams shall be dewatered for inspection purposes without additional compensation when requested.

(g) SEAL CONCRETE.

1. GENERAL.

Seal concrete shall be used by the Contractor only when required by plan details as a structural footing or when directed by the Engineer in accordance with the following conditions. If the material encountered at the designed elevation of the bottom of the footing is so porous that water enters at such a rate that it is impractical to lower water level to this elevation by pumping, or if the material is so plastic that it cannot be prevented from flowing into the excavation by driving sheeting to reasonable depths, the Engineer may require the Contractor to seal the cofferdam with concrete. The seal concrete shall be placed in the manner prescribed in Item 501.03(f). After placement of seal concrete, the cofferdam shall not be dewatered for seven days or until concrete has, by test, indicated a compression strength of 2000 psi {14 MPa}. Immediately prior to placing seal concrete on rock footings, the footing floor shall be cleaned by airlift or other acceptable methods. After cleaning, any mud, silt, etc., which is impossible to remove shall be agitated by means of compressed air jet so that this material will be suspended in the water during the placing of seal concrete.

All footings which are to receive seal concrete, except pile footings, will require an underwater inspection by the Department prior to placing the seal unless approved otherwise by the Engineer. The Contractor shall give at least a 48 hour notice prior to the need for an underwater inspection. The Contractor shall provide transportation to the cofferdam cell and a work station for the diver and his equipment. If the footing floor is found to be unacceptable another underwater inspection will be required after corrections are made.

2. CROSSHOLE SONIC LOGGING OF REINFORCED SEAL CONCRETE FOOTINGS.

a. General Requirements.

Crosshole Sonic Logging (CSL) shall be used where shown to be required on the plans to determine the quality of reinforced seal concrete footings. This testing and evaluation shall not be conducted until 20 hours after the placement of all the seal concrete and must be completed within 45 calendar days after placement.

The CSL tests shall be conducted by an experienced independent testing consultant approved by the Engineer prior to testing.

The CSL tests measure the time it takes for an ultrasonic pulse to travel from a signal source in one access tube to a receiver in another access tube. In uniform, good quality concrete, the travel time between equidistant tubes will be relatively constant and correspond to a reasonable concrete pulse velocity from the bottom to the top of the foundation. In uniform, good quality concrete, the CSL test will produce records with good signal amplitude and energy. Longer travel times and lower amplitude/energy signals indicate the presence of irregularities such as poor quality concrete, voids, honeycombs and soil intrusions. The signal may be completely lost by the receiver and CSL recording system for the more severe defects such as voids and soil intrusions.

b. Preparation for Testing.

Tubes shall be installed in each footing to permit access for the CSL probes. The tubes shall be 1.5 inch to 2.0 inch {37 mm to 50 mm} inside diameter schedule 40 steel pipe. The tubes shall have a round, regular, internal diameter free of defects or obstructions, including any at pipe joints, in order to permit the free, unobstructed passage of a 1.3 inch {32 mm} diameter source and receiver probes. The tubes shall be watertight and free from corrosion with clean internal and external faces to ensure passage of the probes and a good bond between the concrete and the tubes. The tubes shall each be fitted with a watertight shoe on the bottom and a removable cap on top.

The number of tubes installed will depend on the size of the footing. The number of tubes and tube placement may be shown on the plans. If not shown on the plans, the tubes shall be

installed in each footing in a regular, symmetric grid pattern such that each tube is equally spaced from the others. The spacing shall be as directed by the Engineer and shall not exceed 7 linear feet {2.1 m} for any pair of tubes to be crosshole sonic logged. The tubes shall be securely attached to the interior of the cage with a minimum of 4 inches {100 mm} cover. The tubes at the perimeter of a footing may be installed on the outside face of a cage as long as adequate cover and clearance are available. The tubes shall be vertical and as near to parallel as possible. The tubes shall extend for 6 inches {150 mm} above the footing bottoms to at least 3 feet {1 m} above the top of the footing.

In the event that the reinforced seal footing does not seal off the water in the cofferdam, the tubes shall be extended to 3 feet {1 m} above the water surface for further CSL testing at no additional payment. Any joints required to achieve full length pipes shall be made watertight.

Care shall be taken during reinforcement installation operations so as not to damage the tubes. When the cage has been lowered into the cofferdam so that all of the tubes are 75% under water, then the tubes shall be checked to assure that they are vertical and parallel and that all connections are watertight. Before submersing the reinforcement cage, the tubes shall be filled with clean water and capped.

Before the placement of concrete, a minimum of one tube per footing shall be measured and the tube length recorded, including a notation on the stickup of the tubes above the top of the footing. Information on the tube bottom and top elevations and/or length, along with construction dates, shall be provided to the Engineer.

After the concrete in the reinforced seal footing has set and been dewatered, the CSL tube caps shall be removed in preparation for CSL testing. Care shall be exercised in the removal of caps from the tubes so as not to apply excess torque, hammering, or other stresses which could break the bond between the tubes and the concrete.

c. CSL Logging Procedures.

Information on the footing bottom and top elevations and/or depth, along with construction dates, shall be provided to the Engineer and the approved testing organization before the CSL tests are performed. The approved testing organization shall conduct the CSL tests between all pairs of adjacent tubes. Additional logs shall be conducted at no additional cost in the event anomalies are detected.

The CSL tests shall be carried out with the source and receiver probes in the same horizontal plane, unless test results indicate potential defects, in which case the questionable zone may be further evaluated with angled tests (source and receiver vertically offset in the tubes). CSL measurements shall be made at depth intervals of 0.2 feet {60 mm} or less, and shall be done from the bottom of the tubes to the top of the footing. The probes shall be pulled simultaneously, starting from the bottoms of the tubes, over a depth measuring device. Any slack shall be removed from the cables prior to pulling to provide for accurate depth measurements of the CSL records. Any defects indicated by longer pulse arrival times and significantly lower amplitude/energy signals shall be reported to the Engineer and further tests shall be conducted as required to evaluate the extent of such defects. Additional NDT methods which may be used to evaluate possible defects include Singlehole Sonic Logging, Gamma-Gamma Nuclear Density Logging, and/or Surface Sonic Echo and Impulse Response tests.

d. CSL Testing Results.

The CSL results shall be presented to the Engineer in a report. This report shall include recommendations as to the acceptability, unacceptability, soundness, etc., of the seal footing. The report shall be checked, stamped approved, and signed by a Professional Engineer licensed by the Alabama Board of Licensure for Professional Engineers. This Professional Engineer shall not be an employee of the ALDOT. The report shall be submitted directly to the Materials and Tests Engineer with a copy to the Project Engineer. The test results shall include CSL logs with analyses of:

- Initial pulse arrival time versus depth
- Pulse energy/amplitude versus depth

A CSL log shall be presented for each tube pair tested with any defect zones indicated on the logs and discussed in the test report as appropriate.

e. Evaluation of CSL Test Results.

The Engineer will evaluate the CSL test results and determine whether or not the footing construction is acceptable. This evaluation will be completed within 14 calendar days of the date of receipt of the report by the Materials & Tests Engineer.

If the Engineer determines that the footing is acceptable, the CSL tubes shall be dewatered and grouted. The grout shall be of the same strength or higher than the strength of the

concrete used in the original footing. The contractor may use any of the grout mixes listed in Table 1 of Item 453.03(b)2. with the exception that calcium chloride will not be allowed. The contractor may submit another design mix for approval.

If the Engineer determines that the footing is unacceptable, the footing shall be cored in accordance with the requirements given in Subarticle 506.10(b) to allow further evaluation of the shaft. Cores shall be taken without additional compensation unless the testing of the cores indicates that the concrete in the footing meets all specification requirements. If the testing of the cores indicates that the concrete meets specification requirements, the cost of the coring will be paid for as Extra Work.

3. CORE DRILLING OF SEAL CONCRETE FOOTINGS.

Pile footings and footings that are tested by crosshole sonic logging will not be required to be cored unless noted otherwise on the plans or ordered by the Engineer. All other seal concrete footings shall be cored in accordance with the following procedure.

After dewatering the cofferdam, the Engineer will specify the amount and location of holes to be cored in the seal concrete in each footing to determine its quality. An accurate log of cores shall be kept and the cores shall be placed in a crate and properly marked showing the footing depth and elevation at each interval of core recovery. The cores, along with three copies of the coring logs, shall be transported undisturbed to the Materials & Tests Bureau, Montgomery, Alabama, for inspection. No further concrete shall be poured inside the cofferdam until approval is received from the Construction Bureau.

Because it is necessary to obtain a high percentage of core recovery for visual inspection and compressive strength testing, the core bit used for core drilling shall be warranted by the manufacturer to be capable of coring the strength of concrete in the seal footing. The Engineer may require a new bit or replacement of the core barrel at any time inspection indicates that the equipment is incapable of coring as required. The minimum core diameter shall be 3.0 inches {76 mm}.

If the quality of the seal concrete footing is determined to be unacceptable, the Contractor shall construct another foundation or perform corrective work as required by the Department. This foundation or the corrective work shall be constructed without compensation from the Department. The details of the replacement foundation shall be submitted in accordance with the requirements given in Article 105.02 for Working Drawings.

Unless otherwise directed by the Engineer, all footings shall be cored to a point 6 inches {150 mm} above the bottom of the seal concrete footing.

(h) CLASS OF CONCRETE.

The class of concrete required for the specific type of work involved shall be in accordance with the provisions of Section 501.

(i) CONSTRUCTION JOINTS.

In general, each footing shall be constructed as a monolith. If construction joints are required, they shall be constructed as provided in Subarticle 501.03(f).

(j) FINISH.

Concrete surfaces shall be finished in accordance with the provisions of Subarticle 501.03(l) for Class 1 with exposed surfaces receiving a Class 2 finish unless otherwise specified by the proposal or by plan requirements.

503.04 Method of Measurement.

(a) SEAL CONCRETE.

The measurement of the volume of seal concrete in a footing shall be calculated from the following:

L = Length of footing shown on contract plans (feet {meters});
W = Width of footing shown on contract plans (feet {meters});
T = Final approved elevation of the top of the seal footing (feet {meters});
D = Final approved elevation of the bottom of the seal footing (feet {meters});
Vs = Volume of seal concrete for which payment will be made (cubic yards {cubic meters}).

$Vs = L \times W \times (T - D) / 27$ {$Vs = L \times W \times (T - D)$}

Seal concrete outside of these limits of measurement may be required for the construction of a seal concrete footing, depending on the details of construction selected by the contractor. No direct

payment will be made for any seal concrete outside of the footing plan dimensions shown on the contract plans.

(b) COFFERDAM AND PUMPING.

When items for cofferdam and pumping for individual piers or bents are provided by the plans and/or proposal, such will be measured in individual lump sum items for the pier or bent designated.

(c) EXCAVATION AND BACKFILL.

Excavation and backfill when provided by the plans, proposal, or directed will be measured and paid for under the applicable provisions of Sections 214 and 215.

(d) CORE DRILLING.

The actual depth of each core hole drilled at the location directed will be measured in feet {meters} to the nearest 0.1 of a foot {meter}.

(e) SUBFOOTING CONCRETE.

Concrete ordered and accepted for filling voids, cracks, and crevices, as required in Item 503.03(c)1, will be measured by the cubic yard {cubic meter} delivered to the work site and acceptably placed, minus any concrete wasted.

(f) CROSSHOLE SONIC LOGGING OF SEAL CONCRETE FOOTINGS.

Testing by the CSL method will be measured by the linear foot {meter} of tube installed in the seal concrete in which the testing is required to be conducted. Portions of tubes that extend more than 3 feet {1 m} above the top of the seal will not be measured for payment. Tubes that are blocked or tubes at which access is not available for CSL testing will not be measured for payment.

503.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. SEAL CONCRETE.

Accepted seal concrete, used as directed and measured as noted above, will be paid at the contract price, which shall be full compensation for the concrete complete in place exclusive of reinforcing steel.

2. COFFERDAM AND PUMPING.

When Cofferdam and Pumping has been provided for a designated pier or bent, the lump sum item shall be full compensation for the furnishing and installation of all material, dewatering, maintenance, removal, satisfactory clean up of the area, and for all tools, equipment, labor and incidentals necessary to complete the work.

Partial payment after installation of cofferdam will be made based on the following:

Cofferdam complete in place	80%
Excavation performed and columns poured to elevation above normal water elevation	90%
Cofferdam work complete and sheet piling removed	100%

3. CORE DRILLING.

Payment for the length of core drilling shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to complete the work.

Should the quality of the concrete be questionable based on the first cores taken from the footing, the Engineer may order additional cores to be taken from the footing. All additional coring shall be at the Contractor's expense if the footing is determined to be unsatisfactory. If the footing is determined to be satisfactory, the cost of the additional coring will be paid for at the contract unit price bid per linear foot.

When the cores are required due to questionable CSL results, payment for the cores will only be made in accordance with the requirements given in Subitem 503.03(g)2.d.

4. CONCRETE FOR ROCK SUBFOOTINGS.

The Contractor will be paid the delivered invoice cost, minus waste and including any applicable sales taxes, to the project plus 15 percent. This price includes the concrete, gross receipt tax, labor, materials, incidentals, and the placing of the concrete in the designated locations.

5. CROSSHOLE SONIC LOGGING OF SEAL CONCRETE FOOTINGS.

The price bid for the linear feet {meters} of crosshole sonic logging required in seal concrete bridge footings shall be full compensation for all labor, materials, equipment and incidentals

necessary to perform the required tests and furnish the Engineer with the test results and analysis of the test results. The bid price shall also include dewatering the tubes and filling the tubes with grout.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

503-A Seal Concrete - per cubic yard {cubic meter}
503-B Cofferdam and Pumping, Pier No. ____ or Bent No. ____ - per lump sum
503-C Core Drilling Seal Concrete Footings - per linear foot {meter}
503-D Sonic Logging Of Seal Concrete Footings- per linear foot {meter}

SECTION 505
PILING

505.01 Description.

This Section shall cover the work of furnishing and driving foundation piles of the type and dimensions designated including cutting off or building up foundation piles, when required. Piling shall be furnished and installed in accordance with the requirements given in these specifications at the location, tip elevation, penetration and/or bearing shown on the plans or as directed by the Engineer.

505.02 Materials.

All materials shall meet the requirements specified in applicable portions of Section 834, Piling.

505.03 Construction Requirements.

(a) HAMMERS FOR DRIVING PILES.

1. GENERAL.

Piles shall be driven with air, steam, diesel and hydraulic hammers with the exception that prestressed concrete piles 20 inches {510 mm} and larger shall not be driven with diesel hammers unless approved by the Engineer.

Gravity hammers will be allowed if approved in writing by the Engineer.

2. GRAVITY HAMMERS.

When gravity hammers are permitted, the ram shall weigh between 3000 and 4000 pounds {have a mass between 1360 kg and 1815 kg} and the height of drop shall not exceed 10 feet {3 m}. In no case shall the weight {mass} of gravity hammers be less than the combined weight {mass} of drive head and pile. All gravity hammers shall be equipped with hammer guides to insure concentric impact on the drive head.

3. STEAM AND AIR HAMMERS.

The plant and equipment furnished for steam and air hammers shall have sufficient capacity to maintain, under working conditions, the volume and pressure specified by the manufacturer of the hammer. The plant and equipment shall be equipped with accurate pressure gages which are easily accessible to the Engineer. The weight {mass} of the striking parts of air and steam hammers shall not be less than 1/3 the weight {mass} of the drive head and pile being driven, and in no case shall the striking parts weigh {have a mass} less than 2750 pounds {1250 kg}.

4. DIESEL HAMMERS.

Open-end (single acting) diesel hammers shall be equipped with a device such as rings on the ram or a scale (jump stick) extending above the ram cylinder to permit the Engineer to visually determine hammer stroke at all times during pile driving operations. Closed-end (double acting) diesel hammers shall be equipped with a bounce chamber pressure gauge in proper working order, mounted near ground level so as to be easily read by the Engineer.

5. HYDRAULIC HAMMERS.

Hydraulic hammers shall have a built-in monitoring system which determines the ram velocity just before impact. The contractor shall verify that the correct ram weight is entered in the monitoring system.

(b) DRIVING APPURTENANCIES.

1. BLOW COUNT MONITORING EQUIPMENT.

Equipment shall be furnished by the Contractor for displaying the blow count rate and stroke height during driving. This equipment shall be operated at ground level to allow the Engineer to monitor the blow count rate.

2. HAMMER CUSHION.

Where required by the hammer manufacturer, impact pile driving equipment, except gravity hammers, shall be equipped with a suitable thickness of hammer cushion material to prevent damage to the hammer or pile and to insure uniform driving behavior. Hammer cushions shall be made of durable, manufactured materials, provided in accordance with the hammer manufacturer's guidelines except that all wood, wire rope, and asbestos hammer cushions are specifically disallowed and shall not be used. A striker plate, as recommended by the hammer manufacturer, shall be placed on the hammer cushion to insure uniform compression of the cushion material. The hammer cushion shall be inspected in the presence of the Engineer when beginning pile driving at each structure and after each 100 hours of pile driving. A hammer cushion whose thickness has been reduced to less than 75 percent of the original thickness shall be replaced by the Contractor before driving is permitted to continue.

3. PILE DRIVE HEAD.

Piles driven with impact hammers require an adequate drivehead to distribute the hammer blow to the pile head. The drive head shall be axially aligned with the hammer and the pile. The drive head shall be guided by the leads and not be free-swinging. The drive head shall fit around the pile head in such a manner as to prevent transfer of torsional forces during driving while maintaining proper alignment of hammer and pile.

For steel piling, the pile heads shall be cut squarely and a drive head, as recommended by the hammer manufacturer, shall be provided to hold the axis of the pile in line with the axis of the hammer.

For prestressed concrete piles, the pile head shall be plane and perpendicular to the longitudinal axis of the pile to prevent eccentric impacts from the drive head.

For special types of piles, appropriate driving heads, mandrels or other devices shall be provided in accordance with the manufacturer's recommendations so that the piles may be driven without damage.

4. PILE CUSHION.

A concrete pile's head shall be protected by a wooden pile cushion. The minimum thickness placed on the pile head prior to driving shall not be less than 4 inches {100 mm}. A new pile cushion shall be provided for each pile. In addition the pile cushion shall be replaced if during the driving of any pile, the cushion is either compressed more than one-half the original thickness or begins to burn to the extent that flame is visible. The pile cushion dimensions shall equal or exceed the cross sectional area of the pile top, and shall be appropriately sized to fit the dimensions of the pile cap.

5. LEADS.

Piles shall be supported in line and position with leads while being driven. Pile driver leads shall be constructed in a manner that affords freedom of movement of the hammer while maintaining alignment of the hammer and the pile to insure concentric impact for each blow. Leads may be either fixed or swinging type. Swinging leads, when used, shall be fitted with a pile gate at the bottom of the leads. The pile section being driven shall not extend above the leads. The leads shall be adequately embedded in the ground or the pile constrained in a structural frame such as a template to maintain alignment. The leads shall be of sufficient length to make the use of a follower unnecessary and shall be so designed as to permit proper alignment of batter piles.

(c) DRIVING AIDS.

1. GENERAL.

Driving aids such as jets, pilot holes and followers shall not be used unless either specifically permitted in writing by the Engineer or stated in the contract documents. When permitted, driving aids shall be used for installing production piles only after the pile tip elevation for safe support of the pile load is established by load testing and/or test piles driven with the same aids and methods. The Contractor shall perform, at his cost, any extra load tests and/or extra work required to drive test piles as determined by the Engineer as a condition of approval of the driving aids.

2. JETTING.

Jetting shall only be permitted if approved in writing by the Engineer or when specifically stated in the contract documents. The Contractor shall determine the number of jets and the volume and pressure of water at the jet nozzles necessary to freely erode the material adjacent to the pile without affecting the lateral stability of the final in-place pile. The jetting plant shall have sufficient capacity to permit installation to the required elevation, location, and alignment within

specification tolerances. The Contractor shall decide when the jet pipes will be removed above the prescribed tip elevation so that the pile will attain the required capacity at the required tip elevation established in the plans when driven with the approved hammer.

The Contractor shall control, treat if necessary, and dispose of all jet water in a manner satisfactory to the Engineer and in compliance with all regulatory guidelines.

Upon completion of jetting a pile, any voids around the pile shall be filled with clean sand and saturated with water (unless driven under water). The Contractor shall be responsible for all damage to the site caused by unapproved or improper jetting operations.

When driving concrete piles, if 240 blows per foot {300 mm} (20 blows per inch {25 mm}) is reached before the concrete pile reaches the required minimum tip elevation, then jetting may be used, when approved in writing by the Engineer, to facilitate the advancement of the concrete pile. Jetting shall be performed in a manner that allows the pile to continue on the previously established linear path of advancement by eroding the material adjacent to the concrete pile. This may require jetting through a steel pipe previously cast inside the concrete pile presently being driven, using a collar jet or jetting symmetrically with multiple jets.

Once driving of the concrete pile resumes, the lowest stroke of the hammer shall be used until the Contractor and Engineer are satisfied that the original driving resistance has resumed. Under no circumstances shall driving and jetting concrete piling be allowed simultaneously.

3. PILOT HOLES.

Augering, wet-rotary drilling or other methods of boring pilot holes shall be used only when approved by the Engineer or shown on the plans. When permitted, such procedures shall be carried out in a manner which will not impair the load bearing capacity of the piles already in place or the safety of existing adjacent structures. Pilot holes shall be of a size smaller than the diameter or diagonal of the pile cross section that is sufficient to allow penetration of the pile to the specified depth. If subsurface obstructions, such as boulders or rock layers are encountered, the hole diameter may be increased to the least dimension which is adequate for pile installation. The use of spuds, a short strong driven member which is removed to make a hole for inserting a pile, shall not be permitted in lieu of pilot holes.

After a pile is placed in a pilot hole the voids around the pile shall be filled with clean sand before the pile is driven. After driving, additional sand shall be added to the hole to fill the voids left by the settlement of the sand during driving. Water shall then be added to the hole to saturate the final placement of sand. Pilot holes that terminate in rock shall be backfilled to the top of the rock with substructure concrete after seating the pile. The remainder of the hole may be filled with either sand or concrete.

The Contractor shall decide when the pilot hole will be terminated above the prescribed tip elevation so that the pile will attain the required bearing capacity at the required tip elevation established in the plans when driven with the approved hammer. Where piles are to be end-bearing on rock or hardpan, pilot holes may be carried to the surface of the rock or hardpan unless otherwise noted on the plans. The piles shall then be driven with an impact hammer to insure proper seating.

If the Engineer determines that pre-excavation has disturbed the load bearing capacities of previously installed piles, those piles that have been disturbed shall be restored to conditions meeting the requirements of this specification by redriving or by other methods acceptable to the Engineer. Redriving or other remedial measures shall be instituted after pilot hole excavation operations in the area have been completed. The Contractor shall be responsible for the costs of any necessary remedial measures unless the pilot hole excavation method was specifically included in the contract documents and properly executed by the Contractor.

4. FOLLOWERS.

Followers shall only be used when approved in writing by the Engineer or when specifically stated in the contract documents. In cases where a follower is permitted, the first pile in each bent and every tenth pile driven thereafter shall be driven full length, without a follower, to verify that adequate pile length is being attained to develop the desired pile capacity. The follower and pile shall be held and maintained in equal and proper alignment during driving. The follower shall be of such material and dimensions to permit the piles to be driven to the length determined necessary from the driving of the full-length piles. The final position and alignment of the first two piles installed with followers in each substructure unit shall be verified to be in accordance with the location tolerances given in this Section before additional piles are installed.

(d) APPROVAL OF PILE DRIVING HAMMER.

1. GENERAL.

All pile driving equipment furnished by the Contractor shall be in proper working condition and subject to the approval of the Engineer. It is the intent of this specification that all pile driving equipment be sized such that the project piles can be driven with reasonable effort to the ordered lengths without damage. Tentative approval of pile driving equipment by the Materials & Tests Engineer will be based on wave equation analysis and/or other judgements. Final approval is decided based on the satisfactory performance and installation of representative test piles. In no case shall the driving equipment be used on the project until approval of the Engineer is received in writing.

The Contractor shall submit the following no less than 30 calendar days prior to driving piling to allow the Materials & Tests Engineer to evaluate the Contractor's proposed driving equipment.

- Pile hammer operator's manuals from the hammer manufacturers.
- Completed Pile and Driving Equipment Data Form (Form C-14) for each proposed hammer.
- Charts from the hammer manufacturers shall be submitted with the data form for diesel hammers.

For single acting diesel hammers, data equating stroke, blows per minute, and potential energy shall be shown on the charts.

For double acting diesel hammers, data equating bounce chamber pressure to either equivalent energy or stroke of the hammer shall be shown on the charts. The measurements required for the calibration data shown on the charts for double acting diesel hammers shall have been made no more than 90 calendar days prior to the beginning of the driving of the piles.

If more than one hammer is submitted to drive the same size piling, the hammers shall be prioritized in the order of probable use.

Any change in the driving system will only be considered after the Contractor has submitted a revised Pile and Equipment Data Form for a revised wave equation analysis. The Engineer will notify the Contractor of the acceptance or rejection of the revised driving system within 7 calendar days of receipt of a revised Pile and Driving Equipment Data Form. The time required for submission, review, and approval of a revised driving system shall not constitute the basis for a contract time extension to the Contractor.

2. WAVE EQUATION ANALYSIS PROGRAM (WEAP).

The Department, or the Consultant Engineer provided by the Department, will perform all WEAP analyses for each pile driving hammer that the contractor may propose to use. The Department will use the information provided by the Contractor on the Pile and Driving Equipment Data Form to run a wave equation analysis. A Pile and Driving Equipment Data Form will be included in the contract documents or supplied by the Engineer.

The hammer shall be capable of driving the pile to the required tip elevation with a blowcount of less than 240 BPF {blows per 300 mm}. The tensile and compressive driving stresses shall be less than the following maximum values:

Pile Type	Maximum Allowable Compressive Stress	Maximum Allowable Tensile Stress
Steel	0.90 Fy	0.90 Fy
Prestressed Concrete	0.85 f'c – (effective prestress).	(3 times the square root of f'c) + effective prestress

The effective prestress may be obtained from the approved shop drawings.

If the hammer is approved, a blow count/bearing capacity graph with an acceptance criteria will be provided. The blowcount and hammer stroke required to achieve the required minimum bearing capacity (equal to twice the design load) will be given with the blow count/bearing capacity graph.

During pile driving operations, the Contractor shall use the system submitted and reviewed by the Department. The submitted hammer must successfully install test piles. If the hammer does not successfully install the representative piles, the Engineer will require the Contractor to repair that hammer or submit another pile driving hammer with the analyses as outlined above. No variations in the driving system will be permitted without notifying the Engineer in writing, with the exception of increasing the pile cushion thickness and reducing the energy delivered to the pile to control driving stresses. Any changes in the driving system will only be considered after the Contractor has submitted a revised Pile and Driving Equipment Data Form. If changes are made to the driving system, the

Contractor shall perform a load test at no additional cost to the Department unless this requirement is waived by the Materials & Tests Engineer.

In such cases where a WEAP analysis can not be performed, a dynamic load test will be required to verify that the pile driving hammer is capable of successfully installing a representative test or production pile to the required depth without damage.

(e) PILE DRIVING PREPARATION

1. LOCATION AND ALIGNMENT TOLERANCE.

Piles shall be driven as nearly as possible in the exact position designated; however, a maximum deviation of 1.5 inches {40 mm} from exact position will be permissible in pile trestle bents and pile abutments, and a maximum deviation of 3 inches {75 mm} from exact position will be allowed for a foundation pile in footings of piers or abutments. Care shall be taken during driving to prevent and correct any tendency of concrete or steel piles to twist or rotate. Footings and encasements shall be formed around the piles to give at least the minimum concrete cover shown on the plans. Piles that are to be swaybraced shall be aligned as necessary so that swaybracing can be properly welded to the piles. After all piling in a bent are aligned within the specified tolerances, the bent cap shall be placed on the piles in exact position.

If the location and/or alignment tolerances specified in the preceding paragraph are exceeded, the extent of overloading shall be investigated and if, in the judgement of the Engineer, corrective measures are necessary, suitable measures shall be designed and constructed by the Contractor. The design shall be checked, stamped approved, and signed by a Professional Engineer licensed by the Alabama Board of Licensure for Professional Engineers. This Professional Engineer shall not be an employee of the ALDOT. The Contractor shall bear all costs, including delays, associated with the corrective action. Proposed corrective measures must be approved by the Bridge Engineer prior to performance.

2. INSTALLATION SEQUENCE.

The order of placing individual piles in pile groups shall be starting from the center of the group and proceeding outwards in both directions, unless an alternate installation sequence is approved by the Engineer. If starting the installation from the center and proceeding outwards cannot be done because of battered piles, the Contractor shall submit a proposed sequence of installation to the Engineer for approval.

3. INSPECTION.

The Project Engineer shall be given 24 hour notice before the driving of any test pile or production pile. No pile shall be driven except in the presence of a Department Inspector. An accurate driving record will be kept by the Engineer on Form C-16. Each production pile driving record will be kept by the Engineer and entered into the Engineer's daily log book. The Test Pile Driving Record Form C-15 will be completed by the Engineer each time a test pile is driven. This form includes the number of hammer blows per foot {300 mm} for the entire driven length, the driven length, cutoff elevation, penetration in ground, driving problems, significant time delays, whether or not the test pile was dynamically monitored and any other pertinent information obtained by the Engineer. If a redrive is necessary, the Engineer will record the number of hammer blows per inch {25 mm} of pile movement.

(f) PILE DRIVING.

1. GENERAL.

The Contractor shall be responsible for driving piles with the approved equipment and in accordance with the procedures approved by the Engineer.

2. TEST AND PRODUCTION PILES.

A representative test pile shall be driven in the designated location and loaded to verify the minimum bearing capacity. The minimum bearing capacity shall be verified by static testing methods. Correlation between static and dynamic test results will be required prior to using a dynamic test to verify minimum bearing capacity of other test and production piles. The correlation shall also consist of applying a dynamic restrike to the test pile within 48 hours after completion of the static load test using the approved hammer system.

The capacity determined by either test method is assumed to represent the minimum bearing capacity for each of the production piles that the test pile represents. A test pile represents a specific group of production piles that have the same size, design loading and site soil conditions. The test pile locations and the groups of production piles that each test pile represents will be shown on the plans.

Test piles shall be driven at the locations shown on the plans unless the locations are changed in writing by the Materials & Tests Engineer. Unless otherwise directed, test piles shall be driven at such locations as will permit their use in the finished structure. In no case shall test piles driven out of permanent pile locations be pulled and redriven as production piles. Test piles specified to be used as permanent piles in a structure shall have sufficient length to be cut off at plan grade for top of pile. In general, the specified length of test piles will be greater than the estimated length of production piles in order to provide for variation in soil conditions. Precast concrete test piles shall be a minimum of 10 feet {3 m} longer than the estimated length of piling shown on the plans. Steel piles shall be provided such that 10 additional feet {3 additional meters} of driving would not require an additional splice.

Upon completion of the load testing, any test or anchor piling not a part of the finished structure shall be removed or cut off at least 1 foot {300 mm} below either the bottom of footing or the finished ground elevation (if not loaded within the footing area).

The driving equipment, aids and methods used for driving test piles shall be identical to that which the Contractor proposes to use on the production piling. Approval of driving equipment shall conform with the requirements of these specifications. If piling are to be driven in a pile footing, then the Contractor shall excavate the ground at each test pile footing location to the elevation of the bottom of the footing, before the pile is driven, unless shown on the plans or directed otherwise by the Engineer.

3. TEST PILE WITH STATIC LOAD TESTING.

Test piles shall be driven to the minimum tip elevation when provided. Test piles shall be driven to a hammer blow count given on the blow count/bearing capacity graph. This graph shall be used as an estimate of the test pile's bearing capacity which uses the required minimum bearing capacity (equal to twice the design load) and stroke to obtain the required blow count for the test pile. Once the required blow count (and minimum tip elevation, when provided) is reached, the bearing capacity shall be proven (after a 7 day wait for concrete piles and a 36 hour wait for steel piles) with a Static Load Test. This blow count and stroke, or the equivalent blow count and stroke, recorded during the last foot {300 mm} of driving of a passing Static Load Test Pile shall be used as the acceptance criteria for the production piling represented by this test pile. A revised bearing graph will be provided by the Materials & Tests Engineer that reflects the actual capacity of the test pile which shall be used to determine the bearing capacity of all production piles represented by this test pile.

The Static Load Test indicates a failure if the bearing capacity determined from the load test is not equal to or greater than the required minimum bearing capacity. If the load test is a failure, the test pile shall be redriven. The blow count for the redrive shall be obtained by determining the blow count required for a theoretical increased bearing capacity. The blow count for the redrive shall be taken from the blow count/bearing capacity graph in accordance with the following formula:

Load For Obtaining Redrive Blow Count = [2 X (A – B)] + A

A = Minimum Bearing Capacity, B = Load At Failure

The test pile shall then be reloaded. This process shall be repeated as many times as necessary until the load test is determined to be a passing load test.

Test piles driven to plan grade and not having the hammer blow count required may also be spliced and driven until the required bearing is obtained. Concrete splices must be approved by the Engineer.

4. TEST PILE WITH DYNAMIC LOAD TESTING.

Dynamic load testing may be used to supplement static load testing. All dynamic load tests shall be correlated by a minimum of one representative static load test.

If shown on the plans or in the proposal or a change is requested by the contractor and approved by the Materials and Tests Engineer, dynamic measurements will be taken by the Engineer during the driving of piles designated as dynamic load test piles.

The Contractor shall notify the Engineer when the Contractor is ready to drive a dynamic test pile seven days in advance of driving the test pile. If the Contractor changes or delays the date of the dynamic testing, then the Contractor shall pay for all costs associated with the time delay to the dynamic testing Engineer.

Test piles shall be driven to the minimum tip elevation when provided. Test piles shall be driven to the depth at which the dynamic test equipment indicates the required minimum bearing capacity (equal to twice the design load) has been achieved unless directed otherwise by the Materials and Tests Engineer. The stress in the piles will be monitored during driving with the dynamic testing

equipment to insure that the values determined do not exceed the values in Item 505.03(d)2. If deemed necessary by the Engineer, the Contractor shall reduce the driving energy transmitted to the pile by using additional cushions, reducing the energy output of the hammer, or other appropriate methods in order to maintain stresses below the values in Item 505.03(b)2. If non-axial driving is indicated by dynamic test equipment measurements, the Contractor shall immediately realign the hammer system. The Engineer will notify the Contractor or their pile driving Subcontractor if their pile driving procedures violated any of the referenced requirements during the installation of the dynamically tested pile.

The Materials & Tests Engineer may use dynamic measurements to adjust tip elevations after insuring that minimum tip requirements are satisfied. The Materials & Tests Engineer will review the dynamic test data and provide the acceptance criteria for the production piling that are represented by the test pile. A revised bearing graph will be provided by the Materials & Tests Engineer that reflects the actual capacity of the test pile which shall be used to determine the bearing capacity of all production piles represented by this test pile.

For correlation of a static load test with a dynamic load test the Contractor shall, within 48 hours of the static load test, perform a restrike dynamic load test. A cold hammer shall not be used for the restrike. The hammer shall be warmed up before restrike begins by applying at least 20 blows to another pile. The sequence shall consist of striking the designated pile for 50 blows or until the pile penetrates an additional three inches {75 mm}, whichever occurs first. In the event the pile movement is less than 1/4 inch {6 mm} during the restrike, the restrike may be terminated after 20 blows. After restrike, the Materials and Tests Engineer will either accept the tip elevation or specify additional pile penetration and testing.

5. RESTRIKE FOR PRODUCTION PILES

If dynamic load tests have been correlated to at least one static load test then dynamic load testing may be used to perform a re-strike to verify minimum bearing capacity of production piles.

The Materials & Tests Engineer will direct the Contractor (after waiting seven days for a concrete pile and 36 hours for a steel pile) to perform a restrike dynamic load test. A cold hammer shall not be used for the restrike. The hammer shall be warmed up before restrike begins by applying at least 20 blows to another pile. The sequence shall consist of striking the designated pile for 50 blows or until the pile penetrates an additional three inches {75 mm}, whichever occurs first. In the event the pile movement is less than 1/4 inch {6 mm} during the restrike, the restrike may be terminated after 20 blows. Dynamic load test restrike for production piles may be used to verify minimum bearing capacity of piles that fail to achieve the required blow counts determined by test pile installation and static load testing.

6. DRIVING TO REFUSAL.

No test pile is required for a pile to be driven to refusal, unless shown on the plans. The only exception is when a pile will be dynamically monitored because of an inability to perform a WEAP analysis. Refusal is defined as 240 blows per foot {300 mm} (20 blows per inch {25 mm}). Refusal shall only be used when rock is expected to be encountered. A load test will be required for all other situations.

7. HEAVED PILES

Level readings to check on pile heave after driving shall be made at the start of pile driving operations and shall continue until the Engineer determines that such checking is no longer required. Level readings shall be taken immediately after the pile has been driven and again after piles within a radius of 15 feet {5 m} have been driven. If pile heave is observed, accurate level readings referenced to a fixed datum shall be taken on all piles immediately after installation and periodically thereafter as adjacent piles are driven to determine the pile heave range. All piles that have been heaved more than 0.25 inches {6 mm} shall be reseated by driving to original position prior to heave. Reseating shall be done without additional compensation. Reseated piles shall be driven to the required resistance or penetration. Concrete shall not be placed in pile casings until pile driving has progressed beyond a radius of 15 feet {3 m} from the pile to be encased.

(g) LOADING METHODS

1. STATIC LOAD TESTING METHOD

a. Description.

Static load testing shall be used to verify the axial load bearing capacity of pile groups or individual piles. Static load testing should be used after a test pile has been driven to the

minimum tip elevation (if shown on the plans) and has met the bearing capacity estimate based on blow count and hammer stroke from the provided bearing curves. A static load test may also be used in conjunction with a dynamic load test when verifying axial load bearing capacity of piling.

b. General.

When required, the length of piles to be driven shall be determined by the actual loading tests of any designated pile (Test or Production) in the structure. The test shall be performed as defined by ASTM D 1143, Standard Test Method for Piles Under Static Axial Compressive Load using the Quick Load Test Method. In general, these tests shall consist of the incremental application and removal of static pressure exerted on the pile through approved rigging, together with suitable apparatus for accurately determining the superimposed weight {mass} of pressure and pile settlement under each increment of load. The safe allowable load shall be determined by the Engineer from the settlement versus load curve generated by the incremental loading based on Davisson's failure criterion, explained in Subitem 505.03(g)1.c.

A minimum 7 day waiting period shall be observed between the driving of a concrete load test pile and the commencement of the load testing unless otherwise specified in the contract or authorized by the Materials and Tests Engineer. For piles other than concrete this waiting period shall be 36 hours. The Contractor may extend the waiting period as deemed necessary before performing a static load test to allow for maximum soil set up time.

If the Quick Load Test is performed using adjacent production piles as reaction piles for the test pile, the involved production piles should be checked for any permanent upward displacement. If any upward displacement is found, then all production piles used as reaction piles for the Quick Load Test shall be redriven as necessary to correct any possible axial load bearing capacity problem with the involved piles. This redrive shall be performed at the Contractor's expense.

c. Static Load Test Procedure.

The apparatus for applying the load shall be subject to the approval of the Engineer and have a capacity of 1000 tons {8900 kN} or 300 percent of the design load, whichever is less. Incremental loads of 10% of the design load shall be placed on the pile at 2.5 minute intervals until continuous jacking is required to maintain the incremental load or the capacity of the load frame is reached.

All loading tests will be continually inspected by the Engineer. Time, load, and settlement data will be recorded on Form C-15B immediately before and after the application of each load increment and at intermediate time intervals as specified. When the maximum load has been applied, readings will be taken and recorded when jacking has stopped. Additional readings will be taken after 2.5 minutes and again at 5 minutes. If a longer holding period is specified, additional readings will be taken as required. The load shall be removed after the required holding period in 4 equal parts, with time and rebound readings taken at each unloading increment. Readings will be taken immediately following each load removal, allowing 2.5 minutes between increments. Upon removal of the entire load, time and rebound readings will be taken and recorded. Additional time and rebound readings will be taken after 2.5 minutes and again at 5 minutes.

Load test data will be plotted by the Engineer in the form of settlement in inches {millimeters} (ordinate, positive down) versus applied load in kips {kN} (abscissa). Ultimate capacity predictions will be based upon Davisson's failure criterion as applied to the aforementioned settlement curve, as per FHWA's Manual on Design and Construction of Driven Pile Foundations. In this method, the elastic shortening of the pile (QL/AE, in inches {millimeters}) is superimposed on the settlement curve. In the elastic shortening equation, "Q" represents load in kips {kN}, "L" represents length of pile from settlement instrumentation to tip elevation in inches {meters}, "A" represents cross-sectional area in square inches {square meters} (at voided section, if a void is present), and "E" represents elastic modulus in ksi {MPa} (elastic modulus for concrete piles is preferably obtained from dynamic load testing, but may be calculated as 60,000 {5000} times the square root of the design compressive strength, in psi {MPa}, when dynamic load testing is not performed. The elastic modulus for steel piles may always be assumed as 29,000 ksi {200,000 MPa}).

The aforementioned elastic shortening curve is then increased or offset, by 0.15+D/120 in inches {3.81+D/120 in millimeters} (where D = pile diameter or width in inches {mm}). The point in which the offset elastic shortening curve intersects the settlement curve is considered the ultimate pile capacity.

d. Hydraulic Jacks and Load Gages.

When hydraulic jacks and gages are to be used for the superimposed load, the jacks, gages and hydraulic pumps shall have been calibrated with each other within the last 6 months

by an independent laboratory that has been approved by the Materials and Tests Engineer or by a Department laboratory. If multiple jacks are to be used with one gage, the calibration shall be performed at an approved independent laboratory. All jack calibrations shall be conducted in accordance with BMTP-358 and shall be valid for a period of 6 months from the date of calibration; however, should the Engineer have any doubt of their accuracy he may require a check of their calibration using ALDOT equipment. All calibration checks shall be within 5% of the applied load. When a jack, gage and hydraulic pump are calibrated they shall be used as a unit, and changing any one of the three components shall require a recalibration. Gages shall be of the size that will provide ease of reading (approximately 4.5 inch {115 mm} diameter) with gradations for 2 tons {18 kN} or less for loads under 100 tons {890 kN} and gradations of 5 tons {44 kN} or less for loads over 100 tons {890 kN}.

Calibrated jacks, gages and pumps shall have identifiable serial numbers to insure traceability to calibration tests.

2. DYNAMIC LOAD TESTING METHOD.

a. Description.

Dynamic Load Testing shall be used to verify that the pile (test or production) is not overstressed while being driven and to determine the axial load bearing capacity. A Dynamic Load Test may also be used in conjunction with a Static Load Test when verifying the axial load bearing capacity of piling.

b. General.

When required, the length of piles to be driven shall be determined by the actual Dynamic Loading Test of any pile (test or production) in the structure. The test shall be performed as defined by AASHTO T 298, Standard Method of Test for High-Strain Dynamic Testing of Piles. Dynamic measurements shall be taken by the Engineer during the driving of piles designated as dynamic load test piles and/or production piles. In general, Dynamic Load Testing involves attaching two strain transducers and two accelerometers to the pile approximately 2 to 3 pile diameters below the pile head before initial driving (or at a convenient location during restrike dynamic load testing). The dynamic test is performed during actual pile driving. Dynamic load testing shall be performed, when required, on test or production piles only after a WEAP analysis has been performed.

When directed by the Engineer, the Contractor shall (after waiting seven days for a concrete pile and 36 hours for a steel pile) perform a restrike dynamic load test. A cold hammer shall not be used for the redrive. The hammer shall be warmed up before redrive begins by applying at least 20 blows to another pile or other fixed object. After redriving, the Engineer will either accept the tip elevation or specify additional pile penetration and testing.

c. Process

Prior to placement in the leads, the Contractor shall make each designated concrete pile available for taking of wave speed measurements and for predrilling the required instrument attachment holes. Since there must be room on either side of the pile to drill instrumentation holes, the Contractor may be required to move piles to attain adequate clearance. Predriving wave speed measurements will not be required for steel piles, however steel piles must be available for predrilling instrument attachment holes. When wave speed measurements are made, the piling shall be in a horizontal position and not in contact with other piling. When required, the Contractor will furnish the equipment, materials, and labor necessary for drilling holes in the piles for mounting the instruments. The instruments will be attached near the head of the pile with bolts placed in masonry anchors for concrete piles or through drilled holes on steel piles. In no case shall the pile to be dynamically tested be picked up before the pile has been predrilled.

The Contractor shall provide the Engineer with a safe, stable access to the top of the pile installed in the leads. The access shall conform to OSHA requirements. The access system shall be assembled and/or operated by the Contractor and shall provide a working area of not less than 16 square feet {1.5 square meters}. The Contractor shall furnish the Engineer details of the access system with the aforementioned Pile and Driving Equipment Data Form submittal.

The Contractor shall furnish electric power for the dynamic test equipment. The power supply at the outlet shall be 10 Amp, 115 Volt, 55-60 cycle, A.C. only. Field generators used as the power source shall be equipped with functioning meters for monitoring voltage and frequency levels.

(h) PILING LENGTH.

1. ESTIMATED LENGTHS OF PILES.

The estimated length of piles shown on the plans and in the proposal are for bid purposes only. The Contractor shall be responsible for providing the lengths of these piles necessary to obtain the bearing and penetration required as determined from results obtained in driving representative test piles or other pertinent data. It is expected that there will be variations in final tip elevations due to differences in driving resistance because of differing soil conditions.

2. PILE TIP ELEVATION.

The final tip elevation of each pile will be determined by the Engineer during the driving operation but in general, the minimum penetration for any pile shall be not less than 10 feet {3 m} into natural ground and not less than 1/3 the length of the pile. When minimum tip elevations are specified by contract documents, the Contractor shall drive piles to a depth that satisfies this requirement in addition to required minimum bearing capacity.

3. PROPOSED PILE LENGTHS.

a. Steel Piles.

The Contractor shall furnish to the Engineer, for review, the proposed steel pile lengths for use in each bent of a structure before driving the piles.

b Concrete Piles.

The Contractor shall furnish to the Engineer, for review, the proposed concrete pile lengths for use in each bent of a structure before casting the piles. The lengths of concrete piles will be approved by the Engineer before the casting of the piles.

(i) UNSATISFACTORY PILES.

Approval of a pile hammer relative to driving stress damage shall not relieve the Contractor of responsibility for the piles damaged because of misalignment of the leads, failure of the cap block or cushion material, failure of splices, malfunctioning of the pile hammer, pile manufacturer's errors, or other improper construction methods. Piles damaged for such reasons shall be rejected and replaced at the Contractor's expense when the Engineer determines that the damage impairs the strength of the pile.

The method used in driving piles shall not subject the piles to excessive or undue abuse producing crushing, cracking, or spalling of concrete or deformation of the steel. Misaligned piles shall not be forced into proper position. Any pile damage during driving by reason of internal defects, or by improper driving, or driven out of its proper location, or driven below the designated cutoff elevation shall be corrected at the Contractor's expense by a method approved by the Engineer.

Piles which have been bent during installation shall be considered unsatisfactory unless the bearing capacity is proven by load tests performed at the Contractor's expense. If such tests indicate inadequate capacity, corrective measures as proposed by the contractor and approved by the Bridge Engineer, shall be taken such as installation of additional piles, strengthening of bent piles, or replacement of bent piles.

A concrete pile will be considered defective if a visible crack or any defect is observed which, as determined by the Engineer, affects the strength or life of the pile.

(j) SPLICING PILES.

1. GENERAL.

Full length piles shall be used wherever practical. When splicing is necessary and cannot be avoided, the approved method shown on the plans shall be used. If details are not shown on the plans, the contractor's proposed method of pile splicing shall be submitted to the Bridge Engineer for review and distribution.

2. PRECAST PRESTRESSED CONCRETE PILES.

When necessary, the contractor shall submit proposed pile splicing details and design calculations to the Bridge Engineer for review and distribution. The details shall be checked, stamped approved, and signed by a Professional Engineer registered by the Alabama Board of Licensure for Professional Engineers. This Professional Engineer shall not be an employee of the ALDOT. Any driving splice for a concrete pile will require dynamic testing during the driving to verify the performance of the splice. Payment for this requirement will be made under the item for Dynamic Loading Tests.

3. STEEL PILES AND STEEL SHELLS FOR CAST-IN-PLACE CONCRETE PILES.

Splicing of these piles shall be made in accordance with details shown on the plans or furnished. Welded connections for splices shall be used. All work shall be done with approved methods, materials, and experienced personnel who have been ALDOT certified 3F (qualification for fillet welding in a vertical position). Welding shall be in accordance with the Department's current Welding Specification.

Not more than three pieces (two splices) of steel pile will be permitted in making up one full length of proposed pile. In no case shall there be more than two splices exposed to view in any length of piling after driving is completed. In addition to meeting the requirements of the Specifications, the Contractor shall submit documentation of the identification (heat numbers for steel piles) of all portions of a built-up pile.

(k) PILE POINTS.

Pile points shall be furnished and installed as shown on the Plans or as directed by the Engineer. The type of required pile points will be designated on the Plans or by the Engineer. If pile points with cutting teeth are required it will be noted on the Plans and the Contractor shall furnish the required type of pile point with cutting teeth.

The types of pile points designated for use will be classified as follows:

Type A-Heavy pile points.

Type B-Light pile points.

Type A pile points may be used as a direct substitution for the Type B pile points.

The Department has established an Approved Materials List for pile points. Information concerning this list is given in Subarticle 106.01(f) and in Materials, Sources and Devices With Special Acceptance Requirements, List II-2. Only pile points shown on this list shall be used. Prior to allowing the installation of the pile points, the Contractor shall weigh a minimum of three randomly sampled points in the presence of the Engineer. If the average weight {mass} of the pile points is not greater than ninety-five percent of the production weight {mass} shown in List II-2 then the Contractor shall weigh all points in the presence of the Engineer. Only those points that weigh more than ninety-five percent of the production weight {mass} shall be used.

The pile points shall be welded to the ends of the piles in accordance with the following requirements:

-The welds for the attachment of a pile point shall be partial penetration single bevel groove welds placed full flange width along the outside of each pile flange.

-Either the pile point or the outside of each flange of the pile shall be beveled 45 degrees. The depth of the bevel shall be 3/8" minimum for HP10x42 and HP12x53 piles, and 7/16" minimum for HP13x73, HP14x73, HP14x89 and HP 14x117 piles {10 mm minimum for HP250x62 and HP310x79 piles, and 11 mm minimum for HP360x108 and HP360x132 piles}. The width of weld at the outside face of the pile flange shall be the same as the beveled depth.

-E60XX welding rods shall be used.

-All welds shall be made in the flat position. The welder shall be ALDOT certified 1G (qualification for groove welding in flat position). Welding shall be in accordance with the Department's current Welding Specification.

(l) CUT-OFF LENGTHS.

The tops of all permanent piles and pile casings shall be cut-off at the elevation shown on the plans or as ordered by the Engineer. All cut-off lengths not used in the structure shall become the property of the Contractor and shall be removed by the Contractor from the site of the work.

(m) PILE PAINTING AND PROTECTION.

All exposed surfaces of steel piling not encased in concrete shall be painted in accordance with the requirements of Section 521 for structural steel. Storage and handling of piles shall be in accordance with Article 834.11. When concrete encasement is required, the paint shall extend one foot {300 mm} below the top of the concrete encasement.

(n) PERMANENT SHEET PILING.

1. GENERAL.

Permanent sheet piling shall be new piling and shall be furnished and driven by the Contractor as provided on the plans or as designated by the Engineer.

2. CONSTRUCTION DETAILS, PERMANENT STEEL SHEET PILING AND CONCRETE SHEET PILING.

All construction methods for steel sheet piling and precast concrete sheet piling shall conform to the respective requirements prescribed herein for steel and precast concrete bearing piling and as directed. Precast Concrete sheet piling may require the use of some tapered units in order to maintain vertical alignment of the sheet pile wall. Sheet piling shall be driven to the appropriate elevations. Where necessary, cutting off driven sheet piling shall be done by approved methods and in a satisfactory manner.

(o) TEMPORARY STEEL SHEET PILING.

Temporary steel sheet piling wall shall be designed, furnished and driven at the locations shown on the plans or as directed by the Engineer, and removed when no longer needed. Working drawings and design calculations for the sheet pile walls shall be submitted in accordance with the requirements given in Article 105.02 for the submittal of Working Drawings. The design shall be in accordance with the current AASHTO Standard Specifications for Highway Bridges.

The piling shall be driven to an adequate depth and/or so braced or tied back as to protect the work from damage and workmen from danger of injury and to also protect the newly constructed work from failure.

(p) PROTECTION OF EXISTING STRUCTURES AND UTILITIES.

The Contractor shall control his operations to prevent damage to existing structures and utilities as outlined in Article 107.12. Preventive measures shall include, but are not limited to, selecting construction methods that will limit ground disturbance such as vibrations from pile driving operations and other construction related activities. Photographic, video and other surveys of surrounding structures and utilities could be made prior to driving to serve as documentation of the conditions prior to driving.

505.04 Method of Measurement.

(a) TEST PILES.

The actual number of acceptable test piles driven as directed in conformity with these Specifications, will be measured complete in place. Piles paid for as test piles will not be included in the measurement of the linear feet {meters} of production piles. No measurement or direct payment will be made for test pile cut-offs or splices necessary to lengthen test piles.

(b) STATIC LOADING TESTS.

The number of static loading tests measured will be the actual number of accepted static loading tests ordered and completed in conformity with this Specification. If the pile does not carry the load satisfactorily after the load is placed according to the Specifications, and it becomes necessary to redrive the pile and place another load, this will be deemed an additional stage of loading. Each time the pile is driven to additional penetration and load tested again, each loading will be measured as an additional stage of loading, not as an additional loading test.

(c) DYNAMIC LOADING TESTS.

The number of dynamic loading tests measured will be the actual number of accepted dynamic loading tests ordered and completed in conformity with the specifications. There will be no additional payment for a restrike dynamic loading test performed on a designated test pile. Restrike dynamic loading tests required on production piles will be included for measurement as dynamic loading tests.

(d) PILE POINTS.

Pile points will be measured per each point installed on the end of an accepted pile.

(e) STEEL PILE SPLICES.

No measurement or payment will be made for steel pile splices.

(f) STEEL PILING FURNISHED AND DRIVEN.

The accepted lengths of steel piling furnished and driven to remain in the finished structure will be measured in linear feet, complete in place.

No measurement for payment will be made of steel pile cut-offs.

No measurement will be made for steel pile splices.

Pile cap plates and cap channels will be measured and paid for as Structural Steel, per pound {kilogram}.

Piling damaged by the Contractor in handling or driving will not be accepted.

(g) CONCRETE PILING FURNISHED.

The approved lengths of concrete piling (lengths approved by the Engineer for casting) will be measured in linear feet {meters}.

(h) CONCRETE PILING DRIVEN.

The approved casting lengths of concrete piling remaining in the finished structure (casting lengths minus any cut-offs) will be measured in linear feet {meters}.

(i) CONCRETE PILE SPLICE.

The build-up of a pile, where the pile will not be driven with the build-up, will be measured in linear feet {meters} from the joint at the bottom of the build-up to the top of the pile. The linear feet {length in meters} of build-up will be included in the quantity of Concrete Piling Furnished. The splicing of this build-up will be measured as 30 additional linear feet {10 additional meters} of Concrete Piling Furnished.

The build-up and splicing of a pile, where the pile will be driven with the build-up, will not be measured for payment under a contract pay item but will be paid for as Extra Work.

(j) CONCRETE PILE CUT-OFF.

Each cut-off of a concrete pile will be measured as 6 additional linear feet {2 additional meters} of Concrete Piling
Furnished.

(k) PERMANENT SHEET PILING.

The quantity of permanent steel or concrete sheet piling to be measured for payment shall be the quantity in linear feet {meters} of such piling actually remaining in the completed structure and accepted. In computing the linear feet {meters}, the lengths shall be those lengths under cutoffs.

(l) PILOT HOLES.

Pilot holes will be measured for payment by the linear foot {meter}. Pilot Holes will be measured from the top of the material where the auger or drill begins the excavation to the bottom of the hole.

(m) TEMPORARY STEEL SHEET PILING.

Temporary steel sheet piling will be measured for payment in units of square feet {square meters}. This square foot {square meter} quantity will be determined from the length and width of individual sheet piles. The length of a sheet pile will be measured from the embedded tip to 1 foot {300 mm} above the existing ground or placed fill, whichever is appropriate. The width of a sheet pile will be the distance from centerline of the interlock on one side to the centerline of the interlock on the other side. The width of a sheet pile will be measured along the line of the sheets, not adding for bends or corrugations. The square foot {square meter} quantity for which payment will be made will be the sum of the square foot {square meter} areas of the individual sheet piles.

505.05 Basis of Payment.

(a) GENERAL.

The contract unit price bid for the various type piling covered by this Section shall be full compensation for furnishing and installing all materials required by each item of work, and for all equipment, tools, labor and incidentals necessary to complete the work. Each pay item includes fabrication, treatment, transportation, handling, driving, jetting, spudding, capping, painting and finishing where necessary and as required by other portions of the specifications and the plans. The pay item for steel piling includes the splicing and cutting off of the piles. Additional payment will be made for splicing and cutting off concrete piles. All cut-offs shall become the property of the Contractor. No payment will be made for falsework piling and no additional payment will be made for driving piles on a batter.

(b) STATIC LOADING TESTS.

Accepted static loading tests will be paid for at the contract unit price for static loading tests per each, complete in place, which shall be payment in full for all materials, equipment and labor incidental to constructing the loading platform, instrument shelter, procuring and placing the loading material, and/or equipment, and removing and disposing of the platform and material and/or equipment to the satisfaction of the Engineer.

Payment will be made for each additional stage of loading described in Subarticle 505.04(b). Payment will be the percentage of the contract price for a Loading Test given in the following table.

Design Load Shown On Plans (tons) {metric tons}	Percentage of Contract Price for a Loading Test
Up to 50 {45}	50%
Over 50 {45} to 75 {70}	75%
Over 75 {70}	100%

(c) DYNAMIC LOADING TESTS.

Accepted dynamic loading tests will be paid for at the contract unit price for Dynamic Loading Tests per each, complete in place, which shall be payment in full for all equipment and labor incidental to aiding the Engineer in the performance of this test and for all costs associated with down time while setting up equipment, making dynamic measurements, down time while waiting to perform a restrike dynamic test, and the restrike dynamic test.

(d) PERMANENT SHEET PILING.

The quantity of acceptable sheet piling in place after all cut-offs have been made will be paid for at the respective contract price for the type of sheet piling listed. The contract unit price bid for this item shall also include any necessary excavation unless an item of excavation is provided in the contract.

(e) PILE POINTS.

Pile Points will be paid for at the contract unit price per each. This payment shall be full compensation for furnishing the points and all materials, labor and incidentals necessary to install the points.

(f) CONCRETE PEDESTAL FOUNDATIONS.

Where hardmarl, solid rock or other conditions are encountered that make it necessary or desirable to place piles in concrete pedestal foundations, the net length of piling so placed in the structure will be paid for at the contract unit price for the respective kinds of piling. The additional work required for construction of the pedestal foundations will be paid for as extra work as outlined in Article 104.03, Extra Work.

(g) PILOT HOLES.

The contract unit price per linear foot {meter}, measured as noted above, shall be payment in full for all materials, equipment and labor required to excavate the pilot hole. It shall also be payment in full for the disposal of excavated material and for filling the voids in pilot holes around the piles with sand or concrete.

(h) TEMPORARY STEEL SHEET PILING.

The quantity of temporary steel sheet piling acceptably placed, measured as noted above, will be paid for at the unit bid price which includes furnishing the design and piling, driving, bracing, and removing the piling. The piling, after removal, shall remain the property of the Contractor.

(i) STEEL PILING FURNISHED AND DRIVEN.

The accepted lengths of steel piling in the finished structure will be paid for at the respective contract price for steel piling furnished and driven. The extra length (beyond estimated length) of steel pile that may be required to complete a structure will be paid for at the contract price for steel piling furnished and driven. No payment will be made for cut-offs or splices of steel piling.

(j) CONCRETE PILING FURNISHED.

The approved lengths of concrete piling (lengths approved by the Engineer for casting) will be paid for at the respective contract price for concrete piling furnished.

Non-driven pile build-ups and cut-offs will be paid for at the designated rate for concrete piling furnished.

(k) CONCRETE PILING DRIVEN.

The approved casting lengths of concrete piling remaining in the finished structure (casting lengths minus any cut-offs) will be paid for at the respective contract price for concrete piling driven. No payment for build-ups, either driven or non-driven, will be made under this item.

(l) PAYMENT WILL BE MADE UNDER ITEM NO.:

505-A Type Test Piles (*) – per each
505-B Static/Dynamic Loading Tests (*) – per each
505-E Permanent Steel Sheet Piling * - per linear foot {meter}
505-F Permanent Concrete Sheet Piling (width) – per linear foot {meter}
505-G Pile Points (**) – per each
505-H Pilot Holes – per linear foot {meter}
505-I Temporary Steel Sheet Piling – per square foot {square meter}
505-M Steel Piling Furnished and Driven (*) – per linear foot {meter}
505-N Concrete Piling Furnished (*) – per linear foot {meter}
505-O Concrete Piling Driven (*) – per linear foot {meter}

* Pile Designation/Size
** Type/Size of Pile Point
Example: 505-G Pile Points (Type A 10")

SECTION 506
DRILLED SHAFT CONSTRUCTION

506.01 Description.

This work shall consist of all labor, materials, equipment and services necessary to perform all operations to complete a drilled shaft installation in accordance with these Specifications and the details and dimensions shown on the plans.

506.02 Materials.

(a) GENERAL.

All materials shall conform to requirements set forth in Division 800, Materials. The requirements provided for Structural Portland Cement Concrete, Section 501, shall apply in all respects to drilled shafts, except where otherwise indicated by specific requirements given hereinafter in this Section or noted by plan details.

(b) CONCRETE.

Portland cement concrete used in construction of drilled shafts shall hereinafter be referred to as either "Class DS1", "Class DS2" or "Class DS3" concrete. The specific class of concrete that is required will be shown in the Pay Item Description for Drilled Shaft Construction.

The concrete producer shall establish the proportion of materials for each class of drilled shaft concrete following the guidelines described in ALDOT-170, *"Method of Controlling Concrete Operations for Structural Portland Cement Concrete"*, except that, instead of the reference to the Master Proportion Table, the concrete producer shall use the criteria outlined hereinafter in this Subarticle. The concrete supplier shall submit for approval the proposed concrete mix design to the State Materials and Test Engineer following the requirements in ALDOT-170. The distribution of the approved concrete mix design and re-approval of concrete mix designs will be as per ALDOT-170 respectively. Any changes of the materials and/or proportions of the mix design will require a concrete mix resubmittal.

1. Criteria applicable to Class DS1, Class DS2 and Class DS3 concrete:

Minimum Compressive Strength at 28 days shall be 4000 psi {30 MPa}.

The amount of cementitious material shall be a minimum of 600 pounds {360 kg} and a maximum of 800 pounds per cubic yard {475 kg per cubic meter} of concrete.

An air-entraining admixture is required in the concrete mix; the range of air entrainment shall be 1.0% to 5.0% by volume.

The maximum water to total cementitious material ratio shall be 0.40.

Slump requirements:

The allowable range of consistency slump during concrete placement shall be from 6 inches to 9 inches {150 mm to 230 mm}.

The minimum consistency slump for all of the concrete placed in an individual shaft shall be no less than 4 inches {100 mm} at the end of the concrete placement in that shaft.

The temperature of the concrete, at the time of placement in the shaft, shall not be less than 50 °F {10 °C} nor more than 95 °F {35 °C}.

Gradation of the coarse aggregate used shall meet the requirements for either ALDOT Size No. 57, No. 67 or No. 7.

All materials used in manufacturing the concrete shall conform to the requirements of the Specifications.

2. Additional criteria applicable to Class DS1 concrete:

Either Type I or Type II cement shall be used.

The cementitious content may be composed of up to 30% by weight {mass} substitution of either Class C or Class F fly ash additive. In lieu of fly ash, ground granulated blast furnace slag may be substituted for cement up to a minimum substitution rate of 25% and a maximum substitution rate of 50% by weight {mass}.

3. Additional criteria applicable to Class DS2 concrete:

Type II cement shall be used.

The cementitious content shall be composed of no less than 20% nor more than 30% by weight {mass} of Class F fly ash additive. In lieu of fly ash, ground granulated blast furnace slag may be substituted for cement up to a minimum substitution rate of 35% and a maximum substitution rate of 50% by weight {mass}.

4. Additional criteria applicable to Class DS3 concrete:

Type II cement shall be used.

The cementitious content shall be composed of 20% by weight {mass} of Class F fly ash and 10% by weight {mass} of microsilica additives. In lieu of the percentages of fly ash and microsilica, the cementitious content may be composed of 50% by weight {mass} substitution of ground granulated blast furnace slag and 5% by weight {mass} addition of microsilica additives.

(c) SLURRY.

When use of slurry is either shown to be required in the contract documents or selected by the Contractor, mineral slurries shall be used unless another type of slurry is proposed for use by the Contractor and approved by the Engineer. The following minimum requirements apply to material components used in slurries:

1. APPROVED MINERALS.

Sodium Bentonite or Attapulgite shall be used as the principal mineral constituents of slurry. The Engineer may approve use of other minerals upon receipt of demonstrated proof that the requested alternate mineral insures shaft stability at the applicable shaft construction site.

2. MIXING WATER.

Mixing water shall be capable of meeting drinking water standards as outlined in Section 807.

3. SAND.

Clean, locally available sand meeting the requirements of Section 802 (not to exceed four (4) percent by volume) may be mixed in drilling slurries.

4. ADDITIVES.

At the Contractors discretion, additives may be used to control the consistency and/or yield of slurries subject to the limitation that the type and amount of additives used shall not exceed the recommendation(s) of the principal mineral manufacturer.

(d) CASING.

When use of casing is either specified by the contract documents or selected by the Contractor, casings shall be smooth, non-corrugated, clean, watertight steel of ample strength to withstand both handling and driving stresses and the pressures of concrete and the surrounding earth materials. Where permanent casing is required, serviceable used casing may be installed with the approval of the Engineer.

The Contractor is responsible for insuring that all casing, new or used, is capable of withstanding the aforementioned stress and pressure requirements.

(e) STEEL REINFORCEMENT.

Unless otherwise noted on the contract documents, all steel reinforcement shall be Grade 60 {420} billet steel meeting the requirements of Section 502, sized and installed in accordance with the contract plans as applicable. Welding of the reinforcing steel will not be permitted without the written approval of the Bridge Engineer. Welding to the main vertical reinforcing steel will not be permitted.

506.03 Construction Methods and Equipment.

The Contractor shall perform excavations required for shafts through whatever materials are encountered, to the dimensions and elevations shown in the plans or otherwise required by the specifications and special provisions. The Contractor's methods and equipment shall be suitable for the site conditions and materials encountered. The permanent casing method shall be used only at locations shown on the plans or authorized by the Bridge Engineer.

Actual cores recovered from the test borings are available for inspection at the Bureau of Materials and Tests.

(a) GENERAL REQUIREMENTS.

1. CONTRACTOR QUALIFICATIONS.

The Contractor shall submit descriptions of the drilled shaft construction projects completed in the last three years to serve as evidence of the capability to construct drilled shafts. The descriptions of the drilled shaft projects shall contain names and telephone numbers of owners' representatives who can verify the Contractor's participation on those projects. These descriptions shall be submitted with the Installation Plan and will be evaluated by the Engineer.

The evaluation of the Contractor's capability for constructing drilled shafts will have a bearing on the decision by the Engineer to require the construction of a Trial Drilled Shaft.

2. INSTALLATION PLAN.

a. Installation Plan Requirements.

No later than 30 days after the date of the Notice to Proceed, the Contractor shall submit an installation plan for review by the Engineer. This plan shall provide information on the following items as applicable:

- Name and experience record of the drilled shaft superintendent in charge of drilled shaft operations for this project;
- List of proposed equipment to be used including cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, core sampling equipment, tremies, concrete pumps, casing, etc.;
- Details of the overall anticipated construction operation sequence and the proposed sequence of shaft construction;
- Details of planned shaft excavation methods;
- Details of the methods to be used to insure shaft stability (i.e. prevention of caving, bottom heave, etc., using temporary casing, slurry or other means) during excavation and concrete placement. This shall include a review of method suitability to the anticipated site and subsurface conditions. If casings are proposed or required, casing dimensions and detailed procedures for permanent casing installation, and temporary casing installation and removal shall be provided.
- When use of slurry is required or proposed, details of the methods for mixing, circulating and desanding slurry;
- Details of methods to clean the shaft excavation;
- Details of reinforcement placement including support and centralization methods;
- Details of concrete placement method required or proposed including operational procedures for free fall, tremie or pumping as appropriate; and
- The method used to fill or eliminate all voids between the plan shaft diameter and excavated shaft diameter, or between the shaft casing and surrounding soil, if permanent casing is specified.
- Details of the material, equipment, and procedures proposed to accomplish the required load testing.

b. Evaluation of Installation Plan.

The Engineer will evaluate the drilled shaft installation plan for conformance with the plans and specifications. Within 15 days following receipt of the installation plan, the ALDOT Construction Engineer will return the plan for corrections, distribute the plan for construction inspection, or contact the Contractor to establish a mutually agreeable date and time for a meeting to discuss the installation plan. If a meeting is held to discuss the installation plan the Contractor and his drilled shaft project superintendent shall be in attendance. The Contractor will be notified of changes in the submitted installation plan deemed necessary by the ALDOT Construction Engineer within seven days after the aforementioned meeting. Shaft construction shall not begin until the installation plan has been distributed by the ALDOT Construction Engineer for construction inspection. Distribution of

the installation plan for construction inspection shall not relieve the Contractor of the responsibility to satisfactorily complete the work as detailed on the plans and in the specifications.

c. Modification of Installation Plan.

Any proposed modification of the installation plan during construction shall be submitted to the Construction Engineer for review and distribution.

3. PROTECTION OF EXISTING STRUCTURES AND UTILITIES.

The Contractor shall control his operations to prevent damage to existing structures and utilities as outlined in Article 107.12. Preventive measures shall include, but are not limited to, selecting construction methods and procedures that will prevent caving of the shaft excavation, monitoring and controlling the vibrations from construction activities such as the driving of casing or sheeting, drilling of the shaft, or from blasting, if permitted.

4. CONSTRUCTION SEQUENCE.

a. Excavation to the bottom of shaft elevation shall be completed before shaft construction begins unless otherwise noted in the contract documents or approved by the Engineer. Any disturbance caused by shaft installation to a planned drilled shaft area shall be repaired by the Contractor prior to the shaft construction.

b. When drilled shafts are to be installed in conjunction with embankment placement, the Contractor shall construct drilled shafts after the placement of fills unless shown otherwise in the contract documents or approved by the Engineer.

c. Substructure concrete shall not be placed on a drilled shaft until the concrete in the shaft reaches a minimum of 80% of the required 28-day compressive strength and until all CSL test results (when required) are accepted and the CSL tubes have been dewatered and grouted.

(b) METHODS OF CONSTRUCTION.

1. DRY METHOD.

The dry construction method shall be used only at sites where the groundwater level and soil conditions are suitable to permit construction of the shaft in a relatively dry excavation, and where the sides and bottom of the shaft may be visually inspected by the Engineer prior to placing reinforcement and concrete. The dry method consists of drilling the shaft excavation, removing accumulated water and loose material from the excavation, placing the reinforcing cage, and concreting the shaft in less than 3 inches of water.

2. WET METHOD.

The wet construction method may be used at sites where a dry excavation can not be maintained for placement of the shaft concrete. This method consists of using water or mineral slurry to maintain stability of the hole perimeter while advancing the excavation to final depth, placing the reinforcing cage, and concreting the shaft. Where drilled shafts are located in open water areas, exterior casings shall be extended from above the water elevation into the ground to protect the shaft concrete from water action during placement and curing of the concrete. The casing shall be installed in a manner that will produce a positive seal at the bottom of the casing so that no seepage of water or other materials occurs into or from the shaft excavation.

3. CASING FOR DRY OR WET CONSTRUCTION METHODS.

Permanent or temporary casing may be used when shown on the plans or at sites where the dry or wet construction methods are inadequate to prevent caving or excessive deformation of the hole. In this method the casing may be either placed in a predrilled hole or advanced through the ground by twisting, driving or vibration before being cleaned out. Casing which is going to be installed by predrilling and permanently left in rock for the purpose of shielding voids, shall be installed in not more than a 2 inch {50 mm} oversized drill hole. When downsizing of permanent casing is required, no more than six feet of overlap of casing will be allowed.

When the casing method is required but not shown on the plans, the Contractor shall submit details of the proposed casing method (including casing lengths and diameters) and the proposed procedures of casing installation to the Bridge Engineer for review in the installation plan. If the need is determined after work on the shafts has begun, a revised plan proposing this method must be submitted for review.

(c) EXCAVATION PROCEDURES.

1. GENERAL.

Shaft excavations shall be made at locations and to the elevations, geometry and dimensions shown in the contract documents or as directed by the Engineer. A shaft shall not be

excavated as long as an adjacent shaft in the same substructure unit is open unless authorized in writing by the Construction Engineer. Blasting and vibrating casings in place will not be allowed until the concrete in adjacent shafts has reached 80% of the required 28-day compressive strength.

Once the excavation of a shaft has been started, the excavation shall be conducted in a continuous operation until the excavation is completed. For any delay longer than twenty four hours the methods proposed in the installation plan for insuring shaft stability shall be utilized.

2. EXCAVATION LOG.

The Contractor shall maintain an excavation log during shaft excavation. The log shall contain information such as: the description and approximate top and bottom elevation of each soil or rock material encountered during shaft excavation, elevations at which seepage or groundwater flow are encountered, and remarks. The type of tools used for the excavation shall be shown on the log. All changes in the type of tools used for excavation shall be shown on the log. The Engineer will monitor these operations and the logs will be used as a basis of measurement for payment. The Contractor shall resolve all discrepancies on the log noted by the Engineer at the end of each work day. Two copies of the legible, final log shall be furnished to the Engineer within 24 hours after a shaft excavation is completed and accepted.

3. HANDLING EXCAVATED MATERIAL.

Excavated materials which are removed from shaft excavations shall be disposed of by the Contractor in accordance with Subarticle 215.03(g).

4. EXCAVATION SAFETY.

The Contractor shall not permit workers to enter the shaft excavation for any reason unless: suitable casing has been installed, the water level has been lowered and stabilized below the level to be occupied, and adequate safety equipment and procedures have been provided to protect workers entering the excavation. The Contractor is responsible for compliance with applicable State and Federal safety regulations.

(d) TYPES OF DRILLED SHAFT EXCAVATION.

1. DRILLED SHAFT EXCAVATION.

The excavation of the shaft using conventional earth drilled shaft excavation tools will be designated as "drilled shaft excavation".

2. SPECIAL DRILLED SHAFT EXCAVATION.

The excavation of the shaft requiring rock tools and/or procedures to accomplish hole advancement will be designated as "special drilled shaft excavation". This excavation will be for the removal of rock or other hard material within the planned shaft.

(e) EXCAVATING AND DRILLING EQUIPMENT.

1. GENERAL.

Excavation and drilling equipment shall have adequate capacity including power, torque and down thrust to excavate a hole of both the maximum specified diameter and to a depth of twenty (20) percent beyond the depths shown on the plans when operated at rated capacity.

2. ROCK TOOLS AND EQUIPMENT.

When the material encountered cannot be drilled using conventional earth drilling tools and equipment, the Contractor shall provide rock drilling equipment including air tools, approved blasting materials, and other equipment as necessary to construct the shaft excavation to the size and depth required. Concurrence of the Engineer shall be obtained prior to switching from earth to rock drilling tools and equipment. Approval of the Engineer is required before excavation by blasting is permitted.

3. OVERREAMING.

a. Sidewall overreaming shall be required when the sidewall of the hole is determined to have either softened due to excavation methods, swollen due to delays in concreting, or degraded because of slurry cake buildup. Overreaming thickness shall be a minimum of 1/2 inch {13 mm} and a maximum of 3 inches {75 mm}.

b. Overreaming may be accomplished with a grooving tool, overreaming bucket or other approved equipment. The thickness and extent of sidewall overreaming shall be as directed by the Engineer. The Contractor shall bear all costs associated with both sidewall overreaming and additional shaft concrete placement.

4. LOST TOOLS.

Drilling tools which are lost in the excavation shall not be considered obstructions and shall be promptly removed by the Contractor without compensation. All costs due to lost tool removal shall be borne by the Contractor including costs associated with correcting hole degradation due to removal operations and time delays.

(f) EXPLORATORY SHAFT EXCAVATION.

1. GENERAL.

The Contractor will be required to perform some type of exploratory shaft excavation (soil samples, rock cores or drilling or probing) below the bottom elevations shown on the plans unless this requirement is noted on the plans as being deleted. The Contractor shall extend drilled shaft tip elevations when the Engineer determines that the material encountered during this exploratory excavation is unsuitable and/or differs from that anticipated in the design of the drilled shaft.

2. ROCK CORES AND SOIL SAMPLES.

The Contractor shall take 2.0 inch {51 mm} minimum diameter rock cores and/or soil samples at locations as designated on the plans or as directed by the Engineer to determine the character of the material directly below the completed shaft excavation. The soil samples shall be extracted with a split spoon sampler or undisturbed sample tube in accordance with AASHTO T 206 and T 207. The methods and equipment used for the rock coring shall be those given in Subarticle 506.10(b) for the core drilling of drilled shaft concrete. The cores and/or soil samples shall be taken to a minimum of 10 feet {3 m} below the bottom of the drilled shaft excavation unless otherwise noted on the plans or directed by the Geotechnical Engineer. The Engineer may require this depth to be extended up to a total depth of 20 feet {6 m} below the bottom of the shaft. The Contractor may choose to take these cores and/or soil samples prior to excavating for the drilled shafts, however, payment will only be considered for that portion of the cores taken below the bottom elevation of the shafts shown on the plans.

Rock core and soil test samples shall be measured, visually identified and described on the Contractor's log. The samples shall be placed in suitable containers, identified by shaft location, elevation and project number and delivered to the Central Laboratory in Montgomery with the Contractor's field log within 24-hours after the exploration is completed. The Engineer will inspect the samples/cores and determine the final depth of required excavation based on his evaluation of the sampled materials suitability.

3. DRILLING OR PROBING.

At all drilled shaft locations where rock cores and/or soil samples are not designated, the Contractor will be required to drill or probe an exploratory hole below the bottom elevation of the shaft to determine if any voids or crevices are present. The exploratory hole shall be taken to a depth of 10 feet {3 m}, unless noted otherwise on the plans. Exploratory drilling or probing will not be required if it is noted on the plans that this requirement is not necessary. No direct payment will be made for this operation.

(g) OBSTRUCTION REMOVAL.

Surface and subsurface obstructions at drilled shaft locations shall be removed by the Contractor. Such obstructions may include man-made materials such as old concrete foundations and natural materials such as boulders. Special procedures and/or tools shall be employed by the Contractor in the event the hole cannot be advanced using conventional augers fitted with soil or rock teeth, drilling buckets and/or underreaming tools. Special procedures/tools may include but are not limited to: chisels, boulder breakers, core barrels, air tools, hand excavation, temporary casing, and increasing the hole diameter. Blasting shall not be permitted unless specifically approved in writing by the Engineer. Removal of obstructions will be classified as "special drilled shaft excavation".

(h) TRIAL DRILLED SHAFT INSTALLATION.

1. GENERAL.

The Engineer will require the construction of a trial shaft if the submittal of descriptions of previous drilled shaft construction projects does not, in the opinion of the Engineer, substantiate the Contractor's capability for constructing the drilled shafts on this project. The Engineer may also require the construction of a trial shaft to verify the adequacy of unusual construction methods and/or equipment proposed for use in the construction of the production shafts.

The trial drilled shaft shall be constructed if required by special note on the plans.

2. LOCATION AND DEPTH.

The trial shaft(s) shall be positioned as indicated on the plans or as directed by the Engineer. Unless otherwise indicated, shafts shall be drilled to the maximum depth of any production shaft shown on the plans.

3. FAILURE TO DEMONSTRATE ABILITY.

Failure of the Contractor to demonstrate the adequacy of his equipment, methods and/or expertise shall be reason for the Engineer to require alterations necessary to eliminate unsatisfactory results. Additional trial shafts required to demonstrate correction of deficiencies shall be at the Contractor's expense.

4. TRIAL SHAFT APPROVAL.

Once approval has been given to construct production shafts, no changes will be permitted in the personnel, methods or equipment that were used to construct the satisfactory trial shaft without written approval of the Engineer.

5. SITE RESTORATION.

Unless otherwise shown in the contract documents, the trial shaft holes will be filled with non-reinforced concrete in the same manner that production shafts will be constructed. The concreted trial shafts shall be cutoff 2 feet {600 mm} below finished grade or at the mudline if in water. The disturbed areas at trial shaft holes shall be restored as nearly as practical to their original condition. No direct payment will be made for cutting off the top of the trial shaft or for the site restoration.

506.04 Encased Excavations.

(a) GENERAL.

The outside diameter of casings shall not be less than the specified shaft size. No extra compensation will be allowed for concrete required to fill an oversized casing or excavation. All casings, except permanent casing, shall be removed from shaft excavations.

(b) TEMPORARY CASING.

1. GENERAL.

All casing shall be considered temporary unless specifically shown as permanent casing in the contract documents. The Contractor will be required to remove temporary casing before completion of concreting the drilled shaft. Telescoping, predrilling with slurry, and/or overreaming to beyond the outside diameter of the casing may be required to install casing.

2. SIZE SUBSTITUTION.

If the Contractor elects to remove a specified diameter or length of casing and substitute a longer or larger diameter casing through caving soils, the excavation shall be either stabilized with slurry or backfilled before the new casing is installed. Other methods, as approved by the Engineer, may be used to control the stability of the excavation and protect the integrity of the foundation soils.

3. BOUND OR FOULED CASINGS.

Temporary casings which become bound or fouled during shaft construction and cannot be practically removed shall constitute a defect in the drilled shaft. The Contractor shall be responsible for correcting such defective shafts to the satisfaction of the Engineer. Correction may consist of, but is not limited to: removing the shaft concrete and extending the shaft deeper to compensate for loss of frictional capacity in the cased zone, providing straddle shafts to compensate for capacity loss, or providing a replacement shaft. All corrective measures including redesign of shafts caused by defective shafts shall be done to the satisfaction of the Engineer without compensation or an extension of the completion date of the project. In addition, no compensation will be paid for casing remaining in place.

4. REMOVABLE CASING.

When the shaft extends above ground or through a body of water, the portion exposed above ground or through a body of water may be formed with suitable, removable casing except when permanent casing is specified. Removable casing shall be stripped from the shaft in a manner that will not damage the concrete. Casings can be removed when the concrete has attained a compressive strength of not less than 2500 psi {20 MPa} as determined from concrete cylinder breaks provided: curing of the concrete is continued for the full period in accordance with specifications and the shaft concrete is not exposed to salt water or moving water for seven days.

(c) PERMANENT CASINGS.

1. GENERAL.

Permanent casing shall be used when shown in the contract documents. The casing shall be continuous between top and bottom elevations prescribed in the plans. After installation is complete, the permanent casing shall be cut off at the prescribed elevation and the shaft completed by installing necessary reinforcing steel and concrete in the casing.

Exterior surfaces of permanent casings shall be cleaned and coated with the prime coat only of a System 1A Coating in accordance with the requirements given in Section 521 and as shown on the plans. The exterior surfaces shall be coated prior to the installation of the casings. After the installation of the casings, all damage to the coated surfaces of the casings exposed to the air shall be repaired by a repeated application of the same prime coat. When not shown in the contract documents, permanent casing may be used if determined to be necessary by the Engineer and if approved by the Bridge Engineer.

2. MULTIPLE CASINGS.

In cases where special temporary casings are shown on the plans or authorized in writing by the Engineer, the Contractor shall maintain alignment of both the temporary outer and permanent inner casing, and a positive, watertight seal between the two casings during excavation and concreting operations.

506.05 Use of Slurry.

(a) GENERAL.

Slurries shall have a mineral grain size that will remain in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain stability of the excavation and allow proper concrete placement.

(b) MIXING AND STORAGE.

The mineral slurry shall be premixed thoroughly with clean fresh water and adequate time allotted for hydration prior to introduction into the shaft excavation. Slurry tanks of adequate capacity will be required for slurry circulation, storage, and treatment. Excavated slurry pits will not be allowed in lieu of slurry tanks without the written permission of the Engineer.

(c) DESANDING.

Desanding equipment shall be provided by the Contractor as necessary to control slurry sand content at less than 4 percent by volume at any point in the borehole. Desanding will not be required for setting temporary casing, sign post, or lighting mast foundations unless required by the plans or special provisions.

(d) REQUIRED FLUID LEVEL.

1. GENERAL.

During construction, the level of the slurry shall be maintained at a height sufficient to prevent caving of the hole. In the event of a sudden significant loss of slurry in the hole, the construction of that foundation shall be stopped until methods to stop slurry loss or an alternate construction procedure have been approved by the Engineer.

2. REQUIRED HEAD.

Mineral slurry in a shaft excavation shall be maintained at a level not less than 4 feet {1.2 m} above the highest expected static water surface along the depth of the shaft. If at any time the Engineer determines the slurry construction method fails to produce the desired final results, the Contractor shall discontinue this method and propose an alternate method for approval of the Engineer.

(e) CONTROL OF SLURRY.

1. SETUP PREVENTION.

The Contractor shall take all steps necessary to prevent the slurry from "setting up" in the shaft. Such methods may include but are not limited to: agitation, circulation and/or adjusting the properties of the slurry.

2. CONTROL TESTING.

Control tests using suitable apparatus shall be carried out on the mineral slurry by the Contractor to determine density, viscosity and pH. An acceptable range of values for these physical properties is shown in the following table:

MINERAL SLURRY (Sodium Bentonite or Attapulgite in Fresh Water) Acceptable Range of Values			
Property (Units)	At Time of Slurry Introduction	In Hole at Time of Concreting	Test Method
Density (pounds per cubic foot) {kg/m^3}	64.3** – 69.1** {1030** – 1110**}	64.3** – 75.0** {1030** – 1200**}	Density Balance
Viscosity (seconds / quart) {seconds / liter}	28 – 45 {30 – 48}	28 – 45 {30 – 48}	Marsh Cone
pH	8-11	8-11	pH paper, pH meter
** Increase by 2 pounds per cubic foot {32 kg/m^3} in salt water			
a. Tests should be performed when the slurry temperature is above 39 °F. b. If desanding is required, sand content shall not exceed 4 percent (by volume) at any point in the bore hole as determined by the American Petroleum Institute sand content test.			

(f) TESTING OF SLURRY.

1. FREQUENCY.

Tests to determine density, viscosity and pH value shall be done during the shaft excavation to establish a consistent working pattern. A minimum of four sets of tests shall be made during the first 8 hours of slurry use. When the results show consistent behavior the testing frequency may be decreased to one set every four hours of slurry use.

2. TEST REPORTS.

Reports of all tests required above, signed by an authorized representative of the Contractor, shall be furnished to the Engineer on completion of each drilled shaft.

(g) DISPOSAL.

Disposal of all slurry shall be done off site by the Contractor.

506.06 Excavation Measurement and Cleaning.

(a) GENERAL.

The Contractor shall provide equipment and personnel for checking the dimensions and alignment of each permanent shaft excavation. The dimensions, depth and alignment shall be determined under the direction and to the satisfaction of the Engineer after final cleaning.

(b) CLEANING.

Unless otherwise stated in the contract, a minimum of 50 percent of the base of each shaft will have less than 1/2 inch {13 mm} of sediment at the time of concrete placement. The maximum depth of sediment or any debris at any place on the base of the shaft shall not exceed 1.5 inches {40 mm}. Shaft cleanliness will be determined by visual inspection for dry shafts. For wet shafts the bottom of the shaft shall be sounded with an airlift pipe, a tape with a heavy weight {mass} attached to the end of the tape or other means acceptable to the Engineer. In addition, for dry excavations the maximum depth of water covering the bottom of the excavation shall not exceed 3 inches {75 mm} prior to concrete pour.

506.07 Reinforcing Steel Construction and Placement.

(a) GENERAL.

The reinforcing steel cage, consisting of longitudinal and transverse bars, ties, cage stiffeners, spacers, centralizers, and other necessary appurtenances, shall be completely assembled and placed as a unit immediately after the shaft excavation is inspected and accepted, and prior to concrete placement. The reinforcing steel in the shaft shall be securely tied and supported so that the

reinforcing steel will remain within allowable tolerances given in Subarticle 506.11(c) of this Specification.

(b) SPACERS.

1. Concrete spacers or other approved noncorrosive spacing devices shall be used at sufficient intervals near the bottom, and at intervals not exceeding 10 feet up the shaft, to insure concentric spacing for the entire cage length.

2. Spacers shall be constructed of approved material equal in quality and durability to the concrete specified for the shaft. The spacers shall be of adequate dimension to insure the proper annular space between the outside of the reinforcing cage and the side of the excavated hole and/or permanent casing as detailed on the plans or proposed in the installation plan. If not detailed on the plans, a minimum 4 inch {100 mm} annular space will be required.

(c) CAGE SUPPORTS.

Cylindrical concrete feet (bottom supports) shall be provided to insure that the bottom of the cage is maintained at the proper distance above the base as specified by the project plans.

(d) CAGE EXTENSION.

If the drilled shaft excavation is extended to an elevation lower than the plan bottom elevation, reinforcing cage length shall also be extended by the same amount. Cages may be extended at the plan bottom elevation by lap splicing additional longitudinal bars, per planned cage requirements, of sufficient length to provide a compression splice, 4.17 feet {1270 mm} in length, plus the required extension. Hoops for the extension shall be spaced the same as shown for other hoops. Any additional splices of the cage above the plan bottom elevation and not shown on the plans, must have prior approval of the Bridge Engineer. Stiffeners, spacers and other appurtenances shall also be extended as required.

506.08 Concrete Placement Requirements.

(a) GENERAL.

Concrete used for drilled shaft construction shall meet the requirements of Subarticle 506.02(b).

After the reinforcing steel has been placed and before the concrete is ordered, the bottom of the drilled shaft must be resounded to verify cleanliness.

(b) CONCRETE PLACEMENT TIME LIMITATIONS.

1. GENERAL.

Concrete shall be placed as soon as possible after the reinforcing steel has been placed and the bottom of the shaft has been resounded. The concrete placement shall be continuous from the bottom to the top elevation of the shaft.

The elapsed time from the beginning of concrete placement in the shaft to the completion of placement shall not exceed 2 hours except as allowed by the Engineer. The Engineer may allow the concrete placement time to exceed 2 hours if the Contractor adequately demonstrates that the slump of the concrete will not be less than 4 inches {100 mm} during the entire time of concrete placement.

2. SLUMP LOSS/TIME RELATIONSHIP.

a. General.

The Contractor may choose either a laboratory test or a field test to demonstrate the slump loss/time relationship. Adjustments to chemical admixture dosages will be allowed for the sole purpose of extending the time of concrete placement provided that the admixtures are included in the approved concrete mix design. A new slump loss test will be required if changes are made to the concrete mix, including adjustments to chemical admixtures.

b. Laboratory Test.

The Contractor shall demonstrate by trial mix and slump loss tests that the slump of the concrete will not be less than 4 inches {100 mm} during the longer placement time. These tests shall be conducted by an independent testing laboratory, approved by the Department as per ALDOT-405, and in the presence of a Department representative. The slump loss tests shall be performed at intervals not to exceed 30 minutes and shall be made from a trial mix proportioned from the approved concrete mix design. The temperature of the trial mix shall be kept at a level representative of construction site conditions.

c. Field Test.

The Contractor shall demonstrate by construction site slump loss tests that the slump of the concrete will not be less than 4 inches {100 mm} during the longer placement time. The slump loss tests shall be performed at intervals not to exceed 30 minutes and shall be made from the first batch of concrete that is placed in a trial drilled shaft. The concrete used for these slump loss tests shall be sampled at the trial drilled shaft site and shall be kept covered during testing. If a trial shaft is not required then a field test may be performed at the construction site prior to the beginning of the work. The slump test shall be performed by the contractor's Concrete Technician, certified by the Department as per ALDOT-405, in the presence of a Department representative.

(c) PLACEMENT THROUGH SLURRY AND/OR ENCASED EXCAVATIONS.

1. GENERAL.

The Contractor shall insure that a heavily contaminated slurry suspension, which could impair the free flow of concrete, has not accumulated in the bottom of the shaft.

2. REQUIRED SLURRY SAMPLING.

Prior to placing concrete in a slurry filled shaft excavation, the Contractor shall take slurry samples using a sampling tool. Slurry samples shall be extracted from the base of the shaft and at intervals not exceeding 10 feet {3 m} up the shaft, until two consecutive samples produce acceptable values for density, viscosity, pH, and sand content as noted in Subarticle 506.05(c) and Item 506.05(e)2, respectively.

3. UNACCEPTABLE SAMPLING RESULTS.

When any slurry samples are found to be unacceptable, the Contractor shall take whatever action is necessary to bring the mineral slurry within specification requirements. Concrete shall not be poured until resampling and testing results produce acceptable values.

4. REQUIRED CONCRETE LEVEL DURING PLACEMENT.

The level of fresh concrete placed into a casing shall be a minimum of 5 feet {1.5 m} above either the hydrostatic water level or the level of drilling fluid whichever is higher. As a temporary casing is withdrawn, care shall be exercised to maintain an adequate level of concrete within the casing so that fluid trapped behind the casing is displaced upward and discharged at the ground surface without contaminating or displacing the shaft concrete.

506.09 Concrete Placement Methods.

(a) GENERAL.

If a method of concrete placement has not been specifically identified in the contract documents, the Contractor may use any of the placement methods described hereafter. If a concrete pump is used to move the concrete to the drilled shaft, a standby pump shall be immediately available to pump the concrete if there is a pump failure. Details pertaining to compliance with this specification shall be presented as part of the Contractors "Installation Plan" as outlined in Item 506.03(a)2.

Concrete placement shall continue after the shaft excavation is full until good quality concrete is evident at the top of the shaft. Any overflow of concrete at the top of the shaft shall be removed to maintain a uniform appearance and the proper dimensions of the shaft.

(b) FREE FALL PLACEMENT.

1. GENERAL.

The free fall placement of concrete shall only be permitted in dry vertical shafts where the clear opening (inside the reinforcing cage) is not less than 24 inches {610 mm} in diameter. The height of free fall placement shall not exceed 75 feet {22 m}. Concrete placed by free fall shall fall directly to the placement location without contacting either the reinforcing cage or the shaft sidewall.

The Engineer will observe the falling of the concrete within the shaft. If the concrete strikes the reinforcing cage or sidewall, or if there is excessive spatter from the impact of the falling concrete, the Contractor shall reduce the rate of concrete placement, reduce the height of free fall or provide a drop chute for concrete placement as directed by the Engineer.

2. DROP CHUTE REQUIREMENTS.

a. General.

Drop chutes shall consist of a smooth tube of either one piece construction or sections which can be added and removed. Concrete may be placed through either a hopper at the top of the tube or side openings as the drop chute is retrieved during concrete placement.

b. Chute Support.

The drop chute shall be supported so that the free fall of the concrete measured from the bottom of the chute to the point of deposition is less than 75 feet {22 m}. If concrete placement causes the shaft excavation to cave or slough, or if the concrete strikes the rebar cage or sidewall, the Contractor shall reduce the height of free fall and/or reduce the rate of concrete flow into the excavation.

3. DISQUALIFICATION OF FREE FALL METHOD.

If in the opinion of the Engineer, placement cannot be satisfactorily accomplished by the free fall and drop chute method, the Contractor shall change to either tremie or pumping methods to accomplish the pour.

(c) TREMIE CONCRETE PLACEMENT.

Tremies may be used for concrete placement in either wet or dry holes.

1. TREMIE REQUIREMENTS.

a. General.

Tremies shall consist of a tube of sufficient length, weight {mass}, and diameter to discharge concrete at the shaft base elevation. The tremie shall not contain aluminum parts which will have contact with the concrete. The tremies inside diameter shall be at least 6 times the maximum size of aggregate used in the concrete mix but shall not be less than 10 inches {250 mm}.

b. Tremie Tube Wall.

Inside and outside surfaces of the tremie shall be clean and smooth to permit both flow of concrete and unimpeded withdrawal during concreting. The wall thickness of the tremie shall be adequate to prevent crimping or sharp bends which restrict concrete placement.

c. Concrete Placement.

The tremie used for wet concrete placement shall be watertight. Underwater placement shall not begin until the tremie is placed to the shaft base elevation. Valves, bottom plates or plugs may be used to insure concrete discharge begins within one tremie diameter of the base. Plugs shall either be removed from the excavation or be made of a material which will not cause a defect in the shaft if not removed. The discharge end of the tremie shall be constructed to permit the free radial flow of concrete during placement operations.

2. PLACEMENT REQUIREMENTS.

a. General.

The tremie discharge end shall be immersed at least 5 feet {1.5 m} in concrete at all times after starting the flow of concrete. The flow of the concrete shall be continuous. The concrete in the tremie shall be maintained at a positive pressure differential at all times to prevent water or slurry intrusion into the shaft concrete.

b. Defective Shafts.

If at any time during the concrete pour, the tremie line orifice is removed from the fluid concrete column and discharges concrete above the rising concrete level, the shaft shall be considered defective. In such case, the Contractor shall either:

- remove the reinforcing cage and concrete, complete any necessary sidewall removal directed by the Engineer, and repour the shaft or,

- the tremie shall be replugged, recharged with concrete and inserted a minimum of 5 feet {1.5 m} below the existing top level of concrete prior to continuing the pour. The contractor shall be responsible for correcting any defect caused by this procedure without additional compensation.

All costs for replacement of defective shaft concrete shall be the responsibility of the Contractor.

(d) PUMPED CONCRETE PLACEMENT.

Concrete pumps and lines may be used for concrete placement in either wet or dry excavations.

1. EQUIPMENT REQUIREMENTS.

Pump lines shall have a minimum diameter of 4 inches {100 mm} and shall be constructed with watertight joints. Except as modified herein, requirements pertaining to tremie lines

as stated in Item 506.09(c)1, also apply to pump lines and their use. The concrete pump unit shall have sufficient power to insure continuous placement of concrete under all foreseeable placement conditions.

2. PLACEMENT REQUIREMENTS.

a. Discharge Orifice Location and Pressure.

The discharge orifice shall remain at least 5 feet {1.5 m} below the surface of the fluid concrete. When lifting the pump line during concreting, the Contractor shall temporarily reduce the line pressure until the orifice has been repositioned at a higher level in the excavation.

b. Defective Shafts.

If at any time during the concrete pour the pump line orifice is removed from the fluid concrete column and discharges concrete above the rising concrete level, the shaft shall be considered defective. In such case, the Contractor shall remove the reinforcing cage and concrete, complete any necessary sidewall removal directed by the Engineer, and repour the shaft. All costs for replacement of defective shaft concrete shall be the responsibility of the Contractor.

506.10 Testing Requirements For Drilled Shafts.

(a) CROSSHOLE SONIC LOGGING OF DRILLED SHAFTS.

1. GENERAL REQUIREMENTS.

The nondestructive testing method called Crosshole Sonic Logging (CSL) shall be used on all production and trial drilled shafts (a) when constructed with the placement of concrete underwater or through slurry, (b) when required by special note on the plans, (c) when a full length temporary casing is used to prevent water from entering the shaft, or (d) when determined to be necessary by the Engineer. The testing shall not be conducted until forty-eight hours after the placement of all concrete in a shaft and must be completed within 20 calendar days after placement.

The CSL tests shall be conducted by an experienced independent testing consultant approved by the Engineer prior to testing.

The CSL tests measure the time it takes for an ultrasonic pulse to travel from a signal source in one access tube to a receiver in another access tube. In uniform, good quality concrete, the travel time between equi-distant tubes will be relatively constant and correspond to a reasonable concrete pulse velocity from the bottom to the top of the foundation. In uniform, good quality concrete, the CSL test will also produce records with good signal amplitude and energy. Longer travel times and lower amplitude/energy signals indicate the presence of irregularities such as poor quality concrete, void, honeycomb and soil intrusions. The signal will be completely lost by the receiver and CSL recording system for the more severe defects such as voids and soil intrusions.

2. PREPARATION FOR TESTING.

A number of tubes shall be installed in each shaft to permit access for CSL. The number of tubes installed will depend on the diameter of the shaft as specified below:

Shaft Diameter D	Minimum Number of Tubes
D ≤ 4.5 feet {1372 mm}	4
4.5 feet {1372 mm} < D ≤ 5.5 feet {1676 mm}	5
5.5 feet {1676 mm} < D ≤ 6.5 feet {1981 mm}	6
6.5 feet {1981 mm} < D ≤ 7.5 feet {2286 mm}	7
7.5 feet {2286 mm} < D ≤ 8.5 feet {2591 mm}	8
8.5 feet {2591 mm} < D ≤ 9.0 feet {2743 mm}	9
9.0 feet {2743 mm} < D ≤ 10.0 feet {3048 mm}	10
10.0 feet {3048 mm} < D ≤ 11.0 feet {3353 mm}	11
11.0 feet {3353 mm} < D ≤ 12.0 feet {3658 mm}	12

The tubes shall be 1.5 inch to 2.0 inch {40 mm to 50 mm} inside diameter schedule 40 steel pipe. The pipes shall have a round, regular internal diameter free of defects or obstructions, including any at pipe joints, in order to permit the free, unobstructed passage of a 1.3 inch {30 mm} diameter source and receiver probes. The tubes shall be watertight and free from corrosion with clean internal and external faces to ensure passage of the probes and a good bond between the concrete and the tubes.

The pipes shall each be fitted with a water tight shoe on the bottom and a removable cap on the top. The pipes shall be securely attached to the interior of the reinforcement cage with a minimum cover of 4 inches {100 mm}. The Engineer may allow the tubes to be installed on the outside

of the cage if adequate cover and clearance are available. The tubes shall be installed in each shaft in a regular, symmetric pattern such that each tube is equally spaced from the others around the perimeter of the cage. The Contractor shall submit to the testing organization his selection of tube size, along with his proposed method to install the tubes, prior to construction. The tubes shall be as near to parallel as possible. The tubes shall extend from 6 inches {150 mm} above the shaft bottoms to at least 3 feet {1 m} above the shaft tops. If the shaft top is sub-surface, the tubes shall extend at least 2 feet {600 mm} above the ground surface. Any joints required to achieve full length tubes shall be made watertight. Care shall be taken during reinforcement installation operations in the drilled shaft hole so as not to damage the tubes. As the cage is being lowered into the shaft, the tubes shall be checked to assure that they are vertical and parallel and that all connections are water tight. After placement of the reinforcement cage, the tubes shall be filled with clean water as soon as possible. After the tubes are filled with water, the tube tops shall be capped or sealed to keep debris out of the tubes prior to concrete placement.

The pipe caps or plugs shall not be removed until the concrete in the shaft has set. Care shall be exercised in the removal of caps or plugs from the pipes after installation so as not to apply excess torque, hammering, or other stresses which could break the bond between the tubes and the concrete.

3. TYPICAL CSL TEST EQUIPMENT.

Typical CSL test equipment consists of the following components:

- A microprocessor based CSL system for display of individual CSL records, analog-digital conversion and recording of CSL data, analysis of receiver responses and printing of CSL logs.
- Ultrasonic source and receiver probes for 1.5 or 2 inch {40 or 50 mm} ID pipe, as appropriate.
- An ultrasonic voltage pulser to excite the source with a synchronized triggering system to start the recording system.
- A depth measurement device to determine and record depths.
- Appropriate filter/amplification and cable systems for CSL testing.

4. CSL LOGGING PROCEDURES.

Before the placement of concrete, a minimum of one tube per shaft shall be plumbed and the tube length recorded, including a notation of the stickup of the tubes above the shaft tops. Information on the shaft bottom and top elevations and/or length, along with construction dates shall be provided to the Engineer and the approved testing organization before the CSL tests are performed. CSL tests shall be conducted between pairs of tubes. The approved testing organization shall test two principle diagonals through the center and between each tube pair around the perimeter of all tested shafts. Additional logs shall be conducted at no additional cost in the event anomalies are detected.

The CSL tests shall be carried out with the source and receiver probes in the same horizontal plane unless test results indicate potential defects in which case the questionable zone may be further evaluated with angled tests (source and receiver vertically offset in the tubes). CSL measurements shall be made at depth intervals of 0.2 feet {60 mm} or less, and shall be done from the bottom of the tubes to the top of each shaft. The probes shall be pulled simultaneously, starting from the bottoms of the tubes, over a depth measuring device. Any slack shall be removed from the cables prior to pulling to provide for accurate depth measurements of the CSL records. Any defects indicated by longer pulse arrival times and significantly lower amplitude/energy signals shall be reported to the Engineer and further tests shall be conducted as required to evaluate the extent of such defects. Additional NDT methods which may be used to evaluate possible defects include Singlehole Sonic Logging, Gamma-Gamma Nuclear Density Logging, and/or Surface Sonic Echo and Impulse Response tests.

5. CSL TESTING RESULTS.

The CSL results shall be presented to the Engineer in a report. This report shall include recommendations as to the acceptability, unacceptability, soundness, etc., of the drilled shaft. The report shall be checked, stamped approved, and signed by a Professional Engineer registered by the Alabama Board of Licensure for Professional Engineers. This Professional Engineer shall not be an employee of the ALDOT. The report shall be submitted directly to the Materials and Tests Engineer with a copy to the Project Engineer. The test results shall include CSL logs with analyses of:

- Initial pulse arrival time versus depth
- Pulse energy/amplitude versus depth

A CSL log shall be presented for each tube pair tested with any defect zones indicated on the logs and discussed in the test report as appropriate.

6. EVALUATION OF CSL TEST RESULTS.

The Engineer will evaluate the CSL test results and determine whether or not the drilled shaft construction is acceptable. This evaluation will be completed within 14 calendar days of the date of receipt of the report by the Materials & Tests Engineer.

If the Engineer determines that the drilled shaft is acceptable, the CSL tubes shall be dewatered and grouted. The grout shall be of the same strength or higher than the strength of the concrete used in the original drilled shaft. The contractor may use any of the grout mixes listed in Table 1 of Item 453.03(b)2. with the exception that calcium chloride will not be allowed. The contractor may submit another design mix for approval.

If the Engineer determines that the drilled shaft is unacceptable, the shaft shall be cored in accordance with the requirements given in Subarticle 506.10(b) to allow further evaluation of the shaft. Cores shall be taken without additional compensation unless the testing of the cores indicates that the concrete in the shaft meets all specification requirements. If the testing of the cores indicates that the concrete meets specification requirements, the cost of the coring will be paid for as Extra Work.

(b) CORE DRILLING OF DRILLED SHAFT CONCRETE.

Production or trial drilled shafts that are determined to be unacceptable by the CSL tests may be cored to determine the quality of the shaft. The required number and depth of cores will be determined by the Engineer.

Because it is necessary to obtain a high percentage of core recovery for visual inspection and compressive strength testing, the core bit used for core drilling shall be warranted by the manufacturer as being capable of coring the concrete as strong as could possibly be present in the shaft. A new bit or new core barrel will be required at any time the Engineer determines that the equipment may not be capable of obtaining good quality cores. The minimum diameter of the cores shall be 3.0 inches {76 mm}.

An accurate log of cores shall be kept and the cores shall be placed in a crate and properly marked showing the shaft depth at each interval of core recovery. The cores along with three copies of the coring log shall be transported to the ALDOT Bureau of Materials and Tests, Montgomery, Alabama, for inspection.

Construction shall not proceed above a drilled shaft until the quality of the shaft, as represented by the core samples, is determined to be acceptable and notification to continue construction is given by the ALDOT Construction Engineer.

If the Engineer determines that the drilled shaft is acceptable, the core holes and the CSL tubes shall be dewatered and grouted. The grout shall be of the same strength or higher than the strength of the concrete used in the original drilled shaft. The contractor may use any of the grout mixes listed in Table 1 of Item 453.03(b)2. with the exception that calcium chloride will not be allowed. The contractor may submit another grout design mix for approval.

If the quality of the drilled shaft is determined to be unacceptable then the Contractor shall construct another foundation to carry the load that will be placed on the shaft or perform corrective work as required by the Department. This foundation or the corrective work shall be constructed without compensation from the Department. The details of the replacement foundation shall be submitted in accordance with the requirements given in Article 105.02 for Working Drawings.

506.11 Drilled Shaft Construction Tolerances.

The following construction tolerances apply to drilled shafts unless otherwise stated in the contract documents. Drilled shaft excavations and completed shafts not constructed within the required tolerances are unacceptable. The Contractor shall correct all unacceptable shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and work necessary to complete corrections for out of tolerance drilled shaft excavations and/or completed shafts, including engineering analysis and redesign, shall be furnished without either cost to the State or an extension of the contract time of the project.

(a) GENERAL LOCATION.

The drilled shaft shall be within 3 inches {75 mm} of plan position in the horizontal plane at the elevation of the top of the shaft.

(b) VERTICAL ALIGNMENT.

The vertical alignment of a shaft excavation shall not vary from the plan alignment by more than 1/4 inch per foot {20 mm/m} of depth. The alignment of a battered shaft excavation shall not vary by more than 1/2 inch per foot {40 mm/m} of depth from the prescribed batter.

(c) REINFORCING STEEL CAGE.

The spacers for the reinforcing cage shall have a tolerance of minus 1 inch {25 mm} from the required spacing shown on the plans.

The reinforcing steel cage shall be within 1 inch {25 mm} of plan position in the horizontal plane at the elevation of the top of the shaft.

After all the concrete is placed, the top of the reinforcing steel cage shall be no more than 6 inches {150 mm} above and no more than 3 inches {75 mm} below plan position.

(d) CASINGS.

All casing diameters shown on the plans refer to OD (outside diameter) dimensions. Casing shall be clean, round, straight and free of weld breaks and/or holes that would permit passage of water or wet concrete. When approved by the Engineer, the Contractor may elect to provide a casing larger in diameter than shown in the plans. No payment will be made for additional construction materials used in accommodating the Contractor's request for a larger casing diameter.

(e) SHAFT SOCKET.

The diameter of an excavated socket shall have a tolerance of minus 2 inches {50 mm} from the plan diameter.

(f) TOP ELEVATION OF SHAFTS.

The top elevation of the shaft shall have a tolerance of plus 1 inch {25 mm} or minus 3 inches {75 mm} from the plan top of shaft elevation.

(g) EXCAVATION EQUIPMENT AND METHODS.

Excavation equipment and methods shall be designed so that the completed shaft excavation will have a planar bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of +/- 3 % of the diameter.

506.12 Method of Measurement.

(a) DRILLED SHAFT EXCAVATION.

Drilled shaft excavation will be measured by the linear foot {meter} of excavated shaft.

(b) SPECIAL DRILLED SHAFT EXCAVATION.

Special drilled shaft excavation will be measured by the linear foot {meter} of excavated shaft.

(c) DRILLED SHAFT CONSTRUCTION.

Drilled shaft construction will be measured by the linear foot {meter} of shaft.

(d) EXPLORATION BELOW DRILLED SHAFT.

The exploratory drilling below the bottom of a drilled shaft will be measured by the linear foot {meter} of core hole.

(e) PERMANENT DRILLED SHAFT CASING.

Permanent drilled shaft casings will be measured by the linear foot {meter} of casing left in place.

(f) CROSSHOLE SONIC LOGGING (CSL).

Testing by the CSL method will be measured per each shaft tested.

506.13 Basis of Payment.

(a) DRILLED SHAFT EXCAVATION.

The linear foot {per meter} bid price shall be full compensation for all labor, materials and equipment required to complete and support the excavation. This shall also be full compensation for the utilization of slurry and temporary casings, for the disposal of all surplus excavated materials and for incidentals necessary to complete the work. No additional payment will be made for larger diameter or deeper excavations that are made by the choice of the Contractor.

(b) SPECIAL DRILLED SHAFT EXCAVATION.

The linear foot {per meter} bid price shall be full compensation for all labor, materials and special equipment required to complete and support the excavation. This shall also be full compensation for the removal of obstructions, the utilization of slurry and temporary casings, for the disposal of all surplus excavated materials and for incidentals necessary to complete the work. No additional payment will be made for larger diameter or deeper excavations that are made by the choice of the Contractor.

(c) DRILLED SHAFT CONSTRUCTION.

The linear foot {per meter} bid price shall be full compensation for all labor, materials, equipment and incidentals required for the construction of a shaft except for reinforcing steel which will be paid for under Item 502-A. No additional compensation will be made for larger diameter or deeper shafts that are constructed by the choice of the Contractor.

(d) EXPLORATION BELOW DRILLED SHAFT.

The linear foot {per meter} bid price shall be full compensation for all labor, materials, equipment and incidentals required for coring and sample retrieval.

(e) TRIAL DRILLED SHAFT.

Payment for a trial drilled shaft will be made under the appropriate production drilled shaft items of 506-A, B, C, F or G as they may apply. No separate payment will be made for cutting off the trial shaft or site restoration.

(f) PERMANENT DRILLED SHAFT CASING.

The linear foot {per meter} bid price shall be full compensation for all labor, materials, equipment and incidentals required for furnishing, painting and installing the casing. No payment will be made for cutoffs.

If there is no pay item in the contract for permanent casing then the casing will be paid for as extra work as outlined in Article 104.03, Extra Work.

(g) CROSSHOLE SONIC LOGGING.

The price bid for each shaft tested shall be full compensation for all labor, materials, equipment and incidentals necessary to perform the required test and furnish the Engineer with the test results. The bid price shall also include dewatering the tubes and filling the tubes with grout.

Where a drilled shaft consists of different shaft diameters, the price bid shall be full compensation for the sonic logging of the complete depth of the drilled shaft, regardless of differences in the diameter of the shaft. The shaft diameter shown in the pay item for sonic logging is for identification purposes and will be the smallest diameter portion of a drilled shaft.

(h) PAYMENT WILL BE MADE UNDER ITEM NO.:

506-A Drilled Shaft Excavation, ___*__ Diameter - per linear foot {meter}
506-B Special Drilled Shaft Excavation, ___*__ Diameter - per linear foot {meter}
506-C Drilled Shaft Construction, ___*__ Diameter, Class ___**__ Concrete - per linear foot {meter}
506-D Exploration Below Drilled Shaft - per linear foot {meter}
506-F Permanent Drilled Shaft Casing, ___*__ Diameter – per linear foot {meter}
506-G Crosshole Sonic Logging, ___*__ Diameter - per each

* Specify diameter of shaft in feet and inches {millimeters}.
** Specify either "DS1", "DS2" or "DS3".

SECTION 507
ABUTMENT AND BULKHEAD ANCHORS

507.01 Description.

This Section shall cover the work of furnishing and installing complete abutment and/or bulkhead anchor assemblies for precast concrete bridges, timber bridges, and/or timber, metal, or concrete bulkheads, all in accordance with the details shown on the plans and at the locations shown on the plans or directed. Special reference is made to Section 510, Bridges.

507.02 Materials.

All materials shall comply with the appropriate requirements of Division 800, Materials, and the following:

Unless otherwise noted or provided by plan details, all miscellaneous hardware (turnbolts, clamps, bolts, etc.) shall be new galvanized metal, galvanized in accordance with AASHTO M 232.

Wire rope (cable) for rope anchor assemblies shall be of 3/4 inch {19 mm} nominal diameter. Wires shall meet the requirements of ASTM Designation A 475 "Siemens Martin" grade having a Class A galvanization coating or an approved equal.

Galvanizing of materials completely encased in concrete will not be required.

Precast-Prestressed members of anchor assemblies shall comply with the appropriate requirements for precasting and prestressing concrete as noted in Sections 501 and 834.

507.03 Construction Requirements.

All anchor assemblies shall be erected in accordance with the details shown on the plans or directed.

Fabrication of integral parts of an anchor assembly shall be in accordance with the requirements of other appropriate sections of the Specification for the type material involved with specific reference made to Sections 833, 834, 835, and 836.

507.04 Method of Measurement.

An anchor assembly for an abutment shall consist of the number of sets of tieback cables or arms designated on the plans to connect an abutment to the anchors and includes the connecting system of fastening the cables or arms to the anchors and the abutment. Only one assembly will be measured for each abutment regardless of the number of anchors attached to the abutment.

An anchor assembly for a bulkhead shall consist of the number of sets of tieback cables or arms designated on the plans to connect a section of a bulkhead to one anchor and includes the connecting system of fastening the cables or arms to the anchor and bulkhead. A separate assembly will be measured for each anchor attached to a bulkhead.

The anchors will be measured and paid for under the appropriate item of piling designated for use as the anchors.

The abutment or bulkhead will be measured and paid for under the appropriate item(s) of which the abutments or bulkheads are constructed.

507.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Accepted anchor assemblies, measured as noted above, will be paid for at the contract unit price per each which shall be full compensation for furnishing all materials along with the installation of the anchor assemblies, complete in place, attached to the anchor(s) and the abutment or bulkhead, and includes all incidental excavation, backfill, and compaction thereof, miscellaneous hardware, etc., and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

507-A Wire Rope Abutment/Bulkhead Anchor Assembly - per each

507-B Prestressed Concrete Abutment/Bulkhead Anchor Assembly - per each

SECTION 508
STRUCTURAL STEEL AND MISCELLANEOUS METALS

508.01 Description.

The work under this Section shall cover the furnishing, fabricating, erecting, and painting (both shop and field) all structural steel and metal work. All work shall be in conformity with the dimensions, shapes and designs shown on the plans. Erected materials shall conform to lines and grades shown on the plans.

Structural metals covered in this Section shall include structural steel shapes (except piling) and plates, bolts, and other types of fasteners, welding, special and alloy steels, steel forgings and castings, and all types of metal casting as well as any incidental metal construction not covered in other Sections.

Welding of structural steel and other metals shall conform to the requirements of Article 836.46 and any modification thereto provided in the contract.

Applicable requirements of Sections 510 and 521 shall also apply to this Section.

508.02 Materials.

(a) General.

All materials shall conform to the provisions of Division 800, Materials, specific reference is made to the following:

Section 836 - Structural Steel, Fasteners and Miscellaneous Metals.

Section 855 - Coatings, Paints, Enamels, and Varnishes For Metal and Wood Structures.

(b) Except where otherwise provided, all members shall be of structural carbon steel.

(c) Pipe or tubing for railing shall be as specified on the plans.

(d) Forgings shall be of carbon steel and shall be annealed before machine finishing.

(e) Castings shall be made of the type metal specified by the plans, but in general, cast iron shall be used only for unimportant parts.

(f) High strength steel fasteners shall conform to the requirements of Article 836.33. High strength steel lock-pin and collar fasteners will not be permitted unless noted in the plan details.

(g) Materials for bridge deck drainage systems shall conform to the requirements shown on the plans. Galvanizing, if required, shall conform to ASTM A 120 for pipe, AASHTO M 111 for forgings, shapes, etc., AASHTO M 232 Class 50 for miscellaneous hardware and anchor bolt assemblies (anchor bolts, nuts, and washers), and AASHTO M 298 Class 50 for bolt assemblies (bolts, nuts, and washers).

508.03 Construction Requirements.

(a) GENERAL.

Attention is directed to the requirements of Sections 105 and 836 concerning approval of "drawings", "mill orders and shipment statements," and "notice and facilities for inspection" before fabrication of structure members.

All exposed structural steel surfaces, including piling, not in contact with concrete shall, unless otherwise noted by the plans or proposal, be painted in accordance with the provisions of Section 521 utilizing green bridge paint for the top coat (or other color as specified by plans). The painting of the steel and the cost thereof is considered incidental to the furnishing of the structural steel.

When a structure utilizing AASHTO M 270 Grade 50W (weathering) steel is designated to be unpainted, the steel shall be cleaned after fabrication (includes drilling and reaming) in accordance with the provisions of Steel Structures Painting Council specification SSPC-SP-6.

All foreign material which adheres to the steel after fabrication, including tight mill scale, shall be removed without additional compensation. Tight mill scale on the top of the top flanges of girders and beams may remain except in the locations where studs are to be attached. The surface of the steel shall be cleaned to bare metal just prior to attaching studs.

All temporary markings shall be removed before the final acceptance of the structural steel.

(b) SHOP FABRICATION.

Reference is made to the requirements of Section 836 for such work.

Within 30 days after the award of the contract, the Contractor shall notify the State Bridge Engineer in writing of the name and address of the fabricator of the structural steel. The review of shop drawings, and the time allowed for the review given in Section 105, will not begin until this written notification has been received by the Bridge Engineer. The notification shall include the fabricator's proposed fabrication schedule. Evidence of the fabricator's qualifications and experience shall be furnished if requested by the ALDOT Bridge Engineer.

No material shall be fabricated before the Department has been notified where the fabrication order has been placed. The Fabricator is responsible for notifying the Bridge Engineer of any fabrication work to be done outside of their facility, the name and address of the outside fabricator, and the proposed fabrication schedule.

Shops fabricating main structural steel members (as defined by Subarticle 836.01(b)) and/or items paid for under Pay Item 508-B (with the exception of navigational light brackets and inspection catwalks, platforms and ladders) shall be certified by the American Institute of Steel Construction for Major Steel Bridges (MBr) for all steel bridges. For fracture critical work, shops shall be certified for Major Steel Bridges (MBr) with the fracture critical endorsement.

(c) STORAGE.

All material shall be stored in such manner as to prevent corrosion or loss of minor parts. It shall be placed on skids or dunnage above the ground. It shall be kept clean and properly drained.

Girders and beams shall be placed upright and shored (no welding). Long members, such as columns and chords, shall be supported on skids placed near enough together to prevent injury from deflection. All storage and storage sites are subject to the approval of the Engineer. Reference is made to Articles 109.07 and 836.17.

(d) ERECTION.

1. WORKING DRAWINGS.

Working drawings outlining a procedure and the equipment to be used for erection of all continuous span steel units, trusses, and other metal work requiring field splices shall be submitted for distribution in accordance with Article 105.02. If falsework is to be used as part of the erection procedure, these plans, etc. shall be submitted along with the erection procedure.

2. BEARINGS AND ANCHORAGE.

a. Bridge bearings shall be set level in exact position and shall have a full and even bearing on the masonry and shall not be placed on masonry bearing areas which are irregular or improperly formed.

b. Where rocker bearings are used, filler or fabric materials, meeting the following, shall be placed as bedding material under masonry plates.

Such material shall be of the type specified or as ordered or approved by the Engineer and shall be installed to provide full bearing on contact areas.

Immediately before placing the bedding material and installing bearings or masonry plates, the contact surfaces of the concrete and steel shall be thoroughly cleaned.

Preformed fabric pads used as bedding shall be composed of multiple layers of 8 ounce per square yard {271 g/m^2} cotton duck impregnated and bonded with high quality natural rubber or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The thickness of the preformed fabric pads shall be 3/16 inch ± 1/16 inch {5 mm ± 2 mm}. Cotton duck shall meet the requirements of Military Specification MIL-C882-D for 8 ounce per square yard {271 g/m^2} cotton army duck or equivalent. The number of plies shall be such as to produce the specified thickness, after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 psi {69 MPa} without detrimental reduction in thickness or extrusion.

Sheet lead used as bedding shall be common desilverized lead conforming to ASTM B 29. The sheets shall be of uniform thickness and shall be free from cracks, seams, slivers, scale, and other defects. Unless otherwise specified, lead sheets shall be 1/8 inch {3 mm} in thickness with a permissible tolerance of 0.03 inch {0.75 mm} plus or minus.

c. Rocker bearings shall be adjusted so that they will be in vertical position at an ambient temperature of 70 ° F {20 °C}.

d. Masonry plates for self-lubricating bronze bearing plates or PTFE coated bearing plates shall be set 1/2 inch {13 mm} (minimum) into the cap in Portland cement mortar not more than 3/4 inch {19 mm} thick and the depression filled with mortar so that no water will be trapped. No superstructure or other load shall be placed thereon until this mortar has been allowed to set for at least 96 hours in a well moistened condition throughout this period. Prior to erecting girders, the top plate shall be rotated to fit the grade of the girder and the bearing plate shall be adjusted for temperature so that it will be centered on the masonry plate at 70 °F {20 °C}.

e. All holes for anchor bolts shall be formed (as shown on bridge plans) in the concrete in correct locations, perpendicular to the plane of the bridge seat, so that the anchor bolts will be in the center of the hole at 70 °F {20 °C}. The reinforcing steel in the concrete shall be adjusted prior to pouring so it will not interfere with the forming of the hole. The holes shall be large enough to provide for any necessary adjustment in the superstructure unit. All holes shall be plugged during cold weather to prevent water from freezing therein. On short spans the Engineer may permit the anchor bolts to be cast in to the concrete provided satisfactory templates are used, if anchor bolt wells are not required on the plans.

f. Anchor bolts shall not be grouted until after the superstructure unit has been erected and adjusted. Also, the holes for the bolts shall be thoroughly cleaned and moistened with water just prior to grouting. In setting, the holes shall be filled about 75% full with Portland cement grout (1:1 mix) of suitable consistency. The anchor bolts shall then be gently tapped or pushed into the grout until the hole is filled with grout and the anchor nut and washer are in contact with the shoe. The anchor bolts shall again be tapped or vibrated lightly after initial shrinkage of the grout (approximately 30 minutes after mixing). No further jarring of the bolts shall be permitted until after a

48 hour setting period. Nuts at expansion bearings shall be left loose enough to permit free movement of the span.

3. HANDLING MEMBERS.

All members shall be carefully handled to prevent damage to them and in a manner that any camber put into them will not be changed. One pick-up point will be permitted on pieces 50 feet {15 m} or less in length. Two pick-up points, located at or between the 1/4 and 1/3 points, will be required on pieces over 50 feet {15 m} in length. Calculations showing that the pieces will not be damaged, along with erection plans, will be required when pick-up points are requested to be located outside of these areas. This data shall be submitted in accordance with Subarticle 105.02(d). Reference is made to Article 836.17.

4. ERECTION ASSEMBLY.

The parts shall be accurately assembled as shown on the plans and any match marks shall be strictly followed. Splices and field connections shall have at least 50% of the holes filled using bolts (either erection or untorqued permanent bolts) and an adequate number (Minimum 10%) of forged barrel or drift type erection pins for fit up and alignment. The diameter of the erection pins shall be 1/32 inch {1 mm} larger than the diameter of the bolts. Splices and connections carrying traffic during erection shall have 75% of the holes so filled. Erection bolts shall be tightened to snug tight condition. Snug tight is defined as the tightness that exists when the plies of the joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a person using an ordinary spud wrench. Before beginning high strength bolting, the structure shall be adjusted to correct grade and alignment.

Bolts and nuts for bolted beam and girder splices shall be placed so that (1) flange splices have nuts on the exterior face of the splice, (2) web splices have bolt heads on the outside face of exterior beams or girders.

Filler plates for bolted beam and girder splices have been based on theoretical dimensions, the thickness of the plates shall be adjusted in the shop to take care of any difference greater than 1/16 inch {1.6 mm} between the theoretical and actual dimensions. Splices in members of the same theoretical size will require filler plates if the actual dimensions vary more than 1/16 inch {1.6 mm}.

5. DEFECTIVE OR DAMAGED MATERIAL.

Any material that is damaged, distorted or in any way defective and is considered to be repairable shall be corrected by means approved by the Central Office. The Contractor shall submit a detailed proposed procedure for approval prior to making any corrections. Minor misfits involving occasional reaming of a hole will not require Central Office approval. Wholesale reaming of holes will require Central Office approval.

6. HIGH STRENGTH BOLTING.

a. General.

High tensile strength heavy hex bolts shall be used for all field fasteners unless otherwise noted on the plans or in the proposal. The bolts, nuts, washers and direct tension indicators shall conform to the requirements of Article 836.33. All requirements for testing of materials and for calibration of equipment shall be met prior to installation.

b. Bolted Parts.

Surfaces of bolted parts in contact with the bolt head and nut shall not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material.

When assembled, all joint surfaces, including those adjacent to the washers, shall be free of scale. They shall be free of dirt, loose scale, burrs, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing unless noted otherwise on the plans or in the proposal.

c. Bolt Assemblies.

The Contractor shall take special care in storing the bolt assemblies (bolts, nuts, washers and direct tension indicators) to prevent them from rusting. Any components of the bolt assemblies that are rusted shall be thoroughly cleaned or replaced prior to installation. Bolts that have been cleaned shall be lubricated in the field prior to installation. Plain (ungalvanized) bolts shall be "oily" to the touch when installed.

Galvanized nuts shall be lubricated with a lubricant (Beeswax or equivalent) containing a visible dye so that a visual check can be made for proper lubrication prior to installation. Special care shall be taken in storing galvanized bolts with water soluble lubricants.

d. Installation.

Galvanized nuts shall be checked to verify that a visible lubricant is on the threads.

High strength fasteners, plain and galvanized, shall be subjected to jobsite rotational-capacity tests performed in accordance with Item 836.33(c)4. prior to the start of any bolt installation. Washers are required as part of the test. A Skidmore-Wilhelm Gage or equivalent, a standard torque wrench, a suitable steel joint (to conduct test on short bolts if needed) and any other miscellaneous tools or materials required for this test shall be provided by the Contractor. This test shall be performed by the Contractor and witnessed by the Engineer.

Prior to beginning the tensioning operation each day, a minimum of one rotational-capacity test shall be performed to verify that the bolt assemblies are still properly lubricated. The bolt assembly to be tested will be determined by the Engineer and may come from any that are in question, including erection bolts which have been placed, but not tensioned. If this test fails, any assemblies which have been subjected to similar conditions as the failing sample shall be either cleaned and lubricated or replaced prior to tensioning. Additional rotational-capacity tests may be required at the discretion of the Engineer.

Bolts shall be installed with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. If the markings on the nuts are raised then the nuts shall be installed with the markings to the outside. A flat washer may be used when the abutting surface adjacent to the bolt head or nut does not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for lack of parallelism.

Before tightening the bolts to the required minimum tension, all bolts shall first be tightened to snug tight condition, progressing from the most rigid part of the joint towards the free edges. See Item 508.03(d)4. for a definition of snug tight condition. At snug tight, all joining pieces shall be in firm contact. All bolts shall then be tightened to give the minimum tension values shown in Table 1. Tightening shall be done by either the Calibrated Wrench Method, Turn-Of-Nut Method or Direct Tension Indicator Method. The element not being turned (bolt or nut) shall be held with a wrench during tightening to prevent rotation of the fixed element.

TABLE 1	
NOMINAL BOLT DIAMETER & THREAD PITCH	REQUIRED MINIMUM BOLT TENSION
AASHTO M 164 high strength bolts only.	
1/2 inch	12,050 pounds
5/8 inch	19,200 pounds
3/4 inch	28,400 pounds
7/8 inch	39,250 pounds
1 inch	51,500 pounds
1 – 1/8 inches	56,450 pounds
1 - 1/4 inches	71,700 pounds
1 - 3/8 inches	85,450 pounds
1 - 1/2 inches	104,000 pounds
AASHTO M 164M high strength bolts only.	
M16 x 2	91.0 kN
M20 x 2.5	142.1 kN
M22 x 2.5	175.7 kN
M24 x 3	205.1 kN
M27 x 3	266.7 kN
M30 x 3.5	327.2 kN
M36 x 4	474.6 kN

e. Calibrated Wrench Method.

The Contractor shall furnish all wrenches necessary to install the high strength bolts. He shall also furnish a calibration device (Skidmore-Wilhelm Calibrator or equivalent) and use it to calibrate the wrenches used for bolt installation and inspection. The calibration device shall be calibrated by the State Testing Laboratory or other approved laboratory prior to being used. The calibration results will be valid for a period of six (6) months after the date of calibration under normal conditions. The Engineer may require that the calibration device be recalibrated at any time.

Wrenches shall be calibrated on the project at least once daily and for each lot of nuts and bolts to be used. Calibration shall be accomplished by the tightening in the calibration device of not less than 3 typical bolts of each lot to be installed. Power wrenches shall be adjusted to stall or cutout at a tension slightly greater than the minimum required. If manual torque wrenches are used, the torque indication corresponding to the calibration tension shall be noted and used in the installation of all bolts of the tested lot. Nuts shall be in tightening motion when torque is measured. When using calibrated wrenches to install several bolts in a single joint the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the prescribed amount. Impact wrenches shall be of adequate capacity and sufficiently supplied with air to perform the required tightening in approximately 10 seconds.

The Contractor shall spot check the completed bolt assembly installations at the direction and under the supervision of the Engineer. The spot checking shall be done to insure that the minimum bolt tension has been achieved in all of the bolts in the completed connection. The spot checks shall be made with a manual torque wrench that has been furnished by the Contractor and calibrated as noted herein to measure the minimum required bolt tension.

f. Turn-Of-Nut Method.

All bolts shall first be brought to snug tight condition as described in Item 508.03(d)4. The element being turned (bolt or nut) shall then be turned an additional fraction of a turn as specified in Table 2. Where the exterior faces of the members to be joined are sloped from normal to the bolt axis up to a 1:20 slope and beveled washers are not specified, a minimum 3/4 turn from snug tight is required for all bolts.

The Contractor shall furnish a calibration device (Skidmore-Wilhelm Calibrator or equivalent) and manual torque wrench. This equipment shall be calibrated and used to spot check the completed bolt assemblies as required under the Calibrated Wrench Method.

TABLE 2

NUT ROTATION FROM THE SNUG-TIGHT CONDITION [a, b]
GEOMETRY OF OUTER FACES OF BOLTED PARTS

Bolt length measured from underside of head to end of bolt.	Both faces normal to bolt axis.	One face normal to bolt axis and other face sloped not more than 1:20. Beveled washer not used.	Both faces sloped not more than 1:20 from normal to bolt axis. Beveled washers not used.
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters [c]	2/3 turn	5/6 turn	1 turn

[a] Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance should be plus or minus 30 degrees; for bolts installed by 2/3 turn and more, the tolerance should be plus or minus 45 degrees.

[b] Applicable only to connections in which all material within grip of the bolt is steel.

[c] No research work has been performed by the Research Council Riveted and Bolted Structural Joints to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters. Therefore, the required rotation must be determined by actual tests in a suitable tension device simulating the actual conditions.

g. Direct Tension Indicator Method.

The Contractor shall furnish direct tension indicator washers (also called load indicator washers) to be installed as a part of the final bolt assembly. He shall also furnish the gap measuring devices (feeler gages) to be used for inspection purposes. The direct tension indicator washers, noted herein as DTI washers, shall be installed by one of the following methods, however, they shall not in any case be installed in a position where the extrusions or cleats are in contact with the pieces being joined:

Plain Finished Bolts:

The nut is the turned element, the hardened washers are placed adjacent to the nuts, and the extrusions or cleats on the DTI washers are placed in contact with the bolt heads.

The nut is the turned element, the hardened washers are placed adjacent to the nuts, and the extrusions or cleats on the DTI washers are placed in contact with the hardened washers.

The bolt head is the turned element, the hardened washers are placed adjacent to the bolt heads, and the extrusions or cleats on the DTI washers are placed in contact with the hardened washers.

Galvanized Bolts:

The nut is the turned element, the hardened washers are placed adjacent to the nuts, and the extrusions or cleats on the DTI washers are placed in contact with the bolt heads.

All bolts shall first be brought to snug tight condition as described in Item 508.03(d)4. The bolts shall then be tightened to compress the extrusions on the DTI washers. The DTI washers shall be compressed to the point that the gap between the DTI washer (on the extrusion side of the washer) and the adjacent element is reduced to that shown in Table 3. The maximum allowable gap (minimum allowable bolt tension) is the condition where the feeler gage can be entered to the shank of the bolt in only one half of the number of places where inserted around the circumference of the washer. The minimum allowable gap is the condition where the feeler gage cannot be entered in one half or more of the applied places and the gap is not completely closed.

The Contractor shall furnish a calibration device (Skidmore-Wilhelm Calibrator or equivalent) to be used at the job site to determine the acceptability of the DTI washers. This calibration device shall be calibrated as noted under the Calibrated Wrench Method. Three bolt assemblies of each diameter, length and grade shall be checked at the job site in the calibration device. These bolt assemblies shall be installed in the calibration device in the same manner as the intended installation in the structure and shall be tightened with the same equipment intended for job use. A calibration test shall be conducted by tensioning a bolt assembly to the point that the maximum allowable gap is present between the DTI washer and the adjacent element. At this point the tension reading taken from the calibration device shall not be less than five percent greater than the tension required.

The Engineer will use the feeler gages to spot check the completed bolt assembly installations.

The Contractor shall furnish a manual torque wrench which shall be calibrated and used to spot check the completed bolt assemblies as required under the Calibrated Wrench and Turn-Of-Nut Methods.

TABLE 3	
DIRECT TENSION INDICATOR METHOD	
Uncoated Bolts w/DTI Under Turned Element	Maximum Allowable Gap = 0.005 in. {0.127 mm} Minimum Allowable Gap *
Uncoated Bolts w/DTI Under Unturned Element	Maximum Allowable Gap = 0.015 in. {0.381 mm} Minimum Allowable Gap *
Galvanized Bolts w/DTI Under Unturned Element	Maximum Allowable Gap = 0.005 in. {0.127 mm} Minimum Allowable Gap *
* See fourth paragraph of this Subitem (508.03(d)6.g.) above.	

h. Correction of Deficiencies.

All deficiencies found during calibration, installation and spot checking of the bolt assemblies shall be corrected by the Contractor.

i. Cleaning.

All exposed surfaces of bolt assemblies shall be cleaned prior to painting with a cleaning solvent such as mineral spirits or turpentine. This cleaning shall not damage the existing primer coats of paint.

8. BOLTED CONNECTIONS.

All bolts shall extend past the nuts approximately 1/4 inch {6 mm} after tightening. In bolted connections, other than high strength steel bolts, the bolts shall be drawn up tight and the threads burred at the face of the nut with a pointed tool.

9. WELDED SHEAR CONNECTOR STUDS.

Studs shall be field welded in accordance with the requirements given in Section 836.

10. PAINTING.

Painting shall conform to requirements of Section 521.

11. NAME PLATES.

No permanent plates or markers other than those shown on the plans or approved will be permitted on any structure. Any marks or signs painted on structural steel by the fabricators shall be obliterated prior to applying the first field coat by painting over the marks or signs with paint of the same type used for the shop coat.

(e) FIELD INSPECTION.

All work shall be subject to the inspection of the Engineer who shall be given all facilities required for all necessary inspection. Material and workmanship not previously inspected will be inspected after its delivery to the site of the work. Whether shop inspection is made or not, workmanship and materials which do not conform to the Specifications may be rejected at any time prior to acceptance of the project.

(f) CLEANING UP OF WORKSITE.

Upon completion and before final acceptance, the Contractor shall remove all falsework and other temporary construction, and shall leave the site in a condition acceptable to the Engineer.

508.04 Method of Measurement.

(a) ITEMS NO. 508-A, AND 508-D.

The theoretical poundage {mass} of accepted metal in the per pound {kilogram} price items, complete in place, will be computed in conformity with the following:

1. The weight {mass} of steel shall be assumed at 0.2833 pounds per cubic inch {7850 kg/m^3}. The weight {mass} of cast iron shall be assumed at 0.26 pounds per cubic inch {7200 kg/m^3}. The weight {mass} of bronze shall be assumed at 0.315 pounds per cubic inch {8150 kg/m^3}.

2. The weights {masses} of rolled shapes, and of plates up to and including 36 inches {1 meter} in width in the completed structure, shall be calculated on the basis of their theoretical weights {masses} and dimensions given in the handbooks of the mills rolling the various sections and shapes based on the approved shop drawings, deducting for copes, clips, cuts and open holes.

3. The weights {masses} of plates or slabs wider than 36 inches {1 m} shall be computed on the basis of their actual dimensions, as shown on the approved shop drawings, deducting for cuts and open holes. To the nominal theoretical weights {masses} shall be added one-half of the allowed percentage of overrun in weight {mass} given in the applicable tables of AASHTO M 160M.

4. No deduction will be made for holes in which the Contractor is required to install high strength bolts, but only the weight {mass} of heads, nuts, washers and all that portion of the threaded end of the bolt outside of the grip, exclusive of washer, shall be included in the computed weight {mass}, using the following weights {masses} per hundred bolts, regardless of the length of bolts.

Fastener Size (inches)	Weight {Mass} per 100 Units (pounds) {kg}
3/4	60 {27.2 }
7/8	90 {40.8}
1	130 {59.0}
1 – 1/8	180 {81.6}
1 – 1/4	240 {108.9}
Fastener Size	Mass per 100 Units
M16	15.0 kg
M20	30.0 kg
M22	35.0 kg
M24	50.0 kg
M27	70.0 kg
M30	85.0 kg
M36	145.0 kg

The weight {mass} of shop and field fillet welds shall not be measured or computed directly for payment, but the cost thereof shall be included in the price bid for other items of work.

5. The weight {mass} of castings shall be calculated from the detail dimensions shown on the approved shop drawings, with an addition of 10 percent for fillets, overrun and finishing.

6. Only the weight {mass} of materials used in the completed, permanent work will be measured for payment.

7. No allowance in weight {mass} will be made for shop or field paint.

8. For the purpose of measurement and payment, incidentals such as bearing plates, pedestals, and other minor metal parts shall, unless otherwise provided, be considered as structural steel even though made of other materials except the bronze bearing plates and the PTFE coated bearing plates will be paid for under Item 508-C.

9. For purposes of measurement and payment when payment is on a per pound {kilogram} basis, required welded shear connection studs will be included in the quantity of structural steel.

(b) ITEM NO. 508-B.

1. The number of units measured will be the accepted number of structural span units complete in place.

2. Any estimated weights {masses} shown on the bidding plans or proposal are approximate only and the contract price for each item shall include full compensation for the specified structural unit, complete in accordance with the plans and specifications, regardless of the final weight {mass} required and no claim will be allowed for any increase over the estimated weight {mass} of a structural unit unless same is caused by a change in plans or specifications. The cost of any additional work caused by a change in plans or specifications will be paid for as Extra Work.

(c) ITEM NO. 508-C.

Unless otherwise specified on the plans, the Contractor will have the option of furnishing either self-lubricating bronze bearing plates or PTFE coated bearing plates.

The bearing plates furnished will be measured in sets complete in place. A set shall include all the bearing plates required for each structure. Steel plates used in the bronze plate assembly or any other steel plates used in the PTFE plate assembly will be measured as Item 508-A, 508-B or 508-D, whichever is applicable.

(d) ITEM NO. 508-E.

Inspection ladders, when specified for separate payment, shall consist of all ladders required in accordance with plan details for the locations designated measured as one unit. When no separate payment is designated, the cost of such shall be included in the unit price bid for the Item of Structural Steel provided in the contract.

(e) ITEM NO. 508-F.

When separate payment is designated for a bridge deck drainage system, the complete system required to drain each separate structure in accordance with plan details will be measured as one unit per bridge structure. When no separate payment is designated for a bridge deck drainage system, the cost of such will be considered incidental to the work and absorbed in the unit prices bid for other items of work.

508.05 Basis of Payment.

(a) ITEMS NO. 508-A AND 508-D.

The accepted theoretical poundage {mass} of metal in the per pound {kilogram} price items, computed as prescribed, will be paid for at the contract unit price bid for structural steel complete in place, which will be payment in full for fabricating, furnishing, transporting, erecting, and painting (field painting not included in Item No. 508-D) all material, and for all labor, equipment, tools, falsework, cleaning up and incidentals necessary to complete the work.

Unless noted otherwise on the plans, these items shall include the following:

- bridge joint armor plates (both sides of the joint)
- pile cap channels and plates
- connection angles (clip angles) used with prestressed concrete girders
- swedged anchor bolts, nuts and washers
- smooth and swedged dowels
- pipe sleeves

The Engineer will allow on the monthly estimates partial payments as provided in Article 109.07.

(b) ITEM NO. 508-B.

Accepted metal superstructure span units will be paid for at the contract unit price bid for each respective unit, complete in place, which shall be payment in full for furnishing, fabricating, transporting, erecting and painting all materials and for all labor, equipment, tools, falsework, cleaning up and incidentals necessary to complete the work.

Unless noted otherwise on the plans, this item shall include the following:

- all structural steel in the superstructure unit
- structural steel in the bearing devices, except the PTFE coated bearing plates
- expansion dams (sawtooth, etc.) for interior and exterior open bridge joints

Where separate pay items are not provided, this item shall also include furnishing, fabrication, painting or galvanization, transporting and installing ladders, platforms, catwalks, and navigational lighting brackets.

Joint armor plates, channels, angles, anchor bolts, etc. for sealed interior and exterior bridge joint design shall be as specified in Section 522 and are not as a part of this item. This item does not include reinforcing steel and concrete.

Structural steel bearing plates for Type 3, 4 and 5 elastomeric bearings shall be included in the payment for elastomeric bearings under Pay Item 511-A and are not a part of this item.

Partial payments will be made on monthly estimates based on the following schedule:

Fabrication and Delivery to Approved Storage Site *
Erected ** 95%
Steel Cleaned and Field Painted *** 100%

NOTE: * Reference is made to Article 109.07 concerning approval of storage sites and partial payment for stored material.

** This item consists of having all connections complete, all splice plates and bolts cleaned and painted, and entire shop coat of paint in good order (no chips, scratches or thin spots).

*** If weathering steel is specified and no painting is required, 100% payment may be made after the superstructure concrete is placed and the superstructure has been cleaned.

(c) ITEM NO. 508-C.

Payment for bearing plates furnished, complete and installed as shown on the plans, will be made at the contract unit price per set which shall be compensation in full for furnishing and installation and for all tools, labor and incidentals necessary to complete the item. Partial payments will be made on monthly estimates based on the following schedule:

Fabrication and Delivery to Approved Storage Site *
Erected (in place on caps) 100%

NOTE: * Reference is made to Article 109.07 concerning approval of storage sites and partial payment for stored material.

(d) ITEM NO. 508-E.

Accepted ladders, measured as noted above, will be paid for at the contract lump sum price bid for this item. Said lump sum price bid shall be full compensation for all ladders designated complete in place and including all cost for furnishing, fabricating, painting, galvanizing, erection and installing the ladders, and for all materials, tools, equipment, labor and incidentals necessary to complete the work.

(e) ITEM NO. 508-F.

Accepted bridge deck drain systems, measured as noted above, will be paid for at the contract lump sum price bid for each system, complete in place. Said lump sum price bid shall be payment in full for furnishing and installing of all materials, fabrication of materials, erection of materials, paint (if required) and for all tools, equipment, labor and incidentals necessary to complete the work.

(f) BLANK.

(g) PAYMENT WILL BE MADE UNDER ITEM NO.:

508-A Structural Steel - per pound {kilogram}
508-B Structural Steel Superstructure, ___*, ____**, ____*** (SPECIALTY ITEM) - per each
508-C Bearing Plates _____**** - per set
508-D Structural Steel (Except Field Painting) - per pound {kilogram}
508-E Furnishing, Fabrication & Installation of Ladders - per lump sum

508-F Bridge Deck Drainage System - per lump sum
* Length of Continuous/Simple Span
** Lane, if applicable
*** Approximate weight {mass} of structural steel
**** If a specific type of bearing plate is required, so designate (Bronze or PTFE)
Example: 508-B Structural Steel Superstructure, 100'-100'-100' Continuous Span,
Left Lane, Approx. 373,100 pounds (SPECIALTY ITEM)

SECTION 509
UNTREATED AND TREATED TIMBER

509.01 Description.

This Section shall cover the work of furnishing, preparing, and erection of timber or lumber of the stress values, grade, size, and dimensions designated by the plans or proposal. The timber may be treated or untreated as specified by the plans and may require painting if so specified. It shall also include all structural steel, iron, casting, other metal parts, and all hardware required by the Specifications and plans. The type of preservative used shall be the type called for in the plans and/or proposal form. Where more than one type of preservative is included in the contract, each type shall be used as indicated by the plans.

509.02 Materials.

All materials shall conform to the appropriate provisions of Division 800, Materials. Specific reference is made to the following:

Section 816 - Timber, Preservatives
Section 833 – Lumber and Timber, Untreated and Treated

509.03 Construction Requirements.

(a) HANDLING AND STORAGE.

Timber and lumber shall be carefully handled without dropping, breaking of outer fibers, bruising, or penetrating the outer surface with tools. Tongs, cant hooks, peavys, hooks, pike poles, or other equipment likely to break the surface shall not be used.

(b) WORKMANSHIP.

Only competent carpenters shall be employed and all framing shall be true and exact. Nails and spikes shall be driven with just sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces shall be considered evidence of poor workmanship and sufficient cause for the removal of workmen causing them. Any metal work required in conjunction with timber construction shall conform to the requirements of Section 508.

(c) HOLES FOR BOLTS, DOWELS, RODS, AND LAG SCREWS.

Holes for round drift bolts and dowels shall be bored with a bit 1/16 inch {1.6 mm} less in diameter than the bolt or dowel to be used. The diameter of holes for square drift bolts or dowels shall be equal to the least dimension of the bolt or dowel. Holes for machine bolts shall be bored with a bit of the same diameter as the bolt. Holes for rods shall be bored with a bit 1/16 inch {1.6 mm} greater in diameter than the rod. Holes for lag screws shall be bored with a bit 1/16 inch {1.6 mm} less in diameter than the nominal diameter and for a depth not greater than 1/2 the length of the lag screws being used. Countersinking shall be done wherever smooth faces are required. Recesses formed for countersinking shall be painted with hot creosote oil, and after the bolt or screw is in place, shall be filled with an asphalt base roofing patch.

(d) BOLTS AND WASHERS FOR TIMBER CONSTRUCTION.

One washer of the size and type specified shall be used under all bolt heads and nuts which would otherwise come in contact with wood. Cast iron washers shall have a thickness equal to the diameter of the bolt, and a diameter of four times the thickness. For malleable or plate washers, the diameter or side size of the square shall be equal to four times the diameter of the bolt, and the thickness of the washers shall be equal to one-half the diameter of the bolt. Cast iron washers shall be used when the timber is in contact with the earth . All bolts shall be checked after the nuts have been finally tightened. Bolts shall be of such length that not more than 1 inch {25 mm} will protrude beyond the nut when finally tightened.

(e) ADDITIONAL DETAILS.

Additional requirements for timber construction will be listed under the type work for which the timber is used, including but not limited to Sections 503, 505, 510, 630, 631, 635, 636, and 637.

509.04 Method of Measurement.

The quantity to be measured shall be the number of thousand feet board measure {cubic meters} of lumber and timber, complete in place and accepted. Measurements of lumber and timber will be computed using the nominal width and thickness, and the actual length of each piece shown on the plans, unless changes in such dimensions have been authorized in writing. The nominal size dimensions shall be used in the computations even though the actual size be scant in the amount provided above. The measurements of timber will include only such timber as is a part of the completed and accepted work, and will not include timber used for erection purposes, such as falsework, bracing, sheeting, etc.

509.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. Accepted timber and lumber will be paid for at the respective contract unit prices bid per thousand feet board measure {cubic meter}, for untreated timber, treated timber of the designated type, preservative, complete in place, which shall be payment in full for furnishing of all materials, preservative treatment, equipment, tools, labor, hardware (as provided by Article 836.11), and incidentals necessary for the erection and painting (where provided by the plans and/or proposal form) of the work as shown on the plans or specified. It shall include compensation for any excavation and backfill necessary to complete the timber portion of the structure within the limits of the abutments or end bent, and when provided by the plans and/or proposal forms; it shall further include compensation for removal of any untreated or treated timber replaced by new material as directed.

2. Accepted treated timber, (any preservative) (salvaged material) will be paid for at the contract unit price bid, complete in place, which shall cover the cost of furnishing equipment, tools, hardware, incidentals, materials, hauling, handling, and placing of materials salvaged from old structures (or furnished by the State). It shall also cover the cost of removal of any material replaced by salvaged material as provided by the plans.

(b) METAL PARTS AND PILING.

Metal parts, other than hardware (as provided by Article 836.11), will be paid for at the contract prices per linear foot {meter} or per pound {kilogram} for such items, the weight {mass} being computed in the manner as specified for structural steel. Piling will be paid for as specified under Piling.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

509-A Untreated Timber - per MBM {cubic meter}
509-B Treated Timber, Type Preservative - per MBM {cubic meter}
509-C Treated Timber (Any Preservative)(Salvaged Material) - per MBM {cubic meter}

SECTION 510
BRIDGES

510.01 Description.

The work under this Section shall cover the construction of bridges, or parts thereof. When widening or modification of an existing facility is required, the work under this Section shall include the cutting or breaking away of portions of the existing structural material and the preparation of the exposed structural materials for joining of new materials to the lines and grades shown on the plans or as directed.

510.02 Materials.

All materials incorporated in the structure shall be new except where otherwise specified on the plans or in the proposal. The requirements set forth in the Sections listed in this Article, together with any other specifications contributing to the complete structure shall be applicable to this Section.

Section 215 Excavation for Bridges
Section 501 Structure Concrete
Section 502 Steel Reinforcement
Section 505 Piling

Section 508 Structural Steel and Miscellaneous Metals
Section 509 Treated and Untreated Timber
Section 513 Prestressed Concrete Bridge Members
Section 521 Bridge Painting

All steel reinforcement used in a cast-in-place concrete bridge deck shall be AASHTO M 31 {M 31M} Grade 60 {Grade 420}, unless otherwise specified on the plans.

510.03 Construction Requirements.

(a) GENERAL.

1. Bridges shall be constructed in accordance with lines, grades, dimensions, and other details shown on the plans and in conformity with these specifications.

2. Construction requirements of Sections 215, 501, 502, 503, 505, 507, 508, 509, 512, 513, 517, 520, and 521 shall also apply to this Section.

3. Concrete tolerances except for bridge deck riding surfaces shall be as follows:

Width and depth dimensions of girders, barrier rails, and columns shall not vary more than 1/8 inch per foot {10 mm/m} and not more than 1/4 inch {6 mm} total from plan dimensions.

For barrier rail, overhang, and curb, horizontal and vertical alignment shall not vary more than 1/8 inch in 10 feet {3 mm/3 m} and not more than 1/4 inch {6 mm} total from that shown on the plans.

The finished concrete shall be free from objectionable projections, swells, ridges, depressions, waves, holes, and other defects.

4. Attention is directed to Subarticle 501.03(k) for concrete curing and Subarticle 501.03(l) for concrete finishing.

5. Attention is directed to the requirements of Article 107.01 concerning safety.

(b) SUBSTRUCTURES.

1. FOUNDATIONS.
Foundations shall be prepared in accordance with the plans and Section 503.

2. CONCRETE AND STEEL SUBSTRUCTURES.
See construction requirements of Sections 501, 502, and 508.

3. PILING.
See Section 505.

4. DRILLED SHAFTS.
See Section 506.

5. DRAINAGE.
The fill material back of abutments and wing walls shall be drained by means of a system of tiling, French drains, or other construction as shown on the plans. Drains shall be so located that the stream water cannot wash away fill material through the openings. The drainage water shall be discharged through abutment, wing, or pier walls in such manner and at such locations as to eliminate, as far as possible, any objectionable discoloration of exposed concrete surfaces. Drainage intakes, where directed, shall be protected against clogging as provided in Item 214.03(c)2.

(c) SUPERSTRUCTURES.

1. GENERAL.
No superstructure load shall be placed upon finished piers or abutments until directed. Moreover, before any superstructure load is placed on concrete portions of a substructure, one of the following shall be accomplished: (1) A minimum time of 14 days, exclusive of days where four hours or more the temperature is below 40 °F {5 °C}, shall be allowed for the hardening of concrete, or (2) the concrete shall indicate a development of minimum compressive strength of 2400 psi {17 MPa} from cylinders prepared in conformity with AASHTO T 23.

2. BEARINGS AND ANCHORAGE.
See Item 508.03(d)2.

3. STEEL GIRDERS.
See Section 508.

4. PRESTRESSED CONCRETE BRIDGE MEMBERS.
See Section 513.

5. CAST-IN-PLACE CONCRETE GIRDERS,

See Sections 501 and 502. Camber due to dead load and vertical curvature shall be put into the falsework and formwork as required to produce the finished lines and grades shown on the plans.

6. REINFORCED CONCRETE BRIDGE DECKS.

a. Pre-Pour Conferences.

Pre-pour conferences shall be held between the Contractor and Project Engineer prior to placing any bridge deck concrete. As a minimum, this conference shall include a discussion of the rate of pour, personnel and equipment to be used, type of finish, and curing details.

b. Placing Concrete.

In addition to the requirements of Subarticle 501.03(f), the following shall also apply. The rate of pour shall be controlled so that all concrete between construction joints can be placed and compacted in a continuous operation before initial set takes place in contiguous portions of the concrete. In case of breakdown of equipment or other reasons necessitating suspension of placing and compacting the concrete for a period in excess of 45 minutes for mixes without retarders or 60 minutes for retarded concrete, and part of the work involved is such that a construction joint will not be permitted, all of the previously placed concrete in that section shall be removed and replaced by the Contractor without extra compensation.

A deck pour shall not be started when it is raining or threatening rain. Should inclement weather develop during the pour, it will be the Contractor's responsibility to protect the plastic concrete so that placing and finishing operations can be satisfactorily completed without damage to the concrete or concrete surface. Should damage occur, the concrete shall be removed and replaced at the Contractor's expense. The placing of skin patches (the scabbing on of the concrete or grout) on a bridge deck will not be permitted.

All concrete deck slabs shall be placed full thickness in one operation. Unless otherwise shown on the plans, on R.C.D.G. spans, concrete in the girders and slab shall be placed in one operation.

Webwalls may be poured and allowed to set up prior to pouring the bridge deck. If a longitudinal screed is to be used for finishing the concrete in the bridge deck, the concrete for the bridge deck shall not be placed until the webwall concrete has reached a minimum compressive strength of 2400 psi {17 MPa} as determined from the testing of cylinders.

On all continuous spans, a pouring sequence will be shown on the plans. All lower numbered or lettered pours shall be made prior to proceeding to the next higher numbered or lettered pour. Adjacent pours shall not be made until after the previously placed concrete has reached an age of 24 hours.

Simple spans shall be constructed in one pour, except on simple spans over 50 feet {15 m} in length transverse slab construction joints will be permitted. On simple spans over 80 feet {25 m}, transverse slab construction joints will be required. Where slab construction joints are used on simple composite spans, construction joints shall be placed at approximately the quarter points of the span; after pouring the center portion of the span and when the concrete has reached a compressive strength of 2400 psi {17 MPa} by cylinder tests, or after four days, the end slab portions of the span may be poured.

Consideration will be given to reducing the number of construction joints specified above where transverse screeding is to be employed; however, all requests for changes to pouring sequences must be submitted in writing to the State Construction Engineer for approval. If the number of construction joints is reduced, a minimum pour rate of 30 cubic yards {23 m^3} per hour may be required, and an approved retarder may be required in the deck concrete.

During the placing operation, the concrete shall be placed in strips just ahead of the screed for the entire length or width of the pour, whichever applicable. A small roll of grout shall be kept on the leading edge of the screed so that all depressions ahead of the screed will be filled.

c. Finishing.

General Screed Requirements.

All screeds shall be mechanically operated. Screeds and screed supports shall be designed so that they may be pre-set to provide the finish grade and cross-section of the concrete deck surface shown on the plans. They shall be of substantial construction so that the proper settings will be maintained throughout the pour. Screed supports shall be placed and adjusted to properly provide for the deflection of forms, falsework, and structural supporting members which will occur during the placement of concrete. Immediately before concreting operations are started, the screed

shall be operated over the full length and width of the bridge segment to be paved. This test run shall be made with the screed adjusted to its finishing position. While operating the screed during this test, all aspects of the screed and supports shall be checked for proper adjustments. After the Contractor has satisfied himself that the finishing equipment has been adjusted to conform with plan and specification requirements, another test run shall be made for the Engineer for the purpose of recording slab thickness and steel clearance measurements prior to the pour being made.

Longitudinal Screeds.

Longitudinal screeds shall be supported at the ends by transverse headers or by a section of slab previously poured. Screeds must be long enough to span the entire pour as required by the plans and specifications. Intermediate screed supports between approved construction joints will not be permitted. Screeding shall be accomplished by working the longitudinal screed parallel to the centerline of the road (from low side to high side on superelevated curves) in such a manner that laitance, surplus water, and inert materials are removed from the surface.

Transverse Screeds.

Transverse screeds shall be of sufficient weight {mass} to strike off the plastic concrete placed in front of the screed without "riding up" on the concrete. Transverse screeds shall be supported by vertically adjustable rails set a sufficient distance from the gutter line to allow free movement of the screed from gutter line to gutter line. Supports for the screed rail shall be located a maximum of 18 inches {450 mm}, center-to-center, with the slab overhang support brackets located a maximum of 24 inches {600 mm}, center-to-center. Exceptions to the maximum allowable screed rail and support bracket spacing will be considered if the increased spacing is adequately addressed in the design calculations that are required as a part of the Working Drawings (for falsework). Satisfactory means of load distribution with minimum rail deflection shall be provided. The screed rails for any deck pour shall be completely in place for the full length of the pour and shall be firmly secured prior to making test runs and subsequently placing deck concrete. In making the test runs, a "tell-tale" device attached to the screed carriage may be used to check the proper clearance on the top mat of the reinforcing steel.

Work Bridges.

Portable work bridges shall be provided and used to perform finishing and inspection work on the bridge deck after the screeding operation. Surface tolerance as described in Subitem 510.03(c)6.d shall be accomplished before grooving the deck surface.

Final Finishing.

The final finish behind longitudinal screeds shall be obtained by wood floating. The final finish behind transverse screeds shall be obtained by either wood floating or burlap drag. The final texture shall be obtained by the cutting of transverse grooves in the cured concrete.

The bridge decks shall be grooved perpendicular to the centerline. The grooving operation shall not be started until the bridge deck has been cured in accordance with Subarticle 501.03(k).

The grooves shall be cut into the hardened concrete using a mechanical saw device which will leave grooves approximately 1/8 inches {3 mm wide} and 1/8 inches {3 mm} deep. The grooves shall be unevenly spaced and randomly varying between 5/8 inches {15 mm} and 1.125 inches {30 mm}. The grooved finish shall be at right angles to the centerline of the bridge deck, regardless of skew, and shall extend across the roadway from 2 feet {600 mm} inside the face of the curb or barrier rail to 2 feet {600 mm} inside the face of the opposite curb or barrier rail. Each pass of the grooving machine shall be adjacent to the previous pass without overlapping.

All residue, slurry and other waste resulting from the grooving operation shall be continuously removed from the bridge deck so that there is never a build-up of these waste materials. Upon approval by the Engineer, these waste materials may be disposed in earthwork when earthwork is a part of the bridge construction project. The waste materials may be tilled into the earthwork so that water run-off will not transport these materials from the construction site. If the Engineer does not approve of the disposal of the waste material on the construction site, the Contractor shall remove the waste material from the project and dispose of it in accordance with all applicable laws and ordinances for disposal.

d. Surface Tolerance.

The floor shall be constructed to correct elevation, including vertical curvature, within a tolerance of 1/8 inch {3 mm}, except that camber in spans 100 feet {30 m} and longer may exceed the designated amount by 1/4 inch {6 mm} at the midpoint of span. A slight excess of camber is preferred. As soon as the surface has set sufficiently, it shall be straight-edged by the Contractor under

the direction of the Engineer and all areas exceeding 1/8 inch in 10 feet {3 mm in 3 m} from the longitudinal and transverse lines shown on the plans shall be marked and corrected by approved methods. The 10 foot {3 m} straight-edge shall be lapped at least 5 feet {1.5 m} over the prior 10 foot {3 m} check.

e. Curing.

See Subarticle 501.03(k).

f. Drainage.

Deck drains or scuppers shall be installed in the gutters at locations and in accordance with details shown on the plans.

g. Slab Overhang.

The under surface of overhanging slabs shall be provided with a continuous "V" groove 3/4 of an inch {20 mm} in depth at a point not more than 6 inches {150 mm} from the outside face for the purpose of arresting the flow of water, and thus, preventing staining,

h. Expansion Joints.

Plates, channels, or other structural shapes shall be accurately shaped, in the shop, to conform to the section of the concrete floor. The fabrication and painting shall conform to the requirements of these specifications and/or the plans covering those items. Care shall be taken to insure that the surface in the finished plane is true and free from warp. Positive methods shall be employed in placing the joints to keep them in correct position during the placing of the concrete. Unless otherwise shown on the plans, the joint opening shown on the plans is the opening when the temperature of the structure is 70 °F {20 °C}. Special care shall be taken to insure that all expansion joint devices and expansion joint openings are correctly set prior to pouring the concrete adjacent to the joint.

Expansion joints shall be so constructed as to permit freedom of movement of the spans. Open joints shall be cleared of all mortar and other obstructions as soon as possible after pouring the spans.

Sealing of joints, if required, shall be in accordance with plan details.

i. Blank.

j. Barrier Rails Placed By Slip Forming.

Bridge barrier rails constructed by the use of a slip form extrusion machine shall be well compacted dense concrete meeting all the requirements of Section 501, except for the requirement for fixed forms. The forming portion of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine so that the top of the barrier can be maintained at the required grade.

Open joints shall be located as required on Standard Drawing No. I-131. Longitudinal bars shall be cut at joint locations to provide for 2 inch {50 mm} end cover. The Contractor shall be responsible for marking these locations in advance of placement of concrete so that sawed joints will be properly located.

The joints shall be sawed as soon as the concrete has hardened to the degree that tearing and raveling is not excessive, and before uncontrolled shrinkage cracking begins. This time may be as short as four hours or even less in extremely warm weather, but not over 12 hours unless authorized by the Engineer. If extreme conditions exist which make it impractical to prevent uncontrolled cracking by early sawing, the procedure shall be revised immediately to adjust the sequence of sawing.

A minimum saw cut width of 5/16 of an inch {8 mm} shall be maintained. On the inside of the barrier, the saw cut shall extend from the top to the bottom of the rail to the point of intersection with the bridge deck. On the outside of the barrier, the saw cut shall extend from the top to within 11 inches {280 mm} of the bottom of the rail.

7. CONCRETE RAILINGS, CURBS, SIDEWALKS, AND PARAPETS.

In no case shall concrete railings, sidewalks, and parapets be placed until the falsework for the span has been released, rendering the span self-supporting.

The surface of all bridge sidewalks shall have a wood-float finish. No other finish will be required.

8. GROUNDING.

If grounding is required by the plans, each exterior girder of bridges or portions of the bridges using steel girders shall be made electrically continuous by means of copper bonding jumpers across each expansion joint. Jumpers shall be extra flexible copper conductor, No. 2 AWG or larger.

They shall be exothermically welded on the inside of the web close to the bottom flange. Jumpers shall be sized to permit 10 inches {250 mm} movement between girders without straining the jumper or connections. Grounding fields shall be provided at each end of such bridges or portion of bridges. Where end of bridge terminates at an abutment, the field shall consist of one or more driven ground rods as required to give a resistance to ground not to exceed 25 ohms. Multiple grounds or sectional ground rods will be acceptable. Connections between ends of bridge and ground field shall be copper conductor, No. 6. or larger, protected against mechanical injury in all exposed portions by galvanized steel conduit. Resistance measurements shall not be made within 48 hours after a rain shower, or until the ground is reasonably dry after prolonged rainy weather. Where steel sections of bridges terminate at intermediate bents, the grounding field shall consist of No. 2/0 standard stranded copper conductor welded to steel piling or steel reinforcing rods, whichever extends to the lowest depth, and a 2 foot {600 mm} or longer section of copperweld grounding rod extended 4 inches {100 mm} above the bent cap adjacent to end of steel section. All welds shall be exothermic. Connection between ground rod and structure shall be a No. 2 AWG or larger, extra flexible electric copper conductor with provisions for not less than 12 inches {300 mm} horizontal movement of the structure at point of connection. Reference is made to Article 836.09 for additional material requirements.

k. Placement of Cranes on Bridge Decks.

Should the Contractor desire to place a crane on the deck of a bridge, he shall submit a placement plan for review by the Engineer. The Contractor shall not place a crane on the deck until after the review and distribution of the placement plan by the Engineer. The Contractor is solely responsible for any damage to the structure as result of the load being placed on the structure. The placement plan shall be stamped by the designer of record. The designer of record shall be a professional engineer licensed by the State of Alabama. Six complete sets of the following information shall be submitted to the State Construction Engineer:

(1) Specifications of the crane and/or equipment to be placed on the structure.

(2) Mobilization (wheel location) diagram of the crane (with respect to centerline of structure) as it is being mobilized for final positioning on the structure.

(3) Final positioning/usage diagram once the crane is on the structure showing the location of the outriggers, and timber mat requirements (i.e. mat thickness, width, orientation of mats), maximum load to be lifted for a particular positioning of the boom, etc.

(4) A complete stress analysis (superstructure and substructure) on all components affected by loads resulting from the use of the crane and/or equipment on the structure. The analysis shall be provided in accordance with AASHTO Allowable Stress Design Method. Mobilization analysis (item 2) as well as final positioning/usage analysis (item 3) shall be required.

510.04 Method of Measurement.

(a) GENERAL.

The quantities of concrete, steel reinforcement, structural steel, timber, piling, and other various contract pay items which constitute the completed and accepted structure shall, unless otherwise provided herein, be measured for payment according to the specifications for the individual contract pay items provided.

Accepted work, constructed to the dimensions shown on the plans or ordered in writing, will be used to determine the quantities of the respective pay items involved, all in accordance with the provisions of the applicable Section of these specifications.

Attention is directed to the major items of work such as Section 502 for Reinforcing Steel, Section 508 for Structural Steel, Section 509 for Timber, Section 505 for Piling, etc.

(b) ITEM 510-A, AND 510-B.

1. VOLUMETRIC MEASURE.

The volume of accepted concrete within the neat lines of the structure as shown on the plans or revised at the written direction of the Engineer will be computed in cubic yards {cubic meters}. The method of average end areas will not be used where results obtained differ from those obtained by more accurate mathematical computation.

2. DEDUCTIONS.

No deduction will be made for the volume of concrete displaced by steel reinforcement, drainage scuppers, weep holes, service pipes, conduits, anchor bolts, castings of grillages, or structural shapes and plates. No deductions will be made for chamfers of less than 3 inch {75 mm} leg measurements.

The volume of precast concrete or timber pile heads imbedded in concrete will be deducted.

3. ADDITIONAL CEMENT OR CONCRETE USED.

No payment will be made on account of additional cement used or additional volume of concrete used unless ordered in writing. No payment will be made for footing concrete used outside line drill limits or other neat lines shown on the plans, where no forms are used. Additional cement ordered used will be paid for as provided in Item 501.02(c)3.

(c) ITEM 510-C.

Each accepted Bridge Concrete Superstructure unit will be measured for payment as a lump sum unit. Partial payments will be allowed on monthly estimates in accordance with Subarticle 510.05(c).

(d) ITEM 510-E.

Grooving of bridge decks, acceptably completed in accordance with Subitem 510.03(c)6.c., will be measured by the square yard {square meter}.

510.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted structural concrete, measured as noted above, will be paid for under the respective unit price bid for the appropriate item or items provided for such in the proposal. Said unit price bid shall be full compensation for the concrete, complete in place, which shall be payment in full for all backfilling, compacting, disposal of surplus material, all falsework piling, falsework, forms, bracing, all materials except as specified below, and for all equipment, tools, labor, and incidentals necessary to finish and complete the items in accordance with the plans and these specifications. Non-metal expansion joints, scuppers and drains, electrical conduit and equipment, shall be included in the bid price for the concrete, unless otherwise provided on the plans or in the proposal. Steel reinforcement, metal expansion joints, and metal bearings will not be included in the price bid for the concrete but shall be paid for under the appropriate pay item. In case of widening or extension of an existing structure, the breaking away of existing concrete to the approximate lines shown on the plans and disposing of broken concrete and preparing steel reinforcement for splicing as required, will be paid for under Section 206.

No additional compensation will be allowed for constructing or placing expansion joints, scuppers, drains, weep holes, or for placing service pipes or conduits, anchor bolts, plates, castings, grillages, or metal bearings or appurtenances, as such are considered incidental to the placing of concrete or other items of the work, unless otherwise noted by the plans or proposal. Payment for grooving concrete bridge decks will be made at the contract unit price bid per square yard {square meter} which will be full compensation for furnishing the necessary equipment, tools, and labor to perform the work.

(b) ITEMS 510-A AND 510-B.

Payment for concrete measured on a cubic yard {cubic meter} basis as described above will be made at the contact unit price per cubic yard {cubic meter}, complete in place, for the various classes of concrete listed on the plans and the proposal.

(c) ITEM 510-C.

Payment for each accepted Bridge Concrete Superstructure unit will be made at the contract lump sum price bid for each unit, complete in place.

Partial payments will be made on monthly estimates based on the percentage of the total work performed on each unit as estimated by the Engineer.

The number of cubic yards {cubic meters} shown on the plans and in the proposal is approximate only and the lump sum amount bid for each unit will not be increased or decreased except as outlined below.

Structural steel, reinforcement and precast-prestressed concrete units are covered by other pay items.

An increase, or decrease, in the approximate quantity of surface deck area for bridge concrete superstructure required from that shown on the plans which is caused by a design change after the contract has been let will result in an increase, or decrease, in the compensation due the Contractor. This compensation will be made, either increase or decrease, as a proportional amount of the contract bid price of Item 510-C.

For any other changes in the approximate quantity of bridge concrete superstructure, price adjustments will be made in accordance with Article 104.02.

(d) PAYMENT WILL BE MADE UNDER ITEM NO.:

510-A Bridge Substructure Concrete, Class A - per cubic yard {cubic meter}
510-B Bridge Concrete, Class ___ - per cubic yard {cubic meter}
510-C Bridge Concrete Superstructure, __*, __**, ___*** - per lump sum
510-E Grooving Concrete Bridge Decks - per square yard {square meter}

* Station Number, Bridge Identification Number (BIN), Ramp Number, etc.
** Lane, if applicable
*** Approximate quantity of superstructure concrete in cubic yards {cubic meters}

SECTION 511
ELASTOMERIC BEARINGS

511.01 Description.

This Section shall cover the work of furnishing and installing elastomeric bearings for all types of bridge girders. An elastomeric bearing shall consist of at least a single layer of elastomer and may consist of a possible combination of elastomeric layer(s), internal steel sheet laminate(s), PTFE layer, bearing and/or sole plates, and a stainless steel plate.

511.02 Materials.

Elastomeric bearings shall be fabricated to conform with the material requirements given on the plans and in AASHTO M 251 as modified in Section 837.

511.03 Construction Requirements.

Shop Drawings for the elastomeric bearings shall be submitted to the Bridge Engineer for approval.

The elastomeric bearings will be identified on the plans by Type (Type 1, 2, 3, 4, or 5).

Rust that occurs on the portions of bearing plates that are left ungalvanized for welding shall be cleaned to bare metal prior to welding. All bare metal shall be coated after welding with galvanizing repair paint that meets the requirements given in SECTION 855.

511.04 Method of Measurement.

The elastomeric bearings will be measured per each for each type of bearing. The bearings measured for payment do not include the randomly selected samples for testing.

511.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The unit price bid per bearing shall include all costs for equipment, materials (including bearing plates, sole plates, PTFE, and stainless steel plates), labor, bearings furnished for sampling and testing, shop drawings, and all incidentals necessary to furnish and install the complete bearing assembly.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

511-A Elastomeric Bearings Type __*__ - per each

* Bearing Type

SECTION 512
PRECAST NON-PRESTRESSED CONCRETE BRIDGE MEMBERS

512.01 Description.

This Section shall cover the work of furnishing precast non-prestressed bridge members of the size, cross section, and dimension shown on the plans and the erection thereof into designated structures to the lines and grades designated by the plans or directed, all in accordance with this Section and the appropriate requirements of these Specifications. All required accessories and fittings necessary for the incorporation of such members into a bridge structure shall be considered incidental to, and included as, a part of the member furnished.

Special reference is made to Section 501, 502, 503, 508, 510, and 517 for additional requirements.

512.02 Materials.

(a) GENERAL.

All materials used in the fabrication and the installation of the precast members shall comply with the appropriate requirements of Division 800, Materials, ALDOT-364, and the requirements noted in this Section unless otherwise modified by plan details.

(b) CONCRETE MIXES.

1. CONCRETE FOR SUBSTRUCTURE UNITS.

Concrete mixes, etc. for all precast substructure units shall be in accordance with the appropriate provisions of Section 501 for a Class A Concrete.

2. CONCRETE FOR SUPERSTRUCTURE UNITS.

a. Concrete mixes for 15 foot {4.6 m}, 17 foot {5.2 m}, and 19 foot {5.8 m} precast concrete deck units shall be in accordance with the appropriate provisions of Section 501 for a Class A-1c concrete mix.

b. Concrete mix for precast concrete deck units 20 feet {6 m} and over in length shall be designed by the Contractor to meet the requirements noted herein which shall be submitted to the Engineer for approval.

(1) The concrete shall have a minimum 28 day cylinder strength of 5000 psi {35 MPa} or the minimum 28 day cylinder strength specified on the plans.

(2) An approved air entraining agent shall be used to obtain an air content of four percent, plus or minus one percentage point.

Other approved admixtures may be used to increase workability of the concrete. Slump requirements shall be a maximum of 3 inches {75 mm} plus 1/2 inch {13 mm} tolerance except when a water reducing agent is used, then a maximum slump of 4 inches {100 mm} plus 1 inch {25 mm} tolerance may be used.

When a high range water reducing agent is used, a slump requirement greater than 4 inches {100 mm} may be requested by the Contractor in the concrete mix design request submitted to the Engineer for approval.

(3) The size of coarse aggregate shall not be larger than 1/5 of the narrowest dimension between sides of the forms of the member being cast nor larger than 3/4 of the minimum clear spacing between individual reinforcing bars or bundle of bars.

(4) All materials used in manufacturing the concrete shall comply with the requirements of the Standard Specifications.

(c) STEEL REINFORCEMENT.

Reinforcement steels shall meet the appropriate requirements of Section 835, unless otherwise specified by plan details.

(d) MISCELLANEOUS HARDWARE.

Machine bolts, nuts, washers, plates, etc. shall be hot dipped galvanized common stock hardware items, unless otherwise specified by plan details.

512.03 Construction Requirements.

(a) GENERAL.

1. MANUFACTURE OF UNITS.

Unless otherwise noted in this Section or noted on the plans, manufacture of precast units shall be in accordance with the provisions of Items 501.03(m)2 and 3.

Forms shall be so designed and aligned that they will not move during casting operations. Each production line shall be equipped with a complete set of forms so units can be cast and cured in one operation. Movement of forms from, or within, a production line will not be permitted until the next day.

Forms shall be inspected and approved prior to beginning casting operations. Keyways, countersunk keys, and other configurations shown by the plans shall be built into the forms. Tops of headers shall be in the same plane as the top of side forms. The dimensional location of the top of the headers and side forms shall be the same on all forms used in the production of a particular type of size member. Worn, damaged, or otherwise unacceptable forms shall be repaired before casting operations will be authorized.

Curbs, barrier rail, and other roadway surface units shall utilize the same concrete mix used in the deck units.

2. DIMENSIONAL AND SURFACE TOLERANCES.

Members shall not vary more than 1/8 of an inch {3 mm} from plan detail dimensions.

The surface of deck units shall not vary more than 1/8 inch {3 mm} from a 10 foot {3 m} straightedge.

3. SURFACE FINISH OF UNITS.

All surfaces of the precast units shall receive a Class 1 surface finish in accordance with the provisions of Item 501.03(l)2, except the roadway surface of deck span sections, which shall receive a wood float finish and the curb barrier rail sections which shall have a Class 3 surface finish.

4. TESTING.

Preliminary acceptance of precast units will be based on compliance with plan dimensions, the details noted herein, and concrete cylinder tests.

Concrete cylinder tests shall be made on at least six standard specimens made at the time the concrete is deposited in each production line to determine the concrete strength of the castings at different ages. The Contractor shall provide adequate equipment and facilities to test and store the concrete cylinders on or near the fabrication yard. The equipment shall include a hydraulic compression testing machine which has been properly calibrated.

5. FINAL ACCEPTANCE.

Final acceptance of the units will be based on the preliminary approval and the satisfactory installation of the units in the structure in accordance with plan requirements.

(b) HANDLING OF PRECAST MEMBERS.

Care shall be taken in handling all precast elements. While lifting or storing precast members, the tops of each shall be placed upward. Lifting hooks or similar devices for lifting shall be placed at points close to each end of span. They shall be of sufficient strength and embedment to provide safe handling of the precast elements. Blocking under spans, panels, or caps during storage and handling shall be placed close to ends of span only. Lifting devices shall be of sufficient size and capacity to insure safe handling during moving of units.

(c) DELIVERY AND STORAGE AT JOB SITE.

Handling of members during delivery and at job site shall be as noted in Subarticle (b) above.

Span sections delivered to the job site prior to use shall be adequately supported in an upright position only at such bearing points as marked on the span or approved. All lifting and handling shall be done by approved lifting hooks or devices placed at points indicated on the plans.

(d) ERECTING AND PLACING.

Any unit cracked or otherwise damaged in either handling or placing will be evaluated by the Engineer as to whether the damage is minor and may be repaired, or whether it will be rejected. Any repair shall be made in a manner acceptable to the Engineer, and the Engineer's ruling on the unit's acceptability will be final.

In the installation of deck sections, care shall be taken to match the units so that the surface differentiation between adjacent units do not exceed 1/4 of an inch {6 mm}. Deck units which do not meet the surface differentiation requirement will be rejected; however, the rejected unit may be used in a different position in the structure or in another structure, provided the surface differentiation requirement is met.

After placing the units in a structure, they shall be bolted together as shown by plan details to provide snug tight fit; if the flat washers, bolt head and nut do not indicate uniform bearing on each other and the concrete, an appropriate sized beveled washer shall be provided. Snug tight is defined as the tightness such as can be produced by one or two solid blows from an impact wrench or by full effort of a person using an ordinary 2 foot {610 mm} spud wrench. After obtaining the proper bolt fit, the threads shall be burred to prevent removal.

Upon satisfactory completion of the bolting up, the concrete keyway shall be poured using a concrete comprised of a 1:2:3 mix, by weight {mass}, of cement, fine aggregate, and coarse aggregate, respectively. The maximum size of the coarse aggregate shall be 3/8 of an inch {9.5 mm}, and the maximum amount of water allowed shall be 6 gallons per 100 pounds {1 liter per 2 kg} of cement. The exposed surface of the poured keyway shall be struck to the same elevation as the adjoining deck sections and shall be given a wood float finish.

(e) PLACEMENT OF CRANES ON BRIDGE DECKS.

Should the Contractor desire to place a crane on the deck of a bridge, he shall submit a placement plan for review by the Engineer. The Contractor shall not place a crane on the deck until after the review and distribution of the placement plan by the Engineer. See Subitem 510.03(c)6.k. for the placement plan requirements.

512.04 Method of Measurement.

The number of precast concrete units of each type and dimension, complete in place and accepted, will be the actual number of units ordered and accepted, complete in place in a bridge structure.

512.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

A precast concrete member will be paid for at the contract unit price for the type and size (depth, width, and length) designated. This unit price shall be full compensation for manufacturing, delivery and installation, accessories, all items cast into the concrete, tie bolts, expansion materials, cover concrete over fittings, grout and grouting, surface finishing and for all other materials, equipment, labor, and incidentals required to make the bridge member a part of the completed bridge. Structural steel, handrail and bearings will be paid for under other items of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

512-A Precast Concrete Abutment Caps, ____ Wide by ____ Deep by ____ Long - per each
512-B Precast Concrete Intermediate Bent Caps, ____ Wide by ____ Deep by ____ Long - per each
512-C Precast Concrete Type __*_ Span Section, ____ Wide by ____ Deep by ____ Long - per each
512-D Precast Concrete __**_ Section, ____ Long - per each
512-E Precast Concrete Abutment Panels, Type ____ - per each
512-F Precast Concrete Wing Panels, Type ____ - per each
512-G Precast Concrete Abutment Wing Cap Panels - per each

* Types of Span Sections
- Type 1 - Interior Span Section
- Type 2A - Exterior Span Section for Curb A Section
- Type 2B - Exterior Span Section for Curb B Section
- Type 2C - Exterior Span Section for Barrier Rail
- Type 2D - Exterior Span Section with Curb D Section
- Type 2E - Exterior Span Section with Curb E Section

** Types of Sections
- Curb A
- Curb B
- Barrier Rail Intermediate
- Barrier Rail End

NOTE: See plan details for size, shape, dimensions, etc. of the various types of span, curbs, and barrier rail sections.

SECTION 513
PRESTRESSED CONCRETE BRIDGE MEMBERS

513.01 Description.

(a) GENERAL.

This Section shall cover the furnishing of precast-prestressed members and the incorporation of these members in any structure to the lines and grades designated by the plans or directed.

The size, dimension, cross-section, and other details of the members will be shown in the plan details. All required accessories and fittings necessary for the incorporation of such members into a structure are considered incidental to, and included as a part of, the member furnished.

The Requirements provided for Bridges, Section 510; for Reinforcing Steel, Section 502; for Structural Steel, Section 508; and for Structure Concrete, Section 501; shall apply in all respects to precast concrete bridge members, except where otherwise indicated by specific requirements given in this Section or noted by plan details.

Pretensioned-prestressed concrete girders will be classified by "type" according to the current AASHTO Classification, that is, Type IM, IIM, IIIM, etc.

(b) DEFINITION.

The term "pretensioned-prestressed concrete" refers to concrete in which the prestressing strands or wire are tensioned prior to placing the concrete and released after the concrete has gained sufficient strength to retain the prestressing force by bond.

The term "post-tensioned prestressed concrete" refers to concrete in which the stressing steel is installed in voids or ducts cast within the concrete member, and is stressed and anchored after the concrete has developed a specified strength. As a final operation, the voids or ducts are filled with grout under pressure.

513.02 Materials.

(a) GENERAL.

All materials used in the fabrication and installation of the precast members shall comply with the appropriate requirements of Division 800, Materials, and the requirements noted in this Section, unless otherwise modified by plan details.

(b) REINFORCEMENT.

1. STRESSING STEEL.

Stressing steel shall be in accordance with the following unless otherwise specified by plan details:

Stressing Cable - ASTM A 416 - 1723 MPa Min. Tensile Strength. Designs using other strands may be submitted for consideration by the Bridge Engineer.

Stressing Bars -(For Span Sections Only) ASTM A 722 - Type I with Mill test reports including Supplementary requirements S1, S2, and S4.

2. STEEL REINFORCEMENT.

All reinforcing steel and wire fabric for concrete reinforcement shall meet the requirements of Section 835, unless otherwise specified on the plans.

(c) CONCRETE.

1. The Contractor shall submit a design to the Engineer for approval of all concrete to be used in the prestressed members. Prestressed concrete shall have a minimum 28-day cylinder strength of 5000 psi {35 MPa} or the minimum 28-day cylinder strength specified by the plans.

2. An approved air entraining agent shall be used to obtain an air content of four percent plus or minus one percentage point.

Other approved admixtures may be used to increase workability of the concrete. Slump requirements shall be a maximum of 3 inches {75 mm} plus 1/2 inch {13 mm} tolerance except when a water reducing agent is used, then a maximum slump of 4 inches {100 mm} plus 1 inch {25 mm} tolerance may be used. When a high range water reducing agent is used, a slump requirement greater than 4 inches {100 mm} may be requested by the Contractor in the concrete mix design request submitted to the Engineer for approval.

3. The size of coarse aggregate shall not be larger than 1/5 of the narrowest dimension between sides of the forms of the member being cast nor larger than 3/4 of the minimum clear spacing between individual reinforcing bars or bundles of bars.

4. All materials used in manufacturing the concrete shall comply with the requirements of the Standard Specifications.

513.03 Construction Requirements For Manufacture and Installation.

(a) GENERAL.

All materials, details, and procedures shall be as specified herein, noted on the plans, or directed by the Engineer.

The manufacture of prestressed concrete items shall be in accordance with the procedures in ALDOT-367, "Guidelines For Inspection of Prestressed and Post-tensioned Concrete Items." The Engineer's interpretation of ALDOT-367 will be final. The suggested and recommended specifications in

the above procedure shall apply and will be used in the manufacture of prestressed members, unless otherwise specified by plan details or this specification.

The prestressed concrete manufacturing plant shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program. The Manufacturer shall submit proof of certification prior to the start of production. The plant's certification shall be in the appropriate product group and category for the products being produced by the plant.

(b) MANUFACTURE.

The Contractor shall submit to the Bridge Engineer for approval shop drawings showing complete details of prestressed and post-tensioned concrete items as specified in Subarticle 105.02(c) and his proposed tensioning and de-tensioning procedure.

Within 30 days after the award of the contract, the Contractor shall notify the State Bridge Engineer in writing of the name and address of the fabricator of the bridge members. The notification shall include the fabricator's proposed fabrication schedule.

Each production line shall be equipped with a complete set of forms so that all members cast can be cast in one operation. Members shall be cast and cured in one operation and movement of forms from or within a production line will not be permitted until the next day.

Bearing and anchorage of the prestressed concrete members shall be in accordance with the plan requirements. Jacks and Gages, Load Cells, Dynamometers, etc., used for stressing/tensioning shall be calibrated in accordance with the procedures in ALDOT-358, Jack Calibration Procedure.

Forms for pretensioning members shall be so designed and aligned that they will not restrict the longitudinal movement of the casting when the prestressing force is transferred.

For prestressed I-shaped bridge beams of depths not more than 4.0 feet {1.2 m}, the concrete should be placed in at least two continuous horizontal layers in the forms and in at least three layers for prestressed I-beams of greater depth, unless otherwise specified.

Forms for post-tensioning members shall be so designed that members will not be damaged when prestressing force is transferred. Unbalanced post-tensioning will not be permitted.

Forms shall be inspected and approved by the Engineer prior to authorizing casting operations. Keyways, countersunk keys, and other configurations shown by the plans shall be built into the forms. Tops of headers shall be in the same plane as the top of side forms. The dimensional location of the top of the headers and side forms shall be the same on all forms used in a production of a particular type or size member. Worn, damaged, or otherwise unacceptable forms shall be repaired before casting operations will be authorized.

The transfer of prestressing force shall be done when the concrete has reached a strength of 4000 psi {30 MPa}, unless otherwise specified by plan details.

Curing of units shall be in accordance with the provisions of Subarticle 501.03(m).

(c) TESTING.

1. CONCRETE.

At least six standard test specimens shall be prepared at the time the concrete is deposited for each production line to determine the concrete strength of the casting at different ages. The Contractor shall provide adequate equipment and facilities to test and store the concrete cylinders in accordance with AASHTO requirements on or near the fabrication yard. The equipment shall include a hydraulic compression testing machine which has been properly calibrated.

2. STRESSING STEEL AND REINFORCING STEEL.

Sampling and testing shall be in accordance with current Departmental policy.

3. MISCELLANEOUS ITEMS AND ACCESSORIES.

Sampling and testing of miscellaneous items and accessories shall be in accordance with the provisions for the type item provided under the appropriate Section in Division 800, Materials, and the current Departmental policy.

Miscellaneous hardware for precast deck span sections such as machine bolts, nuts, washers, plates, etc. shall be hot dipped galvanized common stock hardware items, unless otherwise specified by plan details.

4. DIMENSIONAL AND SURFACE TOLERANCES.

In addition to the requirements noted in ALDOT-367, roadway surfaces of span sections shall not vary more than 1/8 of an inch {3 mm} from a 10 foot {3 m} straight edge.

5. CAMBER OF MEMBERS.

For span sections at the time of shipment, the total camber shall be between 0 and + 1/2 inch {+ 13 mm}.

For pretensioned AASHTO girders, the camber shall be as indicated by plan details.

(d) SURFACE FINISH OF UNITS.

All units shall receive a Class 1 finish and in addition all outside AASHTO girders shall receive a Class 2 finish, all in accordance with the provisions of Subarticle 501.03(l), unless otherwise provided in the proposal or by plan requirements. When a Class 2 finish is required, it shall be the same as to be used on the other portions of the bridge structure, and the final finish shall not be applied until after the concrete deck is in place on the girders. It will not be necessary to fill small holes in the surface of the prestressed AASHTO girders caused by entrapped air where a Class 2 Surface Finish is not required.

The roadway surface of precast span sections shall receive a wood float finish.

(e) HANDLING, STORING, AND TRANSPORTING.

The Contractor shall be responsible for the proper handling, storage, and transporting of precast members. While lifting or storing precast members, the tops of each shall be placed upward. Lifting hooks or similar devices for lifting shall be placed at points close to each end of span. They shall be of sufficient strength and embedment to provide safe handling of the elements. Blocking under units during storage and handling shall be placed close to ends of span only. Lifting devices shall be of sufficient size and capacity to insure safe handling during moving of units.

(f) ERECTING AND PLACING.

1. GENERAL.

Any unit cracked or otherwise damaged in either handling or placing will be evaluated by the Engineer as to whether the damage is minor and may be repaired, or whether it will be rejected. Any repair shall be made in a manner acceptable to the Engineer, and the Engineer's ruling on the unit's acceptability will be final.

2. PRETENSIONED - PRESTRESSED GIRDERS.

The moving and placement of the girders shall be such that the units are lifted and/or supported at the points shown on the plans or at the supporting points of the unit when it is put into service.

Care shall be taken to insure proper placement on anchor bolts and that the anchor bolts are tightened and secured as noted in the plan details.

3. PRESTRESSED CONCRETE SPAN SECTIONS.

In the installation of span sections, care shall be taken to match the units so that the surface differentiation between adjacent units do not exceed 1/4 of an inch {6 mm}. Span sections which do not meet the surface differentiation requirement will be rejected; however, the rejected unit may be used in a different position in the structure or in another structure provided the surface differentiation requirement is met.

After placing the units in a structure, they shall be bolted together as shown by plan details to provide a snug tight fit. If the flat washers, bolt heads, or nuts do not indicate uniform bearing on each other and the concrete, an appropriate sized beveled washer shall be provided. Snug tight is defined as the tightness such as can be produced by one or two solid blows from an impact wrench or by full effort of a person using an ordinary 2 foot {610 mm} spud wrench. After obtaining the proper bolt fit, the threads shall be burred to prevent removal.

Upon satisfactory completion of the bolting up operation, the concrete keyway shall be poured using a 4000 psi {30 MPa} concrete (the Contractor shall have a design mix for the concrete, approved in the same manner noted in Subarticle 513.02(c)) which has been retempered. This pouring operation requires the following sequence: 1. Standard mixing of the concrete shall be completed a minimum of 45 minutes in advance of placing; 2. The mix shall be retempered by remixing the concrete without additional water just prior to placing; 3. The concrete mix shall be placed in the keyway, tamping and packing the mix as necessary to insure complete filling of the joint; 4. The exposed surface of the joint shall be struck to the same elevation of the adjoining deck sections and the surface given a wood float finish.

(g) ACCEPTANCE OF UNITS.

Preliminary acceptance of units will be based on compliance with plan dimensions, the details noted herein, and concrete cylinder tests.

Final acceptance of the units will be based on the preliminary approval and the satisfactory installation of the units in the structure in accordance with the plan requirements.

513.04 Method of Measurement.

(a) ITEM NO. 513-A.

The number of pretensioned-prestressed concrete girders of each length and type measured for payment will be the actual number of girders of each length and type ordered, installed, and accepted.

(b) ITEM NO. 513-B.

The length of pretensioned-prestressed concrete girders measured for payment will be the ordered length of each type ordered, installed, and accepted. The length measured for payment will be the casting length shown on the approved shop drawings minus any allowances for elastic shortening and shrinkage for each girder. This will be the length recorded on the Shipping Notice (BMT-139) prepared by the Department's Plant Inspector and shipped with the girders.

(c) ITEMS 513-C and 513-D.

The number of precast (post-tensioned or pretensioned) concrete span sections of each type and dimension, complete in place and accepted, will be the actual number of units ordered and accepted completed in place in a bridge structure.

(d) RELATED ITEMS.

Items not specifically covered by the unit price coverage noted in Subarticle 513.05(a) necessary to complete the bridge structure will be measured and paid for under the appropriate item of work noted elsewhere in Sections 501, 502, 508, and 510 of the Standard Specifications.

513.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. ITEMS 513-A and 513-B.

The accepted pretensioned-prestressed concrete girders, measured as noted above, will be paid for at the respective unit price bid for each of the type girders designated on the plans or proposal. Said price shall be full compensation for furnishing all materials, manufacturing, and installation of the girders, including premolded bituminous filler, and all necessary accessories; for all items cast into the concrete, including metal bearing plates, and studs welded to these plates; for obtaining a Class 2 surface finish on the outside of all exterior girders; and for all other materials, equipment, tools, labor, and incidentals necessary to complete and place the girders into the proper position in the bridge.

The placement of the concrete slab and other related items of work which are to be measured for payment separately will be paid under their respective items of work.

2. ITEMS 513-C and 513-D.

Accepted pretension concrete deck span sections, measured as noted above, will be paid for at the respective contract unit prices each, for the respective type member of the depth, width, and length desired. Said unit price shall be full compensation for the manufacturing and furnishing of the member complete in place in the bridge, for necessary accessories, for all items cast into the concrete, for the tie bolts, for expansion and bearing materials, for cover concrete over fittings, for grout and grouting, for placement of keyways, for surface finishing and for all other materials, equipment, tools, labor, and incidentals required to complete the bridge, except structural steel and handrail.

3. PARTIAL PAYMENT.

Partial payments will be made in accordance with the following schedule:

Fabrication and Delivery to Approved Storage Site *

Erected and the Required Finish Applied to Girder Units or the Bolting Up and Casting of Keyway on Deck Units - 100%

* Reference is made to Article 109.07 concerning approved storage sites and partial payment for stored material.

Any unit that fails to meet the contract requirements or is damaged prior to acceptance of the project will be rejected by the Department and any partial payments made on the unit prior to its rejection will be recovered by the Department on the next monthly estimate or final estimate, whichever is applicable.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

513-A ___*__ Pretensioned-prestressed Concrete Girders, Type __** (SPECIALTY ITEM) - per each

513-B Pretensioned-prestressed Concrete Girders, Type ___** (SPECIALTY ITEM) - per linear foot {meter}

513-C Prestressed Concrete Interior Span Sections, ____ Wide by ____ Deep by ____ Long (SPECIALTY ITEM) - per each

513-D Prestressed Concrete Exterior Span Sections, ____ Wide by ____ Deep by ____ Long (SPECIALTY ITEM) - per each

* Length

** Type IM, IIM, IIIM, etc., as per AASHTO Classification.

SECTION 515
WATERPROOFING AND DAMPPROOFING

515.01 Description.

(a) GENERAL.

This Section shall cover the work of furnishing and applying a waterproofing or dampproofing surface to concrete in accordance with the methods prescribed for the several classes of waterproofing or dampproofing described below, each to be applied where called for on the plans and in conformity with the requirements of these Specifications.

(b) METHODS.

The following four classes of waterproofing and one of dampproofing are covered by these Specifications:

1. CLASS A WATERPROOFING.

Prime coat, mop coat of hot asphalt, and 2 alternate layers of fabric and moppings of hot asphalt.

2. CLASS B WATERPROOFING.

Prime coat, mop coat of hot asphalt, and 2 alternate layers of fabric and moppings of hot asphalt with a mortar protection course.

3. CLASS C WATERPROOFING.

Prime coat, mop coat of hot asphalt, and 2 alternate layers of fabric and moppings of hot asphalt with an asphalt plank protection course.

4. CLASS D WATERPROOFING.

Manufactured waterproofing products.

5. DAMPPROOFING.

Prime coat and 2 mop coats of hot asphalt.

515.02 Materials.

(a) GENERAL.

All materials shall conform to the provisions of Division 800, Materials. Specific reference is made to the following:

Section 802, Fine Aggregates.
Section 805, Mineral Filler.
Section 815, Cement.

(b) PRIMER.

Primer used with asphalt mop coats shall meet the requirements of ASTM D 41.

(c) MOP COAT.

Asphalt for mop coat shall meet the requirements of ASTM D 449, Type I, II, or III as designated by plan details; however, unless otherwise designated, Type II shall be used.

(d) WATER PROOFING FABRICS.

Waterproofing fabric shall be woven cotton fabric meeting requirements of ASTM D 173.

(e) ASPHALT PLANK.

Asphalt plank shall be in accordance with requirements of ASTM D 517.

(f) CLASS D WATERPROOFING MATERIALS.

All Class D Waterproofing materials furnished by the Contractor for use shall be listed on List II-10, WATERPROOFING MATERIALS, of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

(g) MORTAR FOR PROTECTION COURSE.

Mortar for protection course shall be in accordance with requirements of Section 611.

515.03 Construction Requirements.

(a) CLASS A WATERPROOFING.

1. PREPARATION OF SURFACE,

The surface to be waterproofed shall have cured for at least seven days and shall be reasonably smooth and free from projections or depressions which might cause puncture of the membrane. The surface shall be dry, so as to prevent the formation of steam when the hot asphalt is applied, and immediately before the application of the waterproofing, the surface shall be thoroughly cleaned of dust and loose material.

No waterproofing shall be done in wet weather nor when the temperature is below 60 ºF {15 ºC}, without special authorization from the Engineer.

2. APPLICATION.

The surface to be waterproofed shall be given a complete coat of primer which shall be permitted to set before the first mop coat is applied.

Asphalt shall be heated to a temperature between 300 ºF {150 ºC} and 350 ºF {175 ºC} with frequent stirring to avoid local overheating. Heating kettles shall be equipped with thermometers and oil jackets.

In all cases, the waterproofing shall begin at the low point of the surface to be waterproofed so that water will run over and not against or along the laps.

The first strip of fabric shall be of half width; the second shall be full width, lapped the full width of the first sheet; and the third and each succeeding strip shall be full width and lapped so that there will be two layers of fabric at all points with laps not less than 2 inches {50 mm} wide. All end laps shall be at least 12 inches {300 mm}.

Beginning at the low point of the surface to be waterproofed, a section of about 20 inches {500 mm} wide and the full length of the surface shall be mopped with the hot asphalt and there shall be rolled into it, immediately following the mop, the first strip of fabric, of half width, which shall be carefully pressed into place so as to eliminate all air bubbles and obtain close conformity with the surface. This strip and an adjacent section of the surface of a width equal to slightly more than half the width of the fabric being used shall then be mopped with hot asphalt and a full width of fabric shall be rolled into this, completely covering the first strip, and pressed into place as before. This second strip and an adjacent section of the concrete surface shall then be mopped with hot asphalt and the third strip of fabric shingled on so as to lap the first strip not less than 2 inches {50 mm}. This process shall be continued until the entire surface is covered, each strip of fabric lapping at least 2 inches {50 mm} over the second preceding strip. The entire surface shall then be given a final mopping of hot asphalt.

The completed waterproofing shall be a firmly bonded membrane, composed of an asphalt prime coat, a mopping of asphalt, and two alternating layers of fabric and moppings of asphalt. Under no circumstances shall one layer of fabric touch another layer at any point or touch the surface of concrete, as there must be at least three complete moppings of asphalt.

In all cases the mopping on concrete shall completely cover the surface and on cloth it shall be sufficiently heavy to completely conceal the weave. On horizontal surfaces not less than 12 gallons {5 L} of asphalt shall be used for each 100 square feet {each square meter} of finished work and on vertical surfaces not less than 15 gallons per 100 square feet {6 L/m^2} shall be used. The work shall be so regulated that at the close of a day's work all cloth that is laid shall have received the final mopping of asphalt. Special care shall be taken at all laps to see that they are completely sealed down.

3. DETAILS.

At the edges of the membrane and at any points where it is punctured by such appurtenances as drains or pipes, suitable provisions shall be made to prevent water from getting between the waterproofing and the waterproofed surface.

All flashing at curbs and against girders, spandrel walls, et cetera, shall be done with separate sheets lapping the main membrane not less than 12 inches {300 mm}. Flashing shall be closely sealed either with a metal counter flashing or by embedding the upper edges of the flashing in a groove poured full of joint filler.

Joints which are essentially open joints, but which are not designed to provide for expansion, shall be caulked with oakum and lead wool and then filled with an approved bituminous material before the membrane is placed.

Expansion joints, both horizontal and vertical, shall be provided with sheet copper in "U" or "V" form and premolded joint filler as called for on the plans. Expansion joints shall be sealed on the face adjacent to the membrane with an approved bituminous material. The membrane shall be carried continuously across all expansion joints.

At the ends of the structure the membrane shall be carried well down on the abutments and suitable provision made for all movement.

4. DAMAGED MEMBRANE PATCHING.

Care shall be taken to prevent injury to the finished membrane. Any damage which may occur shall be repaired by patching, utilizing original waterproofing methods as set forth above. Patches shall extend at least 12 inches {300 mm} beyond the outermost damaged portion and the second ply shall extend at least 3 inches {75 mm} beyond the first.

5. BACKFILLING.

No backfilling shall be done without the permission of the Engineer, and in no case, until the final mop coat has hardened. Backfill shall be placed in such a manner that the waterproofing will not be damaged. No stones, broken concrete, bricks, or other material likely to damage the membrane shall be placed adjacent to waterproofed surfaces.

(b) CLASS B WATERPROOFING.

In addition to the requirements for Class A Waterproofing noted in Subarticle (a) above, Class B Waterproofing shall require a mortar protection layer as follows:

Mortar Protection Layer.

Over the waterproofing membrane constructed as specified in Subarticle (a) above, there shall be constructed a protection layer which, unless otherwise specified or shown on the plans, shall be a 2 inch {50 mm} thickness of Portland cement mortar. This mortar layer shall be reinforced midway between its top and bottom surfaces with wire netting of 6 inch {150 mm} mesh and 12 gage {2.7 mm} wire or its approved equivalent. The top surface shall be troweled to a smooth, hard finish and, where required, true to grade.

On undercut surfaces (the underside of surfaces making an angle of less than 90° with a horizontal plane) the membrane shall be protected with a layer of 3-ply roofing felt laid in hot asphalt in lieu of the mortar covering. The asphalt used for this purpose shall be the same as that used in building up the membrane.

The construction of the protection course shall follow the waterproofing so closely that the latter will not be exposed without protection for more than 24 hours.

The protection course shall be cured in accordance with the requirements for curing concrete, Section 501.

No backfilling shall be done until the protection course has been in place seven days.

(c) CLASS C WATERPROOFING.

In addition to the requirements for Class A Waterproofing noted in Subarticle (a) above, Class C Waterproofing shall require an asphalt plank protection layer as follows:

Asphalt Plank Protection Layer.

Over the waterproofing membrane constructed as specified in Subarticle (a) above, there shall be constructed a protection layer of plain asphalt plank 1.25 inches {32 mm} thick, Whole planks, in regular, straight courses, shall be used except as required to make closures and trim around openings and obstructions. Closing and trimming pieces shall be carefully cut to size. The entire surface of the membrane shall be covered with the plank. Before laying, all surplus talc or other powder shall be removed from the plank with a stiff brush or broom. Each plank shall be laid in a mopping of hot asphalt and the edge and end of planks in place shall be coated with hot asphalt before

the next plank is placed. The asphalt used for this purpose shall be the same as that used in building up the membrane. Each individual plank shall be crowded tightly against the adjacent plank and the completed work shall have a uniform smooth surface without open cracks or spaces.

(d) CLASS D WATERPROOFING.

Waterproofing materials for Class D Waterproofing shall be installed in accordance with the manufacturer's requirements.

No backfilling shall be done without the permission of the Engineer. Backfill shall be placed in such a manner that the waterproofing will not be damaged. No stones, broken concrete, bricks, or other material likely to damage the waterproofing material shall be placed adjacent to waterproofed surfaces.

(e) DAMPPROOFING.

1. PREPARATION OF SURFACE.

The provisions of Subarticle (a) above shall govern.

2. APPLICATION.

Surfaces to be dampproofed shall be given one coat of hot primer before the first mop coat. The primer shall be well worked in to give a uniform coating. The priming coat shall be applied approximately 24 hours before applying the first mop coat. The primer shall be dry before this first mop coat is applied.

After the primer is dry, the first mop coat of asphalt shall be applied hot over the entire surface to be dampproofed and well worked in. After the first mop coat is dry, a second mop coat shall be applied. The amount of material for each mop coat shall be not less than 4.5 gallons per hundred square feet {2 L/m^2} of surface.

Asphalt shall not be heated above a temperature of 350 ºF {175 ºC}. The material shall be stirred frequently while being heated. Kettles shall be equipped with armored thermometers and oil jackets.

Backfilling shall be as provided by Subarticle (a) above.

515.04 Method of Measurement.

The quantity of Waterproofing and Dampproofing to be paid for under this Section shall be the actual number of square yards {square meters} of waterproofing of the various types as previously described and dampproofing, respectively, measured in place, completed and accepted.

515.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The quantity of Waterproofing and Dampproofing, measured as provided above, will be paid for at the contract unit price per square yard {square meter} for the particular type of waterproofing specified, which price and payment shall be full compensation for furnishing and placing all materials, including the protection course, and for all equipment, tools, and labor necessary for the satisfactory completion of the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

515-A Class ___ Waterproofing - per square yard {square meter}
515-B Dampproofing - per square yard {square meter}

SECTION 517
BRIDGE AND SIDEWALK HANDRAIL

517.01 Description.

This Section shall cover the work of fabricating, furnishing, and installing handrail on structures in accordance with details and at the location shown on the plans, all in conformity with the requirements noted herein or shown on the plans.

517.02 Materials.

Materials used in fabrication and installation shall conform to the applicable Section of the Specifications that the structure to which the railing is to be attached was constructed, the details shown on the plans, and the following:

Galvanized Steel Pipe Handrail. Galvanized steel pipe shall meet the requirements of ASTM A 53, Grade B; this grade of pipe to include rail elements and post..

Steel shapes, plates, and accessories shall be structural or alloy steel galvanized in accordance with AASHTO M 111.

Bolts, nuts, washers, and other fasteners shall be galvanized in accordance with AASHTO M 232, Class C, with nuts tapped after galvanization in accordance with AASHTO M 291 {M 291M}.

Galvanized Steel Handrail. Galvanized steel shall be structural or alloy steel, hot dipped galvanized after fabrication in accordance with AASHTO M 111.

Bolts, nuts, washers, and other fasteners shall be galvanized in accordance with AASHTO M 232, Class C, with nuts tapped after galvanization in accordance with AASHTO M 291 {M 291M}.

Beam Type Handrail. Beam type handrail shall meet the requirements for beam guardrail as provided in Sections 630 and 864.

Aluminum or Galvanized Steel Sidewalk Handrail. Material for use in aluminum or galvanized steel sidewalk handrail shall meet the requirements specified on the plans.

Concrete Handrail. Concrete handrail shall be cast-in-place type conforming to the appropriate requirements of Section 501 and the details shown on the plans.

Posts for Beam Type Handrail. Steel posts shall meet the requirements of Sections 836 and 864.

Timber posts shall be creosote-treated in accordance with Section 833.

517.03 Construction Requirements.

Rail shall be erected in accordance with the best construction practices and in conformity with lines, elevations, and other details indicated on the plans.

The plans will show construction details and will specify the type or alternate types of handrail to be used.

Where the Contractor is permitted to choose the type rail he wishes to use, he shall indicate in the proposal his choice. One type, once selected, shall be used throughout the project.

517.04 Method of Measurement.

The accepted bridge and sidewalk handrail will be measured in linear feet {meters}, to the nearest 0.1 of a foot {0.1 m}, along the axis of the top rail between extreme limits of the handrail without deductions for laps, posts, or joints.

All stair railing, posts, and appurtenances for one stair tower, including pipe railing on the superstructure but not a part of the bridge or sidewalk handrail, installed and accepted complete in place will be measured as one set of stair railing.

No measurement or separate payment will be made for post or miscellaneous hardware required for installation of handrail and stair railing, such being considered incidental to the installation of the rail.

517.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of linear feet {meters} of bridge and/or sidewalk handrail and the number of sets of stair tower handrail, measured as provided above, will be paid for at the contract unit prices of the appropriate pay items complete in place, which shall be payment in full for all materials including rail elements, posts, hardware, and paint; for forms; for constructing, bracing, and erecting; and for all equipment, tools, labor and incidentals necessary to complete the items in accordance with plans and specifications.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

517-A __*__ Handrail - per linear foot {meter}
517-B Beam Type Handrail, Type Posts - per linear foot {meter}
517-C Type Railing Stair Railing - per set
517-D Aluminum/Galvanized Steel Sidewalk Handrail - per linear foot {meter}
* Galvanized Steel, Galvanized Steel Pipe, or Cast-In-Place Concrete

SECTION 520
REPAIR OR RAISING EXISTING BRIDGES

520.01 Description.

This Section shall cover the work of furnishing all materials, tools, equipment, labor, falsework, or cribbing and all incidental items necessary to repair members or portions of an existing bridge or change the elevation of an existing bridge as may be required by the detailed plans.

The work shall also include the removal and satisfactory disposal of all waste material, damaged portions replaced, and all falsework and/or temporary bracing, etc.

520.02 Materials.

Since the majority of the work required under this Section is primarily a work item, materials not to be incorporated into the completed structure shall be of such quality as to serve the needs adequately. However, any material which is to become a part of the completed structure shall meet the requirements of Division 800, Materials, for the respective type of member or part involved.

520.03 Construction Requirements.

(a) REPAIRING OF EXISTING BRIDGE.

The Contractor shall assemble all materials and equipment required to complete the repairs on any particular member of the bridge and shall adequately strut and brace members which are to be cut to ensure maintaining correct distance between joints and provide temporary load carrying members and supports during such time as members are cut, prior to the cutting of any main member. Prior to beginning work, the Contractor shall submit to the Engineer his plans for bracing main members for approval.

(b) RAISING EXISTING BRIDGE.

The Contractor shall furnish sufficient equipment of adequate capacity to raise any particular unit of the bridge, or the entire bridge, without injury to same, giving (1) uniform support and bearing at sufficient intervals and (2) adequate falsework, each as approved by the Engineer to support safely the portion of or the entire bridge while being raised until it is set on its new permanent supports. Prior to beginning work the Contractor shall submit to the Engineer (1) his plans for falsework and (2) list of equipment proposed for use. Both of these must be approved before the actual raising operation begins.

When raising of a bridge involves a truss structure, the Contractor may be permitted to remove existing trusses from the bridge piers and store them at an approved storage site, provided a satisfactory method of removal, transporting, and re-installation of the trusses is submitted and approved by the Bridge Engineer. In such event the Contractor shall make all necessary arrangement for and furnishing of any storage area.

NOTE: Storage areas must be approved by the Engineer, and a site will not be considered for approval unless the proposed site is under the direct control of the Contractor and its location is either on the project or in close proximity thereto.

520.04 Method of Measurement.

Each existing bridge to be repaired, raised, or bridge having a portion or portions of same to be repaired or raised will be shown on the plans and in the proposal by its station number, and for the purpose of measurement and payment will be considered a complete and separate unit.

520.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. ITEM 520-A.

Payment for repairs to existing bridge shall be made at the contract bid price (lump sum) which shall be payment in full for all material, equipment, tools, labor, falsework, struts, support, and incidentals necessary to complete the work required by this Section and detailed in the plans.

2. ITEMS 520-B AND 520-C.

Payment will be made at the respective contract lump sum prices for items of raising existing bridges or portions of existing bridge at designated stations listed in the contract. The lump sum price shall be payment in full for the furnishing of all equipment, tools, labor, falsework and/or

cribbing, storage area, and incidentals necessary to complete the work including the removal and satisfactory disposal of falsework and/or cribbing.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

520-A Repairs to Existing Bridge, Station _____ - per lump sum
520-B Raising Existing Bridge, Station _____ - per lump sum
520-C Raising Portion of Existing Bridge, Station _____ - per lump sum

SECTION 521
STEEL BRIDGE COATING

521.01 Description.

This Section shall cover the work of shop and field coating of structural steel portions of bridges.

The details described are applicable regardless of whether the coating of a new structure is included in the cost of the steel or the proposal provides for separate payment for the field application of the coating. Included also is the cleaning, conditioning, and field coating of an existing bridge for which the proposal provides for payment. The term "existing" being interpreted to mean "not newly constructed", or already in place (i.e. maintenance application of coatings).

521.02 Materials.

Materials shall conform to the provisions of Division 800, Materials. Specific reference is made to Section 836, Structural Steel, Fasteners and Miscellaneous Metals and to Section 855, Coatings, Paints, Enamels, and Varnishes for Metal and Wood Structures.

521.03 Construction Requirements.

(a) GENERAL.

1. COATING SYSTEMS.

A coating system shall consist of the coating components as specified in Subarticle 855.05, unless shown otherwise on the plans. The Contractor shall notify the Project Engineer by letter, with a copy to the Bridge Engineer if on new construction, of the name and address of the supplier of the coating system along with the name and the supplier number of the primer, intermediate, and top coats to be used.

The type of coating system to be used will be shown on the plans or in the specifications.

2. APPLICATION.

All coats shall be installed in accordance with the manufacturer's instructions and precautions for use.

If requested by the Engineer, the Contractor shall have a representative of the coating manufacturer present at the beginning of the application of the coats. The representative shall remain for a period of time determined by the Engineer as necessary to insure the coatings are being applied satisfactorily.

Coats shall be applied by spray. Rollers may be permitted on flat surfaces if the manufacturer's instructions for application allow the use of rollers.

Regardless of the method of application, the coats shall be applied uniformly to insure complete coverage and to give the required thickness on all metal.

The coating shall be kept properly mixed at all times during application.

Equipment for spraying shall have the ability to produce satisfactory results without use of thinner, unless the use of such is recommended by the coating manufacturer. Only skilled operators shall be used for spray equipment. If drift becomes a problem, the Engineer may require spraying to be suspended until conditions are favorable. Spray equipment shall include traps or separators to remove oil and water from the compressed air. Care shall be taken against excessive loss by overspraying. The spray equipment shall be kept clean so that dirt or dried coating material or other foreign materials are not deposited in the coat film.

Subsequent coats shall not be applied over a previously applied coat prior to the recoat time specified by the manufacturer.

3. NUMBER, THICKNESS, AND COLOR OF COATS.

After erection, all metal work on which the prime coat has been applied in the mill or shop shall be coated with the number of coats specified for the system used. All metal work that has

not been coated in the mill or shop shall be coated with all required coats after erection is complete at the job site in conformity with the requirements of Item 521.03(a)1. The color and dry film thickness of each coat shall be as specified in Article 855.05.

(b) CLEANING SURFACES.

1. GENERAL.

Unless noted otherwise on the plans, for coating System 1, the surfaces that are to be coated shall be blast cleaned with an acceptable abrasive to conform to the requirements of Steel Structures Painting Council specification SSPC-SP-10 Surface Preparation Specification No. 10 - "Near White Metal" Blast Cleaning, inclusive.

Unless noted otherwise on the plans, for coating System 2, the surfaces that are to be coated shall be blast cleaned with an acceptable abrasive to conform to the requirements of Steel Structures Painting Council specification SSPC-SP-6 Surface Preparation Specification No. 6 - "Commercial" Blast Cleaning, inclusive.

After blast cleaning, the anchor pattern shall be 25 - 75 μm deep in a dense and uniform pattern of depressions and ridges, as determined by use of a press-o-film type tape and a spring micrometer or equal as approved by the Department, for all coating systems. The press-o-film type tape and a spring micrometer shall be provided by the Contractor.

Unless noted otherwise on the plans, for coating System 3, the surfaces that are to be coated shall be prepared by hand or power tool cleaning, water jetting, or other means to remove loose paint and loose rust.

Before the application of the primer to the blasted surfaces, the metal shall be brushed with clean bristle brushes, or blown with compressed air or vacuumed to remove all traces of loose dirt from the surface and to remove abrasive deposits from cracks, crevices, corners, and pockets. Oil and grease shall be removed by means of a suitable solvent. On welded work, care must be taken prior to blasting to remove all weld spatter, flux, slag, fume, and other objectionable deposits and, if required by the Engineer, to neutralize the area of the weld with suitable chemicals. Any area repaired by grinding or any other method after blasting shall be reblasted if deemed necessary by the Engineer.

The primer coat shall be applied at the time recommended by the coating manufacturer, if that time is less than twenty-four hours after cleaning. The primer coat shall always be applied within twenty-four hours after cleaning. Under no circumstances shall the steel be permitted to rust before coating, regardless of the time elapsed. The occurrence of rusting after cleaning shall be sufficient cause to require recleaning by blasting or other methods approved by the Engineer.

The fabricator’s Quality Control and/or coatings department personnel shall be responsible for checking and recording (daily) the coating-related processes at the outset of the coating operations. This information shall be provided on a form furnished by the fabricator and shall contain at least the ambient temperature, steel temperature, relative humidity, dewpoint, average anchor profile, paint system number, batch number, time and date blasted, and time and date painted. After each required coat of paint has cured, the average coating thickness of each coat on each member shall be recorded. Minimum and maximum thickness as specified on the manufacturer’s written data shall be required. The averages shall be taken from three evenly divided sections over the length and on each side of the member under examination. The averaging shall be based on SSPC-PA2 guidelines. Forms shall be signed by a Q.C. inspector and a copy given to the ALDOT representative prior to final approval of fabricated items. Manufacturers’ certifications of all batch numbers of paint being used are also required prior to final approval. Average anchor profile of blasted steel shall be checked using press-o-film type tape. The actual press-o-film type tape used shall be included with the copy of the paint records. Where materials other than beams and girders have been accumulated during a single shift or production run, the anchor profile of randomly selected members shall be checked.

No coat shall be applied until the surface to be coated has been inspected and approved by the fabricator's Quality Control Inspector. This applies to additional coats as well as the surface of the steel after dirt, rust, scale, loose coating material, and salts have been removed.

The Contractor shall dispose of any accumulated debris in accordance with the requirements of the Alabama Department of Environmental Management (ADEM). Any testing that may be required by the ADEM to be performed on this debris shall be the responsibility of the Contractor.

2. REMOVAL OF COATINGS AND CONTAINMENT SYSTEM.

a. General.

The preparation of surfaces for the application of System 1 or System 2 coatings, will require a containment system, unless otherwise designated on the plans. The preparation of surfaces for the application of System 3 coatings, will not require a containment system, unless otherwise designated on the plans. When the use of a containment system is required, all coating material and waste debris shall be collected, contained, and disposed of in a manner which will prevent their release into the environment, and in an effective way to protect workers from exposure to hazardous materials.

The Contractor shall be responsible for attaining any required permits necessary to perform the work.

b. Worker Protection.

The Contractor shall comply with all requirements of the Occupational Safety and Health Administration (OSHA) and other applicable regulatory agencies with regard to exposure to hazardous materials in construction.

The Contractor shall be responsible for the training of all workers exposed to hazardous materials. The workers shall be informed of the hazards of exposure to these materials and trained in the precautions to take when performing the work.

The Contractor shall provide respiratory protection and protective clothing to all workers and persons entering the containment area that are exposed to hazardous materials. Protective clothing and equipment shall be approved by OSHA or other applicable regulatory agencies.

c. Containment System.

The containment system shall consist of vertical (and horizontal if necessary) screening with a collection/recovery area in position at all times that coating removal work is in progress. Screening material shall consist of approved material suitably stiffened by bracing to form an assembly with sufficient strength to withstand winds and adverse weather conditions normally encountered during the season in which the work is performed. The screening shall extend the full vertical distance between bridge steel and collection area. The containment system shall not cause a hazard to the traveling public.

The containment system shall be designed to have air-moving equipment capable of (1) maintaining OSHA acceptable airborne concentrations of hazardous material, (2) providing adequate worker visibility, (3) preventing any spent material or dust from leaving the enclosure, and (4) collecting the material for disposal. Air quality will be visually monitored by the Engineer. Any visible cloud of dust outside the containment structure shall be justification for suspension of the work.

Work shall not begin until the Contractor has furnished the Engineer with a containment plan for surface preparation operations and said plan has been reviewed and approved by the Construction Engineer. Such plan shall include:

(1) A work phase diagram describing how the debris shall be contained while blasting and coating operations are conducted.

(2) A detailed drawing and/or description of the enclosure listing the type of canvas, type of bracing material, type of connections to structure, type of dust collection equipment, and the type of containers to be used.

(3) The method for, and the place of, storage and disposal of contaminated debris shall be identified.

d. Collection, Storage, and Disposal.

Coating material and other debris shall be collected by the Contractor in the containment system and stored in approved containers for subsequent transportation to an approved disposal site. The Contractor shall store and dispose of contaminated debris in accordance with the requirements of the ADEM. Any testing required by the ADEM to be performed on the collected waste shall be the responsibility of the Contractor.

The Contractor shall collect representative samples of the waste, as generated, in the storage vessel. A composite sample shall be collected for each 40 cubic yards {30 m^3} generated per bridge site and analyzed for metals using the Toxic Constituents Leaching Procedure (TCLP) as specified in EPA manual SW-846. Adjacent dual bridges will be considered as one site, unless noted otherwise on the plans. All test results shall be submitted to the Engineer for coordination with the Materials and Tests Engineer. Waste which exceeds any regulatory threshold for a characteristic waste

shall be handled as a hazardous waste. The Contractor shall be responsible for complying with all hazardous waste rules and regulations of the EPA and the ADEM including, but not limited to, such things as generator I.D. numbers, labeling, manifesting, etc. The waste shall not be stored for over 90 days, it must be transported only by a permitted transporter, and must be disposed of in an authorized hazardous waste facility. No treatment shall be conducted at the point of generation. Any land ban certifications shall be the responsibility of the Contractor. The Contractor, acting on behalf of the Department, is the generator of the waste and shall sign any manifest or similar documents as such. The Contractor shall secure the approval of the Engineer for the transporter and the disposal facility at least five days prior to initiation of a shipment of waste. All personnel involved in the waste generation or handling shall be trained in accordance with EPA/OSHA directives.

Waste which does not exceed the regulatory threshold for a characteristic waste shall be handled as an industrial solid waste. It shall be stored in accordance with the ADEM (Land Division-Solid Waste Branch) directives. Disposal shall be in accordance with the ADEM guidelines at an ADEM approved facility. The Contractor shall secure, in writing, the ADEM authorization for said disposal. The Engineer shall be given a copy of the authorization upon receipt by the Contractor.

If contaminated material is transported to or through another state, work performed in that state shall be in conformance with any applicable regulatory agencies in the state involved.

(c) CONDITIONS FOR COATING APPLICATION AND SURFACE PREPARATION.

1. COATING.

Coating operations shall take place only when the surrounding air temperature or temperature of the steel is above 40 °F {5 °C} and not expected to drop to or below 32 °F {0 °C} prior to drying of the coating. Coatings shall not be applied to damp or frozen steel surfaces. Coatings shall not be applied when the steel surface is within 5 °F {3 °C} of the dew point or at relative humidities above 85%. Coating operations shall take place only during good weather conditions. Coatings shall not be applied during rain, snow, or fog conditions or when it is likely that moisture in the form of rain, fog, snow, or dew will contact coated surfaces which have not cured to water resistance.

2. SURFACE PREPARATION.

Surface preparation operations shall take place only in good weather conditions. Surface preparation shall not be performed on steel surfaces which may come into contact with rain, fog, snow, or dew prior to application of the coating. Surface preparation operations shall not take place when the steel surface is within 5 °F {3 °C} of the dew point or when the steel surface is below 32 °F {0 °C}. The equipment to check the dew point, humidity, and steel temperature shall be furnished by the Contractor.

(d) NEW CONSTRUCTION COATING.

1. PRIMER COAT.

a. General.

All metal work shall be coated in the shop (except for certain contact surfaces covered in Subitem b. below) with one primer coat of the prescribed coating, as provided by Item 521.03(a)1., unless otherwise specified on the plans.

b. Coating Application.

Shop contact (faying) surfaces shall not be coated. Surfaces not in contact, but which will be inaccessible after assembly or erection, shall be coated with all required coats before assembly or erection except for bolted field splice surfaces. After initial priming of fabricated items, seams not sealed by welding must be caulked with a sealant as per the paint manufacturer's recommendations. Any areas not readily accessible to spray painting operations, which are required to have a primer coat, shall have primer applied by other means. These areas would include, but shall not be limited to, all holes in fabricated items and all clips of stiffeners or gusset plates.

Immediately after all fabrication work is complete and has been accepted as such, all surfaces shall be coated with the primer coat of the specified coating system, except as specified in Article 836.50 and as follows:

Surfaces within 2 inches {50 mm} of field welds shall not be shop coated.

Members embedded or in contact with concrete slabs will not require coating, unless specified herein or by plan details. Coating of these areas or partial coverage due to overspray, etc. will be allowed provided the coating coverage does not exceed the requirements of the adjacent coated areas. Surfaces of members in contact with web walls shall be coated.

On expansion dams, all underside surfaces not in contact with concrete shall be painted with primer to the maximum thickness recommended by the coating manufacturer.

When an inorganic zinc primer coat is required, the area of the girder (web and flange), the splice plates, filler plates, gusset plates for all diaphragms, crossframes and lateral bracing, top of the top flange of steel members supporting concrete slabs, and the edges of the top flange shall be coated with the inorganic zinc primer in the shop. The slip coefficient testing shall be as specified in Article 855.03.

When an inorganic zinc primer coat is required, the intermediate coat shall not be applied until the primer coat has cured. The Contractor shall ensure that this does not occur by testing the primer coat curing by means of a method recommended by the coating manufacturer.

All overspray, loose or foreign, that would inhibit successful bonding of a subsequent topcoat shall be removed by a method approved by the manufacturer of the product.

c. Protection of Primer Coat.

The freshly coated steel shall not be handled or moved, except when unavoidable, until the coat is dry. All handling shall be performed using methods acceptable to the Bridge Engineer's representative. Storing shall be done in such a manner that the coating will not be removed or covered with dust, dirt, or other foreign material. The steel shall be loaded using methods acceptable to the Bridge Engineer's representative and shall be properly supported and secured so as not to damage the coating in shipment. Nylon tie-downs, or other materials approved by the Engineer, shall be used to secure the steel members during shipment.

d. Erection Marks.

Erection marks corresponding to those of the erection diagram shall be plainly marked upon coated surfaces.

2. INTERMEDIATE COAT AND TOPCOAT.

a. Field Cleaning.

Field cleaning shall cover the cleaning of all surfaces to be coated of salt, rust, loose scale, dirt, mortar, grease, or other foreign matter. In general, the choice of cleaning equipment shall be the Contractor's provided satisfactory results are obtained. Oil and grease shall be removed by the use of a suitable solvent. Care shall be taken not to damage an underlying coat; however, if damage occurs, the underlying coat or coats shall be immediately repaired. On welded work all slag, flux, and spatter shall be removed prior to coating.

b. Erection Coating.

Immediately after erection of materials (all connections complete), all splice plates, bolts, nuts, washers, and other portions of the structure (except portions in contact with the concrete slab) which have not received a shop applied primer coat shall be field cleaned and coated with a coat of the same coating used in the shop. Likewise, all surfaces that have been scraped, chipped, or otherwise damaged during erection or areas that have deteriorated since the shop applied primer coat was applied, shall be renewed prior to application of the next coat with an approved touch-up coating compatible with the primer and next coat.

All of the above is considered a part of the erection process and must be completed before consideration will be given for partial payment under the category of erected as covered in Article 508.05.

c. Field Coating.

The intermediate coat and/or topcoat shall not be applied until the requirements of Subitems a. and b. above have been accomplished. The coating of spans with a concrete deck shall not be done until after the deck is placed. All concrete spills and splashes shall be washed from the structural steel prior to the mortar taking a set.

In no case shall a succeeding coat be applied until the previous coat has dried throughout the full thickness of the coating film.

The coatings shall be protected from discoloration or disfigurement by dust, insects, or other cause until dry. The Contractor shall protect pedestrian, vehicular, and other traffic upon or underneath the bridge and also all portions of the bridge not to be coated against damage or disfigurement by spray, spatters, splashes, and smirches of coating material. If in the opinion of the Engineer, traffic produces an objectionable amount of dust, the Contractor shall, without extra compensation, allay the dust for the necessary distance on each side of the bridge, and take any other precautions necessary to prevent dust and dirt from coming in contact with freshly coated surfaces. It shall be the Contractor's responsibility to protect all property, public and private, from coating damage.

(e) RECOATING EXISTING BRIDGES.

1. CLEANING METAL.

All portions of steel and other metals of existing structures to be coated shall be cleaned in accordance with Item 521.03(b)1. Steel and other metals shall consist of the metals of the substructure and superstructure structural steel areas and contiguous metal surfaces, and such surfaces as galvanized pipe, conduits and junction boxes, metal ladders, gratings, railings, platforms, operator's houses (metal or other material), navigation light stands, guyed masts, supporting overhead cable (excluding public utility masts, cable brackets and appurtenances), traffic gate housing, metal drains on steel spans, and surfaces of all machinery housing and parts that do not require lubrication. Any cleaning that is deemed by the Engineer to be harmful to the metal shall be discontinued.

2. PRIMER COAT.

All surfaces ordered cleaned as provided in Item 1 above shall be coated with the primer coat for System 1 or 2 coatings. For System 3 coatings cleaned in accordance with Item 1 above, only the bare spots shall be primed. If all coatings are removed to a blast cleaning of SSPC 6 or better, a primer coat will not be required.

3. INTERMEDIATE COAT AND/OR TOPCOAT.

Following the application of the primer, recoating shall consist of applying the intermediate coat specified for the chosen system. Following the application of the intermediate coat for a three coat system, recoating shall consist of applying the topcoat chosen for that system. These coats shall be applied to all metal surfaces listed in Item 1 above. For System 3 coatings, only one full coat at the manufacturer’s recommended thickness will be required, unless noted otherwise on the plans. An additional coat as specified in List III-1 of the Department's "Materials, Sources, and Devices with Special Acceptance Requirements" manual may be required by plan note to prevent chalking or to change the color.

The coats shall be protected as required in the third paragraph of Subitem 521.03(d)2.c.

521.04 Method of Measurement.

The completed and accepted work shall be measured in lump sum units, each identified by station number or mile {kilometer} post number in the proposal.

521.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Separate payment for applying a coating to a new bridge will be made only when the proposal includes a pay item for this work. Otherwise, payment for this work shall be included in Items 508-A, 508-B, 508-E, or 508-F, whichever is appropriate.

Items 521-A and 521-B, measured as provided above, will be paid at the contract lump sum prices for the specified units. These prices shall be full compensation for all shop or field cleaning of metal, for containing, collecting, storing, testing, transporting and disposing of blast cleaning debris, for furnishing abrasives and cleaning solvents, for furnishing a surface profile comparator, for furnishing and applying the coating material, for supplying safety equipment and clothing, and for all materials, equipment, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

521-A Coating New Bridge at _____ - per lump sum
521-B Coating Existing Bridge at _____ - per lump sum

SECTION 522
BRIDGE JOINT SEALS

522.01 Description.

This Section shall cover the work of furnishing and installing bridge joint seals at the locations shown by the plans or directed, all in accordance with this specification and plan details. Said seals are for the purpose of preventing the passage of water and other materials through the joint.

Types of bridge joint seals have been classified as follows: Compression Seals and Diaphragm Type Seals.

522.02 Materials.

Materials furnished for use under this Section shall conform to the appropriate requirements of Division 800, Materials, and the plan details.

522.03 Construction Requirements.

(a) GENERAL.

The sealing of bridge joints shall be limited to those joints noted by the plans to be sealed.

The plans and proposal will designate the "total joint movement" for which a joint is to function. Shop drawings of the bridge joint seal system designated by the plans or, if allowed, selected by the Contractor from the plan designated alternates, must be approved by the Bridge Engineer.

Shop drawings, etc. of the seal system shall be submitted to the Bridge Engineer for approval. After final approval of the drawings, the Contractor shall resubmit seven copies of the drawings plus one set of satisfactory reproducibles (Mylar or equal) for distribution.

(b) FORMING OF JOINT.

Special attention shall be given to joint construction to insure that proper allowances for temperature, skew, etc. are made in forming the joint width. In the same manner, the anchorage system (bolts, plates, etc.) or joint armor shall be carefully set in the formwork to insure proper anchorage and functionability of the completed joint. All elements of the joint seal system shall be on hand before commencing forming of the joint.

(c) INSTALLATION OF BRIDGE INTERIOR JOINTS.

It shall be the Contractor's responsibility to insure that the joint width, alignment, etc. is in accordance with the bridge plan details and approved shop drawing. Any deviation from the plans and approved shop drawings shall be reported and corrective remedial action taken before installing the seal element.

Installation of the seal element shall be in accordance with the manufacturer's recommendation and Departmental directives. Care shall be taken to insure the proper cleaning of the joint and use of lubricants, adhesives, or combination lubricant-adhesive during the installation. Splicing of the seal elements will not be permitted in a joint system unless so noted by plan details or the approved shop drawings.

(d) INSTALLATION OF BRIDGE END JOINTS.

The Bridge Contractor shall install that portion of the bridge end joint anchorage system required to be installed in the bridge deck in accordance with bridge plan details and approved shop drawings. The remaining elements shall be match-marked and properly stored as directed until such time as the bridge end slab is constructed or the contract is terminated, at which time the stored elements shall be turned over to the Engineer.

The Contractor constructing the bridge end slab shall have the responsibility of incorporating that portion of the joint seal system required by the bridge plans and approved shop drawings into the bridge end slab. It shall be the Contractor's responsibility to insure that the joint width, alignment, etc. is in accordance with above noted requirements; any deviation shall be reported and corrective remedial action taken before installing the seal element. The portion of the joint seal system to be installed in the bridge end slab and the seal element will be made available to the bridge end slab Contractor along with installation details if such is not provided by the plan details. The Contractor shall have full responsibility for protection, etc. of elements of the joint seal system furnished him until the joint seal system is accepted. Any damage to the elements caused by his operations shall be corrected as directed without additional compensation. Installation of the seal element shall be as noted in the second paragraph of Subarticle 522.03(c).

522.04 Method of Measurement.

(a) ITEMS 522-A, 522-B, and 522-C.

Ordered and accepted sealed joints will be measured in linear feet {meters} along the top surface of the designated joint between the bridge gutters to the nearest 0.1 foot {millimeter}. No measurement will be made for that portion of the seal required by plan details to extend through or above the gutter line; such being considered incidental to the sealing of the joint.

(b) ITEMS 522-D and 522-E.

These items, when provided, will be measured as a lump sum unit for the designated bridge structure. Said measurement will cover the sealing of all the bridge joints of the type designated, interior or end, all in accordance with the plan requirements and the details noted in this Section.

522.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. ITEM 522-A.

The accepted sealed bridge joints, measured as noted above, will be paid for at the contract unit price bid for each designated joint width, which shall be full compensation for the fabrication and furnishing of all materials necessary to provide a complete functional sealed joint (armor plates, anchor bolts, extrusions, channels, seal elements, etc.), for the incorporation and installation of all elements into the structure, and for all equipment, tools, labor, and incidentals necessary to provide a complete operational sealed joint.

2. ITEM 522-B.

The accepted bridge end joint seal system, measured as noted above, will be paid for at the contract unit price bid for each designated joint width, which shall be full compensation for the fabrication and furnishing of all materials necessary to provide a complete, functional sealed joint (armor plate, anchor bolts, extrusions, channels, seal element, etc., except the lubricant-adhesive used to install the seal element), for the partial installation of that portion of the seal system required to be installed in the bridge decks, and for all equipment, tools, labor, and incidentals necessary to complete this item of work.

3. ITEM 522-C.

The accepted partial installation of the bridge end joint seal system, measured in the same manner as noted for a complete sealed system, will be paid for at the contract unit price bid which shall be full compensation for incorporation of that portion of the bridge end joint seal system required to be installed into the bridge end slab and the installation of the seal element (all components of the seal system, except the lubricant-adhesive used to install the seal element), for the lubricant-adhesive, and for all equipment, tools, labor, and incidentals necessary to provide a completely operational joint system.

4. ITEM 522-D.

The accepted sealed bridge, measured as noted, will be paid for at the contract lump sum price bid which shall be full compensation for the fabrication and furnishing of all materials necessary to provide completely functional joint seal systems (armor plates, anchor bolts, extrusions, channels, seal elements, etc.) for the structure, for the incorporation and installation of all elements into the structure, and for all equipment, tools, labor, and incidentals necessary to provide the structure with complete, functional joints.

5. ITEM 522-E.

The accepted bridge end joint seal systems, measured as noted above, will be paid for at the contract lump sum price bid which shall be full compensation for the fabrication and furnishing of all materials necessary to provide the completely functional bridge end joints systems (armor plates, anchor bolts, extrusions, channels, seal elements, etc., except the lubricant-adhesive used to install the seal element) for the structure, for the partial installation of the seal systems (that portion of the seal systems required to be installed in the bridge decks), and for all equipment, tools, labor, and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

522-A Furnishing and Installing Bridge (Interior or End) Joint Seal System ___ inch {mm}
Total Joint Movement - per linear foot {meter}

522-B Furnishing and Partial Installation of Bridge End Joint Seal System ___ inch {mm}
Total Joint Movement - per linear foot {meter}

522-C Partial Installation of Bridge End Joint Seal System - per linear foot {meter}

522-D Furnishing and Installing Bridge (Interior or End) Joint Seal Systems,
Station _____ - per lump sum

522-E Furnishing and Partial Installation of Bridge End Joint Seal Systems,
Station _____ - per lump sum

SECTION 524
REINFORCED CONCRETE BOX CULVERTS

524.01 Description.

The work under this Section shall cover the furnishing of materials and constructing reinforced concrete box culverts (including bridge type), or portions thereof, in accordance with the lines, grades, dimensions, and other details shown on the plans or provided in the proposal, in accordance with these Specifications.

When widening or modification to an existing facility is required or directed, the work under this Section shall include the cutting or breaking away of portions of the existing structural material and the preparation of the exposed structural material for joining with the new materials to the lines and grades shown on the plans or directed.

This Section shall also cover the work of furnishing and installing precast reinforced concrete box culvert units to form structures in accordance with plan details and the requirements noted in this Section.

Unless a particular type of culvert is specified on the plans, the Contractor shall have the option to select either a cast in place or a precast method for construction of the culvert or culvert extension.

524.02 Materials.

All materials incorporated in the structure shall be new except where otherwise specified on the plans or in the proposal.

The requirements set forth in the Sections listed in this Article, together with any other specifications contributing to the complete structure in each case, shall be applicable to the work required under this Section.

Section 214 Structure Excavation and Backfill for Drainage Structures and Minor Structures
Section 501 Structural Concrete
Section 502 Steel Reinforcement

Precast reinforced concrete box culvert units shall be manufactured in accordance with the provisions of AASHTO M 273 {M 273M} for culverts with less than 2 feet {600 mm} of fill height and of AASHTO M 259 {M 259M} for culverts with 2 feet {600 mm} or more of fill height amended to conform to the requirements noted in the detailed plans and the following:

If so shown on the plans, culvert units meeting the requirements of AASHTO M 259 {M 259M} may be used for non-traffic-bearing installations having less than 2 feet {600 mm} of fill height.

Concrete materials shall conform to the appropriate requirements of Section 501.

The Contractor shall submit a design mix, having a 28-day cylinder strength of 5000 psi {35 MPa}, to the Engineer for approval of all concrete to be used in the precast units. Acceptance of the precast units will be based on visual inspection and compressive tests of concrete cylinders, cast and cured along with the units, obtaining a compressive strength of 5000 psi {35 MPa}.

Joint sealer for precast units shall be one of the types meeting the requirements of Article 846.01, unless specified otherwise by the plans.

524.03 Construction Requirements.

(a) EXCAVATION AND BACKFILLING.

Excavation and backfilling shall be in accordance with the provisions of Section 214.

In addition, for precast culverts the foundation requirements of Section 214 shall be modified to require a bedding of at least a 4 inch {100 mm} compacted layer of foundation backfill placed between graded forms set 1 foot {300 mm} outside each outside wall of the box culvert. The foundation backfill shall be fine graded off the forms, compacted as directed by the Engineer, and shaped to fit the bottom of the precast section. After placement of the sections, the forms may be removed.

(b) STRUCTURE CONSTRUCTION.

1. GENERAL.

Unless modified herein, the construction, forming, and pouring of the culvert shall be in accordance with the applicable provisions of Section 501, Structure Concrete.

The concrete used in the structure shall, unless otherwise provided by plan details, be a Class A, Type 1 Mix as provided in Item 501.02(c)2.

2. CAST IN PLACE UNITS.

a. Placing of the Concrete.

In general, the base slab of box culverts shall be placed and allowed to set before the remainder of the culvert is constructed. Suitable provisions shall be made for bonding the sidewalls to the culvert base.

In the construction of box culverts 8 feet {2400 mm} or less in height, the sidewalls and top slab may be constructed as a monolith. When this method of construction is used, any necessary construction joints shall be vertical and at right angles to the axis of the culvert.

In the construction of box culverts more than 8 feet {2400 mm} in height, the concrete in the walls shall be placed and allowed to set before the top slab is placed.

Before concrete is placed in the sidewalls, the culvert wall base shall be thoroughly cleaned of all shavings, sticks, sawdust, or other extraneous material and the surface carefully chipped and roughened in accordance with the method of bonding construction joints as specified in Section 501.

Each wing shall be constructed, if possible, as a monolith. Construction joints, where unavoidable, shall be horizontal and so located that no joint will be visible in the exposed face of the wing wall above the ground line.

b. Construction Joints.

Construction joints shall be provided on all culverts over 60 feet {18 m} in length with the spacing of the joints set to provide approximately equal sections of the culvert lengths.

One construction joint will be required for culvert lengths between 60 feet {18 m} and 90 feet {27 m}.

Two construction joints will be required for culvert lengths greater than 90 feet {27 m} and less than 135 feet {41 m}.

Three construction joints will be required for culverts from 136 feet {41 m} to 170 feet {52 m} in length.

For culverts over 170 feet {52 m} in length, construction joints shall be spaced at approximately equal intervals of not less than 40 feet {12 m} nor more than 55 feet {17 m}.

All construction joints shall be constructed normal to the center line of the culvert.

3. PRECAST UNITS.

Precast units shall be manufactured in accordance with the provisions of AASHTO M 273 {M 273M} (ASTM C 850 {C 850M}) or AASHTO M 259 {M 259M} (ASTM C 789 {C 789M}), whichever is applicable, the plan details, and these specifications with special attention directed to Subarticle 501.03(m) and Section 831 with the exception that the internal dimensions shall not vary more than -1.0% or + 2.7% from the design dimensions.

The Contractor shall submit details for each size unit to be used. For barrel openings and fill heights not shown in AASHTO M 259 {M 259M} or M 273 {M 273M}, the Contractor shall submit a design for approval. The design submittal shall consist of calculations and complete details on standard plan sheets (22 inches by 36 inches {ANSI-D 559 mm x 864 mm}) and shall be prepared and stamped by a Registered Professional Engineer registered in the State of Alabama and not employed by the Alabama Department of Transportation. The design shall be as prescribed in AASHTO M 259 {M 259M} or M 273 {M 273M} with all units given consideration for MS-18 loading and an alternate military loading (Interstate) for the entire length of culvert. All design loads shall be applied in accordance with the current AASHTO "Standard Specifications for Highway Bridges." Each precast unit shall be of the same basic shape as shown in AASHTO M 259 {M 259M} or M 273 {M 273M} and shall be cast as a monolithic unit.

Details and designs shall also be submitted for connecting the precast units to cast in place wings, other cast in place drainage structures, bends in culvert alignment, drop boxes, and drainage pipe entrances into precast units. Where new or existing cast in place culverts are extended with precast units, a uniform cast in place transition, a minimum of 10 feet {3 m} long, shall be provided. A doweled or tongue and groove condition shall be provided at the junction of the precast unit and the cast in place section.

Two sets of details and two sets of designs shall be submitted directly to the Bridge Engineer for consideration and approval. Twelve calendar days will be required for each examination of each submission of designs and details for three structures or less and four days per structure for submissions containing more than three structures. For the purpose of this Specification, a structure shall be considered as any culvert with uniform barrel opening, any transition between culvert types or sizes, or any pipe entrances, bends, drops, etc. After approval of drawings, the Contractor shall furnish

to the Bridge Engineer one set of reproducible drawings (Mylar or equal) on standard plan sheets (22 inches by 36 inches {ANSI-D 559 mm x 864 mm}) for record purposes.

Precast units shall be laid to the same line and grade requirements noted in Item 530.03(a)2. for pipe. The method of joining the sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even. Unless specified otherwise by the plans, the Contractor shall have the option to use any of the type joint sealers specified for rigid pipe in Article 846.01. If, in the opinion of the Engineer, the type sealer selected by the Contractor will fail to perform its intended function, the Contractor shall be required to select a different joint sealer specified in Article 846.01. The method of sealing the joints shall be, as nearly as practicable, the same as for concrete pipe as specified in Subitem 530.03(d)3a.

End sections for precast barrel units, if required, shall be constructed in accordance with plan details. Those installations not requiring end sections will, unless otherwise shown on the plans or directed, require similar parapets and toe walls, except for the length, as shown for installations having end sections.

Precast units shall be backfilled the same, as nearly as practicable, as for pipe as specified in Subarticle 530.03(e).

4. CONCRETE SURFACE TOLERANCES.

The finished concrete shall be within reasonably close conformity to the line, grades, and dimensions shown on the plans or directed, and from objectionable cavities or projections.

5. CONCRETE SURFACE FINISH.

Concrete surfaces shall be finished in accordance with the provisions of Subarticle 501.03(l) for Class 1 with exposed surfaces receiving a Class 2 finish, unless otherwise specified by the proposal or by plan requirements.

524.04 Method of Measurement.

(a) CAST IN PLACE UNITS (WHEN CAST IN PLACE CONSTRUCTION IS SPECIFIED ON THE PLANS OR WHEN ALLOWED AT THE CONTRACTOR'S OPTION).

Culvert length for determining quantities of the respective pay items involved will be the length shown on the plans or ordered in writing.

The required length of culvert will be converted for payment into cubic yards {cubic meters} of Culvert Concrete and pounds {kilograms} of Steel Reinforcement as determined from computation tables shown on Standard or Special Drawings for cast in place box culverts. Wingwalls, parapets, toewalls, and apron plan quantities, and payment for these items, shall also be based upon cast in place design quantities.

Steel Reinforcement will be measured and paid for under Section 502.

Excavation and Backfill will be measured and paid for under Section 214.

(b) PRECAST UNITS (WHEN EITHER CAST IN PLACE OR PRECAST CONSTRUCTION IS ALLOWED AT THE CONTRACTOR'S OPTION).

Culvert length for determining quantities of the respective pay items involved will be the length required for a cast in place culvert of the same size as the precast culvert. Culvert wing (end section) quantities will be the same as for the cast in place wing specified on the contract plans.

The required length of culvert will be converted for payment into cubic yards {cubic meters} of Culvert Concrete and pounds {kilograms} of Steel Reinforcement as determined from computation tables shown on Standard or Special Drawings for cast in place box culverts. Wingwalls, parapets, toewalls, and apron may be either precast or cast in place. Plan quantities, and payment for these items, shall also be based upon cast in place design quantities, regardless of which alternate is selected for construction.

Fill concrete required between multiple cell installations will not be measured or paid for separately.

Steel Reinforcement will be measured and paid for under Section 502.

Excavation and Backfill will be measured and paid for under Section 214 and shall be the same as quantities for a comparable cast in place culvert.

No additional payment will be made where barrel lengths, apron areas, backfilling, or items of work have to be increased due to using precast in lieu of cast in place alternatives.

No separate payment will be made for any other items of work involved.

(c) PRECAST UNITS (WHEN PRECAST CONSTRUCTION IS SPECIFIED ON THE PLANS).

Culvert length for determining quantities of the respective pay items involved will be the length required for a cast in place culvert of the same size as the precast culvert. Culvert wing (end section) quantities will be the same as for the cast in place wing specified on the contract plans.

The required length of culvert will be converted for payment into cubic yards {cubic meters} of Culvert Concrete and pounds {kilograms} of Steel Reinforcement as determined from computation tables shown on Standard or Special Drawings for cast in place box culverts. Wingwalls, parapets, toewalls, and apron plan quantities, and payment for these items, shall also be based upon cast in place design quantities.

Fill concrete required between multiple cell installations will not be measured or paid for.

Steel Reinforcement will be measured and paid for under Section 502.

Excavation and Backfill will be measured and paid for as provided in Section 214.

No separate payment will be made for any other items of work involved.

524.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Items 524-A and 524-B.

No direct payment will be made for an individual structure under these items, but the quantities, measured as noted above, will be paid for at the contract unit price bid for the appropriate item. Such payment shall constitute full compensation for the completed structure ready for use, including any contractor required design work, any cofferdam construction, temporary diversion channels, flood protection, falsework, form material, or other erection expenses and for furnishing, hauling, and incorporating all prescribed and necessary materials into the structure, and for all labor, tools, equipment, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

524-A Culvert Concrete (_*_) - per cubic yard {cubic meter}

524-B Culvert Concrete Extension (_*_) - per cubic yard {cubic meter}

* Specify type, e.g. Precast or Cast In Place, only if applicable.

Do not show a type in parentheses unless a particular type is specified on the plans.

SECTION 525
CONCRETE RETAINING WALLS AND CRIBBING

525.01 Description.

The work under this Section shall cover the furnishing and constructing concrete or reinforced concrete, retaining walls, and concrete cribbing; all in accordance with these specifications at the designated locations and in conformity with the dimensions, lines, and grades shown on the plans or established by the Engineer.

525.02 Materials.

All materials incorporated into the structures shall be new, except where otherwise specified on the plans or in the proposal.

The requirements set forth in the Sections listed in this Article, together with any other specification contributing to the complete structure in each case shall be applicable to the work required under this Section.

Section 214 Structure Excavation and Backfill for Drainage Structures and Minor Structures
Section 501 Structure Concrete
Section 502 Steel Reinforcement

525.03 Construction Requirements.

(a) RETAINING WALLS.

1. EXCAVATION AND BACKFILL.

Excavation and backfill shall be in accordance with the provisions of Section 214.

2. STRUCTURE CONSTRUCTION.

Unless otherwise modified on the detail plans, forming and pouring of the concrete shall be in accordance with the provisions of Section 501, Structure Concrete.

Concrete used in the structure shall, unless otherwise provided by plan details, be a Class A, Type 1 mix as provided in Item 501.02(c)2.

3. CONCRETE SURFACE TOLERANCES.

The finished concrete shall be within reasonable close conformity to the lines, grades, and dimensions shown on the plans or directed, and free from objectionable cavities or projections.

4. CONCRETE SURFACE FINISH.

Concrete surfaces shall be finished in accordance with the provisions of Subarticle 501.03(l) for Class 1 with exposed surfaces receiving a Class 2 finish, unless otherwise specified by the proposal or by plan requirements.

(b) CONCRETE CRIBBING.

1. EXCAVATION AND BACKFILLING.

The foundation or bed for the cribbing shall be excavated as required, and shall be firm and stable and shall have been approved before any crib member is placed. If unsuitable foundation material is encountered at the proposed elevation for the cribbing bed, it shall be removed and replaced as directed with foundation backfill as specified in Section 214.

Backfill material shall be selected from the roadway excavation in such a manner as to provide the most porous type of material available for the backfilling operations; no vegetable matter or chalky soil shall be used.

2. CONSTRUCTION.

Unless otherwise modified by plan details, concrete used shall be produced in accordance with the provisions of Section 501, with rib members made of Class A, Type 1 concrete as provided in Item 501.02(c)2.

The details of the crib members and their arrangement shall be as shown on the plans. If specific details for reinforcement are not shown on the plans, or if the Contractor uses factory-made crib members, he shall submit detailed specifications and plans; such plans and specifications must be approved before delivery of the material is started.

All members shall be cured and finished as required under Section 501, free from depressions and spalled, patched, or plastered surfaces or edges, or any other defect likely to impair their strength or durability. Cracked or otherwise defective members shall be rejected. Exposed portions of crib walls shall have a surface finish as noted in Item 525.03(a)4.

Unless otherwise provided by the plans or proposal, the inside of the crib and 2 feet {600 mm} back of and beyond the ends of the crib shall be backfilled with selected portions of the roadway excavation.

Backfilling shall follow closely the erection of the cribbing tier units. The crib wall shall not be laid more than 3 feet {1 m} above the backfilled portion.

The backfill shall be placed carefully to avoid distortion of the crib wall, in layers not to exceed 8 inches {200 mm} in thickness and tamped or consolidated uniformly as directed by means of mechanical compactors. The puddling method of backfilling shall not be used.

525.04 Method of Measurement.

(a) RETAINING WALLS.

The volume of concrete in the retaining wall measured for payment will be the net volume of concrete (without deduction for the reinforcing steel) in the accepted structure.

Reinforcing steel will be measured and paid for under Section 502.

Excavation and Backfill will be measured and paid for under Section 214.

(b) CONCRETE CRIBBING.

The volume of concrete cribbing measured for payment will be the actual net volume of the concrete (without deduction for steel reinforcement) in the accepted crib members placed as ordered in the completed structure. No separate measurement will be made for the reinforcement steel, steel dowels, or sleeves.

Excavation of trench, etc. for the crib shall be measured and paid under the item of Unclassified Excavation.

Foundation backfill, where ordered, shall be measured and paid for as specified in Section 214.

No separate measurement will be made for backfilling of the cribbing.

525.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. RETAINING WALLS.

The volume of retaining wall concrete, measured as provided above, shall be paid for at the contract unit price bid per cubic yard {cubic meter} which shall be full compensation for the furnishing of all material except reinforcing steel and the incorporation of the materials into finished structures, for all formwork, falsework, or other erection costs and for all tools, labor, equipment, and incidentals necessary to complete this item of work.

2. CONCRETE CRIBBING.

The volume of concrete cribbing, measured as provided above, will be paid for at the contract unit price bid per cubic yard {cubic meter} which shall be payment in full for furnishing, transporting, handling, installing the concrete crib members, backfilling of the crib as noted in Subarticle 525.04(b), and for all labor, tools, equipment, and incidentals necessary to complete and maintain the work until final acceptance.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

525-A Retaining Wall Concrete - per cubic yard {cubic meter}
525-B Concrete Cribbing - per cubic yard {cubic meter}

SECTION 530
ROADWAY PIPE CULVERTS

530.01 Description.

This Section shall cover the work of furnishing and installing pipe type culverts of the size, shape, wall thickness, type material, and appropriate strength designated on the plans or in the proposal. The installation shall be at the locations shown on the plans or designated in conformity with the lines and grades shown by the plans or designated by the Engineer. The work shall include the furnishing and construction of such joints, cuttings, and connections to other pipes or structures as may be necessary to complete the work as shown on the plans or directed.

The following abbreviations will be used:

Concrete Pipe	P.C. for plain concrete R.C. for reinforced concrete
Corrugated Metal	C.M. for any acceptable corrugated metal pipe covered by these specifications
Protective Coating	C. for any protective coating of metal pipe allowed by these specifications
Paved Invert	P.I.
Corrugated Steel	C.S. for Plain Corrugated Steel C.C.S. for Coated Corrugated Steel C.C.S.P.I. for Coated C.S. Paved Invert
Corrugated Aluminum	C.A. for Plain Corrugated Aluminum C.C.A. for Coated C.A. C.C.A.P.I. for Coated C.A. Paved Invert
Concrete Lined	C.L.

Unless a specific type of pipe is designated by the plans or proposal, the Contractor may use one of the optional types of pipe shown by the plans or proposal. However, an installation, once started, shall be made with the same type of pipe throughout unless specifically designated otherwise by plan details, or directed in writing. The Contractor, at his option, may furnish a stronger grade pipe than specified provided no additional cost is incurred by the State for such installation.

The Contractor shall also have the option to use Horizontal Elliptical (H.E.) Pipe in lieu of Concrete Arch Pipe provided the H.E. pipe equals or exceeds the Arch pipe in strength and equivalent opening. If the Contractor elects to use H.E. pipe, he shall still be paid under the Pay Item for which the H.E. pipe replaces.

530.02 Materials.

All materials furnished for use shall conform to applicable portions of Division 800, Materials. Special reference is made to the following:

Section 846 - Pipe Culvert Joint Sealers

Section 850 - Roadway Pipe

If H.E. pipe is used as outlined in Article 530.01, the pipe shall meet the requirements of AASHTO M 207 {M 207M}. The test reports shall also state the size and class of Arch pipe for which the H.E. pipe is substituted.

530.03 Construction Requirements.

(a) GENERAL.

1. PIPE INSPECTION.

Pipe shall be laid only in the presence of the Engineer or his authorized representative, and shall not be covered until approved. Pipe installed contrary to this requirement will be rejected and shall be replaced by the Contractor without additional compensation.

2. GRADE AND ALIGNMENT.

The pipe shall be laid with ends abutting and with not more than a 1 inch {25 mm} variation from established alignment at the vertical centerline or from grade at the flowline. The Engineer will provide in the designated grade sufficient camber to prevent development of sag or reverse slope due to foundation settlement under embankment load.

3. CULVERT EXTENSIONS.

Existing pipe culverts shall be extended in the same manner as specified for installing new culverts.

4. DEPTH OF FILL.

The fill height for determining the class or wall thickness of pipe will be the distance from the elevation of the top of the pipe to elevation at the top of the base course.

5. COATED, PAVED INVERT, AND CONCRETE LINED PIPE.

In the installation of coated, paved invert, or concrete lined pipe, care shall be taken not to damage the protective coating, lining, or the paved invert. Any damage shall be repaired with approved material or replaced as directed.

6. CORRUGATED STEEL OR CORRUGATED ALUMINUM PIPE.

Where aluminum pipe is to be connected to galvanized or other metal pipe, the surfaces shall be separated from contact by an approved type of gasket.

7. GALVANIZED PIPE.

Any damage to galvanizing shall be painted with two coats of approved galvanizing repair paint, Section 855, or approved zinc spelter paint.

(b) EXCAVATION OF TRENCH.

Details of trenching and bedding of pipe will be shown on the plans. All pipe 48 inches {1200 mm} or less in horizontal diameter shall be laid in a trench extending at least 1 foot {300 mm} above the elevation of the top of the pipe. For such pipe, where the ground surface is less than 1 foot {300 mm} above the elevation of the top of the pipe, the Contractor shall first construct and compact the fill to a minimum height of 1 foot {300 mm} above the elevation of the top of the pipe and for a minimum distance of 10 feet {3 m} in each direction from the outside edge of the pipe. The trench shall then be excavated as specified in Section 214. Caution shall be used to keep the sides of the trench vertical and to specified dimensions. Extra wide excavation to accommodate pans or other unsuitable excavating equipment will not be permitted. Excavation above subgrade will be classified and paid for as roadway excavation. Excavation below subgrade will be classified and paid for as structure excavation except that no payment will be made for excavating that part of a fill section placed more than 1 foot {300 mm} above the top of the pipe.

For pipe over 48 inches {1200 mm} in horizontal diameter, trenching will be required only where the original ground is above the elevation of the bottom of the pipe, and backfilling shall be performed as specified in Item 210.03(d)2.

Should the material encountered at the elevation of the trench floor not be suitable to support the structure, removal of unsuitable material and placement of foundation backfill shall be

performed and will be paid for as specified in Section 214. Temporary drainage necessary for proper installations shall be provided by the Contractor without additional compensation.

(c) PIPE BEDDING.

1. GENERAL.

All pipe culverts placed under this Section shall be placed in a prepared bed of one of the types noted herein. Unless otherwise provided, a Class "C" Bedding shall be used.

2. CLASS A BEDDING.

The pipe culvert shall be bedded in a continuous concrete cradle conforming to plan details.

3. CLASS B BEDDING.

The pipe shall be bedded with ordinary care in a prepared foundation bed to a depth of not less than 30 percent of the vertical diameter of the pipe plus 4 inches {100 mm}. The thickness of the foundation bed shall be a minimum of 4 inches {100 mm} in thickness and shall be shaped to fit the pipe for at least 15 percent of the vertical outside diameter. Recesses in the trench bottom shall be shaped to accommodate the bell of the pipe when bell and spigot type pipe is used.

"Ordinary" care in this Article shall mean sufficient care to insure that the permissible variations listed in Item 530.03(a)2 will not be exceeded.

The bedding material shall be sand or an approved selected sandy soil.

4. CLASS C BEDDING.

The pipe shall be bedded with ordinary care in a loosened soil foundation shaped to fit the lower part of the pipe exterior with reasonable closeness for at least 10 percent of its overall height. Use of a template for shaping will not be required. The shaped foundation shall be loosened by pulverizing the soil to a minimum depth equal to 0.125 times the diameter of the pipe or 3 inches {75 mm} maximum. "Ordinary care" in this Article shall mean sufficient care to insure that the permissible variations listed in Item 530.03(a)2 will not be exceeded.

Where ledge rock, rocky or gravelly soil, hard pan, or other unyielding foundation material is encountered at a culvert site, the pipe shall be bedded as follows: The hard unyielding material shall be excavated below the elevation of the bottom of the pipe, or pipe bell, for a depth of at least 12 inches {300 mm}, or 1/2 inch for each foot {40 mm for each meter} of fill over the top of the pipe, whichever is greater, but not more than 24 inches {600 mm}. Payment for this material shall be made under Structure Excavation. The width of the excavation shall be 12 inches {300 mm} greater than the outside diameter or span of the pipe and shall be filled with selected fine compressible material, such as silty clay or loam taken from selected grading operations or areas beyond the right of way and paid for as Foundation Backfill. This material shall then be lightly compacted in 6 inch {150 mm} compacted lifts and shaped as specified above.

5. CLASS C-1 BEDDING.

When so specified on the plans, Class C-1 bedding or imperfect trench method shall be used as follows:

The pipe shall be placed and backfilled as specified in Subarticles 530.03(d) and (e) to a point 1 foot {300 mm} above the top of the pipe. The fill shall then be continued as specified in Section 210 for a minimum distance of 10 feet {3 m} in each direction from the outside edge of the pipe and to a height equal to outside diameter of the pipe plus 1 foot {300 mm} above the top of the pipe.

Next, a trench equal in width to the outside diameter of the pipe shall be dug in the fill directly over the culvert down to an elevation 1 foot {300 mm} above the top of the pipe. Care shall be exercised to keep the sides of this trench as nearly vertical as possible. The trenches shall then be refilled with loose, highly compressible soil, except that straw, hay, cornstalks, leaves, brush, or sawdust may be used to fill the lower 1/4 to 1/3 of the trench. After this loose backfill is completed, the remainder of the fill up to subgrade elevation shall be constructed as specified in Section 210.

Compensation for the extra excavation and backfill involved in the imperfect trench method shall be included in the unit price of other items and no direct payment will be made for this work. At the Contractor's option, the embankment may be constructed full height prior to laying the pipe.

(d) PLACING PIPE.

1. GENERAL.

Proper facilities shall be provided for lowering the sections of pipe into the prepared trench.

The pipe laying shall begin at the downstream end of the pipe line. The lower segment of the pipe shall be in contact with the shaped bedding throughout its full length. Bell or groove ends of rigid pipe and outside circumferential laps of flexible pipe shall be placed facing upstream. Flexible pipe shall be placed with longitudinal laps or seams at the sides.

Paved invert pipe shall be laid so that the longitudinal center line of the paved segment coincides with the designated flow line.

All flexible (C.S. or C.A.) pipes 48 inches {1200 mm} or larger in diameter shall be shop elongated or field strutted except for arch pipe and concrete lined pipe. Details for field strutting shall be as provided by the plans and shall be accomplished prior to placing any embankment adjacent to the structure. Only horizontal ties shall be used in strutting paved invert pipe. The pipe shall be laid in the trench with the separate sections firmly joined together and with outside laps of circumferential joints pointing up stream and with longitudinal laps on the sides. Any metal in joints which is not protected by galvanizing shall be coated with suitable asphaltum paint. If headwalls are to be placed, the ends of the pipes laid on a skew shall be neatly cut off parallel with the centerline of the highway and flush with the outside face of the headwalls.

2. MULTIPLE PIPE CULVERTS.

Where multiple lines of pipe are used, they shall be spaced far enough apart to permit thorough tamping of earth between adjacent lines. To this end the adjacent sides of circular pipe shall be at least 0.5 times the nominal pipe diameter apart, or 3 feet {1 m}, whichever is less. Spacing for arch pipe shall be as shown on the plans.

3. JOINING PIPE.

a. Rigid Pipe (Concrete, C.I.)

Rigid pipe may be of bell and spigot, tongue and groove, or other approved design unless a specific type is specified. The method of joining pipe sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even.

Joints shall be sealed with mortar, bituminous plastic cement, rubber type gaskets, or other type sealers that may be approved. Joints shall be thoroughly cleaned before being sealed and shall be sealed for the full circumference of the joint unless otherwise directed.

When mortar is used for sealing joints, the procedure shall be as follows: Before each succeeding section of pipe is laid, the hub of the pipe shall be moistened and the lower half filled on the inside with cement mortar of sufficient thickness to bring the inner surfaces of abutting pipes flush and even. After the pipe is laid, the remainder of the joints shall be moistened and filled with mortar and sufficient additional mortar used to form a bead around the joint. No joint shall be entirely cemented until the next two joints in advance, if any, are laid. The inside of the joint shall be wiped and finished smooth. Mortar on the outside of the pipe shall be protected from the air and sun by one of the curing methods provided for concrete, Section 501, or by covering with moist earth.

When bituminous plastic cement or other mastic sealers are used, the interior surface of the hub, beginning at the lip of the normal interior surface of the pipe, shall be coated with a layer of sealing material that will cover at least 0.33 times the distance, measured along the surface of the hub, parallel to the normal length of the pipe. The thickness of the mastic placed shall be such that it will provide a uniform seal between the edges of the pipe sections being joined (approximately 1/2 of an inch {10 mm} on the inside shoulder of the hub and approximately 1/8 of an inch {3 mm} of material on the remaining area to be covered). No joint shall be considered satisfactory when the space between the edges of the pipes being joined exceeds 1/2 of an inch {10 mm} for more than 0.33 times the circumference of the pipe. The inside of the joint shall be wiped and finished smooth.

When rubber or other types of gaskets are used for sealing joints, they shall be installed as recommended by the manufacturer,

b. Flexible Pipe (C.S., C.A.)

Flexible pipe shall be firmly joined by coupling bands of an approved type. Joints shall be thoroughly cleaned before being joined and shall be sealed for the full circumference of the joint with an approved sealer unless otherwise directed.

4. INSPECTION.

All pipe shall be inspected before any backfill is placed. Any pipe found to be out of alignment, unduly settled, or damaged shall be taken up and relaid or replaced.

(e) BACKFILLING PIPE.

1. GENERAL.

After the pipe has been installed, the pipe trench shall be backfilled with the best of the suitable material excavated from the trench; if none of this excavated material is suitable, material from the roadway shall be used and paid for as such, or suitable material shall be hauled in and used with payment being made under the classification of the material ordered used. For backfilling above a point 1 foot {300 mm} above the top of the pipe, material from the trench may be used unless unsuitable for embankment.

Backfilling will not be permitted until authorized by the Engineer. When mortar joints are used, backfilling shall not begin until the joints have cured or until authorized by the Engineer.

2. PLACING AND COMPACTION OF BACKFILL.

The backfill material shall be compacted at near optimum moisture content, in layers not exceeding 6 inches {150 mm} compacted thickness, to a density of not less than 95 percent of AASHTO T 99 density by methods detailed in Section 210. Mechanical tampers shall be used unless another method of compaction is approved in writing; inundation or jetting will not be permitted unless specified on the plans. Care shall be exercised to thoroughly compact the backfill under the haunches of the pipe and to insure that the material is in intimate contact with the pipe. The backfill shall be brought up evenly in layers on both sides of the pipe for its full length until the trench is filled or up to subgrade elevation if the trench is in cut.

When the top of the pipe is exposed above the top of the trench, embankment material shall be placed and compacted for a width on each side of the pipe equal to at least twice the horizontal inside diameter of the pipe, or 12 feet {4 m} whichever is less. The embankment on each side of the pipe, for a distance equal to the horizontal inside diameter of the pipe, shall be of the same material and compacted in a normal manner except where the Class C-1 (imperfect trench) method is prescribed. All pipe, after being bedded and backfilled as specified in this Section, should be protected by a 3 foot {0.6 m} cover of fill before heavy equipment is permitted to cross during construction of the roadway.

3. PROTECTION OF PIPE.

The Contractor shall exercise necessary care in installing and backfilling pipe, and it shall be his responsibility to see that the pipe is not damaged by lateral forces during backfilling, by heavy loads operating over the pipe, or by other causes. All damaged pipe shall be replaced or repaired by the Contractor at his own expense at the option of, and to the satisfaction of, the Engineer.

Any pipe not true to designated alignment and grade within specified tolerances, or any pipe that shows settlement due to faulty installation, shall be relaid or replaced by the Contractor without additional compensation. Any pavement that settles or breaks over a pipe shall be replaced or repaired by the Contractor, at the option of the Engineer, without additional compensation. All pipe lines shall be thoroughly cleaned out prior to final acceptance.

530.04 Method of Measurement.

The accepted length of pipe culverts laid as ordered will be measured along the bottom flowline, or invert, of the pipe complete in place. Measurements will be made between inside walls of designated structures (junction boxes, inlets, etc.) and along the centerline of the flowline of special fittings (elbows, wyes, etc.). The above applies to round or arch, beveled or unbeveled, pipe. However, in no case will measurement be made for lengths greater than the sum of the nominal laying lengths of the pipe sections used or for lengths greater than the length of culvert ordered by the Engineer. No separate measurement for payment will be made for the excavation and/or backfill volume needed to reroute water for temporary drainage which might be necessary for the proper installation of the pipe or to perform the imperfect trench method of installation.

Structure excavation and foundation backfill, including that necessary for the installation of roadway pipe of a temporary nature, when ordered will be measured and paid for as prescribed in Section 214.

530.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted length of pipe culverts, measured as above provided, will be paid for at the respective contract unit prices for the various sizes, and types of pipe provided in the proposal, complete in place, which shall be payment as herein provided and also for all work, equipment, materials, and incidentals connected with the execution of the Class Bedding specified for installation, except that Foundation Backfill and Structure Excavation shall be paid for separately.

(b) ITEM NUMBER AND ITEM NAME.

The internal diameter of circular pipe, the span and rise of arch pipe, the class of pipe, the class of pipe bedding, if other than Class "C", and the type or types of pipe allowed will be shown in the item name.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

530-A ___ inch {mm} Roadway Pipe, Class __*__ Bedding (__**__) - per linear foot {meter}

530-B ___ inch {mm} Span, ___ inch {mm} Rise Roadway Pipe, Class __*__Bedding (__**__)

- per linear foot {meter}

* If other than Class "C", so note.

** Show acceptable types of pipe.

Examples:

Specific Type: Class ____ R.C., or ____ gage {mm} C.C.S.P.I., or ____ gage {mm} C.C.S., or ____ gage {mm} C.C.A.P.I., or____ gage {mm} C.C.A.

Optional Types: Class ____ R.C. or equal strength C.C.M.P.I. or Class ____ R.C. or equal strength C.C.M.

SECTION 531
CORRUGATED METAL STRUCTURAL PLATE PIPE, ARCH PIPE, AND ARCH CULVERTS

531.01 Description.

This Section shall cover the work of furnishing corrugated metal structural plate pipe, arch pipes, and arches (coated and uncoated) of the sizes, plate thickness, and dimensions required by the plans and installing such at the locations shown by the plans or designated, all in conformity with these specifications to the lines and grades given. The corrugated metal plate pipe shall be full circle or other approved pipe shapes. Corrugated metal plate arches shall be part of circle construction anchored on footings, floor, or grillage of description shown on the plans.

531.02 Materials.

All materials shall conform to the provisions of Division 800, Materials. Specific reference is made to Section 841, Corrugated Metal Structural Plate for Pipe and Arches.

531.03 Construction Requirements.

(a) GENERAL.

The pipe or arch structure shall be carefully erected according to plans and erection drawings and true lines and grades, as given, on approved foundations. Arches shall be set in galvanized steel shapes on concrete or masonry footings, or on timber grillages or concrete floors built in full compliance with the specifications for Sections 501, 509, or 611. The structure shall be erected on its permanent foundations.

(b) ERECTION.

Structural plate pipe, pipe arches, and arches shall be erected in their final position by connecting the plates with bolts at longitudinal and circumferential seams. Drift pins may be used to facilitate matching of holes. Each plate shall have legible identification numerals to designate its position in the structures. All plates shall be placed in the order recommended by the manufacturer with joints staggered so that not more than three plates come together at any one point. All bolts shall be drawn tight before beginning the backfill and shall have not less than 200 nor more than 300 foot-

pounds {270 nor more than 400 N•m} of torque in their final tightening for steel plate or not less than 100 nor more than 150 foot-pounds {135 nor more than 200 N•m} for aluminum plates.

(c) EXCAVATION, BEDDING AND BACKFILL.

This work shall be performed as specified in Section 530.

(d) ELONGATION OR STRUTTING.

All structural plate pipes of 60 inches {1500 mm} or larger diameter shall be shop-elongated or field strutted as shown on the plans. Strutting shall be accomplished prior to placing any embankment adjacent to the structure. Strutting will not be required where required elongation has been fabricated into the plates at the factory. Elongation or strutting of plate arch pipe will not be required. Elongated pipe shall be installed with the longer axis vertical.

531.04 Method of Measurement.

Corrugated metal structure plate pipe, arch pipe, and arch culverts, structure excavation, and foundation backfill will each be measured in the same manner as specified in Article 530.04.

531.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The length, determined as above described, will be paid for at the contract unit prices per meter for corrugated structural plate pipe, arch pipe, or arch culverts of the several sizes, as the case may be, which prices and payments shall constitute full compensation for furnishing, handling, erecting, installing, and backfilling the pipe or arches, and for all materials, labor, equipment, tools, and incidentals necessary to complete this item, but will not constitute payment for any concrete, masonry, steel reinforcement, or excavation.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

531-A ___ inch {mm} , ___ inch {mm} Plate B.C. If Applicable
Corrugated Steel or Aluminum P.I. If Applicable Structural Plate Pipe
- per linear foot {meter}

531-B ___ inch {mm} Span, ___ inch {mm} Rise, ___ inch {mm} Plate B.C. If Applicable
Corrugated Steel or Aluminum P.I. If Applicable Structural Plate Arch Pipe
- per linear foot {meter}

531-C ___ inch {mm} Span, ___ inch {mm} Rise, ___ inch {mm} Plate B.C. If Applicable
Corrugated Steel or Aluminum Structural Plate Arch - per linear foot {meter}

SECTION 532
SLOTTED DRAINS

532.01 Description.

This Section shall cover the work of furnishing and installing a slotted drain which provides a drainage slot along the longitudinal section of the drain. This drainage slot shall be formed by either the angle slot design or the grate slot design as shown by plan details. Unless the plans or proposal designates which design to use or requires a special design, the Contractor shall have the option to select either design, but once selected, the same design shall be used throughout the project. When required by the plans, the Contractor shall furnish and install a specified special design slotted drain. Also when required by the plans, the Contractor shall furnish and install a special design slotted drain which provides a variable height drainage slot along the longitudinal section of the drain.

532.02 Materials.

The materials for the slotted drain shall meet the requirements shown on Special Drawing No. CSP-532 and the requirements given in this Section.

The Department has established a list of products approved for use. These products can be found on List II-16, SLOTTED DRAIN PIPE, of the Department's manual, "Materials, Sources, and Devices With Special Acceptance Requirements" (available from the Bureau of Materials and Tests). The Contractor may choose from any of these products, unless otherwise noted.

Backfill material shall be Class A, Type 2a concrete meeting the requirements of Section 501. Job Control test cylinders will not be required for this concrete.

532.03 Construction Requirements.

(a) GENERAL.

1. CONNECTIONS TO EXISTING STRUCTURES.

Connections to existing structures may require the use of a transitional fitting and/or section(s) of pipe to provide a suitable connection without damage to the grates or drains, etc. of the structures.

2. END SEALS.

When the drain or pipe begins or terminates without a connection to other pipes or drainage structures, the pipe end shall be sealed or plugged with a suitable cap as shown on plan details, properly connected to provide a waterproof connection.

(b) SLOTTED DRAIN PIPE.

This type pipe is designed to be placed with the slotted drain at or near the pavement, shoulder, or median surface.

The general construction requirements of Article 530.03 are applicable except as modified by the following:

Excavation shall be kept as nearly as possible to the minimum width, depth, and length shown on the plans.

The pipe shall be supported or held in place in such a manner as to permit flow of the concrete backfill material around the pipe.

The drainage slot shall be protected during installation by a removable wood strip, heavy duty tape, or other suitable material adequately performing the intended function, affixed to the slot to prevent infiltration of material into the pipe. After finishing the surface, the protective covering shall be removed.

Under no circumstances shall any portion of the slot extend above the paving material or curb and gutter section.

Joints for corrugated steel slotted drain pipe shall be made using approved connecting bands meeting the requirements of Subarticle 850.02(d).

532.04 Method of Measurement.

The accepted length of slotted drain laid as ordered will be measured in linear feet along the bottom flowline, or invert, of the slotted drain complete in place. Connections to other structures (i.e. elbows, pipe, joints, etc.) will not be measured for payment unless shown otherwise on the plans. Excavation and backfill will not be measured for payment.

532.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Slotted Drain, measured as noted above, will be paid for at the contract unit price bid complete in place, which shall be full compensation for fabricating, furnishing and installing a slotted drain meeting the requirements noted herein and the details shown on the plans (this includes a variable height grate or special design drain when required), for furnishing and installing connections to other structures (when required), for all excavation, backfill, satisfactory disposal of surplus materials, and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

532-A ___ inch {mm} _*__ Slotted Drain Pipe (_**_) - per linear foot {meter}

* Specify " Corrugated Steel", "Concrete", "(*Specify the Special Design*)", etc., only if applicable.

** Specify "With Variable Height Grate", etc., if applicable.

SECTION 533
STORM SEWERS

533.01 Description.

This Section shall cover the work of furnishing and constructing storm sewers of the kind, strength, and size pipe provided in the proposal, in accordance with the requirements of these specifications and installing such sewers at the locations shown on the plans or designated and in

conformity with established lines and grades. These items shall also include the furnishing and construction of such joints, necessary cutting and connections to other pipe, catch basins, endwalls, etc., as may be required to complete the work shown on the plans or directed.

533.02 Materials.

(a) GENERAL.

Materials furnished for use shall conform to the appropriate provisions of Division 800, Materials, with specific reference made to Section 854 and the following:

Abbreviations:

In addition to the abbreviations provided in Article 530.01 the following will be used:

Smooth Lined Corrugated Metal - C.S.L.C.M. (C.S.L.C.S. for Steel; C.S.L.C.A. for Aluminum)

Smooth Flow Corrugated Metal - C.S.F.C.M. (C.S.F.C.S. for Steel; C.S.F.C.A. for Aluminum)

Coated Concrete Lined Corrugated Steel - C.C.L.C.S.

Vitrified Clay - V.C.

Poly(Vinyl Chloride) - P.V.C.

Polyethelyene - P.E.

Unless a specific type of pipe is specified by the plans or proposal, the Contractor will be permitted to use any of the optional types of pipes permitted by the following:

Diameters up to and including 24 inches {600 mm} - A.C., P.C., V.C., Class 1 C.S.L.C.M., 16 gage {1.6 mm} C.S.F.C.M., 16 gage {1.6 mm} C.C.L.C.S., P.V.C., or P.E.

Diameters over 24 inches {600 mm} - A.C., Class 2 R.C., Class 2 C.S.L.C.M., 14 gage {2.0 mm} C.S.F.C.M., 14 gage {2.0 mm} C.C.L.C.S., P.V.C., or P.E. (P.E. up to 36 inches {900 mm} diameter).

Any storm sewer pipe to be placed under a roadway or subject to continuous traffic, or having a fill height of more than 10 feet {3 m}, shall be not less than a Class 3 R.C., or equivalent strength C.S.L.C.M., C.S.F.C.M., or C.C.L.C.S. Pipe. The fill height charts on the plans for roadway pipe shall be used to determine strengths or equivalent strengths for storm sewer pipe.

The Contractor may at his option furnish a higher grade pipe than those specified above or, with written approval, a Cast Iron or Ductile Iron pipe meeting the appropriate requirements of Section 854, provided no additional cost is incurred by the State for such substitution.

All smooth flow pipe 48 inches {1200 mm} or larger in diameter shall be shop elongated.

(b) JOINT SEALERS.

An applicable type of joint sealer required by Section 846 which will produce a water tight joint shall be used, unless otherwise specified by the plans or proposal.

533.03 Construction Requirements.

(a) GENERAL METHODS.

Pipe shall not be laid except in the presence of the Engineer or Inspector and shall not be covered until approved.

Any sewer line placed under a roadway or subject to continuous traffic shall be placed in accordance with the appropriate provisions of Article 530.03.

(b) EXCAVATION AND FOUNDATION.

1. EXCAVATION.

The trench shall be excavated beginning at the outlet end and proceeding upgrade, true to the established line and grade. Tunneling will not be permitted unless authorized in writing. The removal of trees or other obstructions encountered necessary for the construction of the work shall be done by the Contractor without extra compensation. Trenches shall be properly sheeted and braced wherever needed. Unless otherwise directed, the trench shall be of the size, within the limits, provided by Subarticle 214.04(a).

2. FOUNDATION.

If deemed necessary, foundation backfill as provided by Article 214.02 shall be used. The foundation in the trench shall be so formed and treated as to prevent subsequent settlement. If the foundation is in rock, foundation backfill consisting of a 12 inch {300 mm} cushion of well compacted sand, fine gravel, slag, broken stone, or other approved material shall be placed upon the rock. If the excavation has been made deeper than necessary, proper bearing shall be secured by means of a layer

of fine gravel, or other suitable material. In all cases recesses shall be formed to receive the bell or hub, so that the full length of the pipe barrel will rest on the trench bottom.

(c) LAYING PIPE.

1. GENERAL.

The laying of pipes in finished trenches shall be started at the outlet end and proceed upgrade so that the spigot or groove ends point in the direction of flow. All pipes shall be laid with ends abutting and with not more than 1 inch {25 mm} variation from established alignment at the vertical centerline or from grade at the flowline. The bottom of the trench shall be shaped accurately to the outside surface of the pipe for a depth at least 0.10 times the outside diameter. Pipes shall be fitted and matched so that when laid in the work they will form a sewer with a smooth, uniform invert. Hubs or bells shall be carefully cleaned before pipes are lowered into the trenches. Pipe shall be so lowered as to avoid damage and unnecessary handling in the trench.

2. SEALING JOINTS.

Unless otherwise directed, all joints shall be sealed as specified in Item 530.03(d)3 for the entire circumference of the pipe. Trenches shall be kept free from water until mortar in the joints and masonry has hardened. Walking or working on or over the completed pipe line, except such as is necessary for tamping or backfilling, will not be permitted until at least 3 feet {1 m} of backfill is in place over the pipe.

(d) BACKFILLING.

1. MATERIAL.

All trenches and excavations shall be backfilled with approved natural soil or, if directed or provided by the plans, with foundation backfill material after the sewer pipe is laid therein, unless otherwise specified.

2. METHODS.

Backfilling shall not begin until mortar joints have cured or until backfilling is authorized by the Engineer. The material shall be carefully deposited simultaneously on both sides of the pipe in uniform layers not to exceed 6 inches {150 mm} in compacted thickness, solidly tamped or rammed with proper tools so as not to injure or disturb the pipe. If stone, gravel, or slag is provided or specified as backfilling, the sewer pipe shall be covered with clean gravel or broken stone or slag placed around and above it to a height of not less than 4 inches {100 mm} above the upper surface of the pipe. The remainder of the trench shall then be backfilled with the excavated material. The Contractor shall restore all roadways or crossings, which are disturbed by the placing of sewers, to their original condition and shall replace all surface material and all paving, macadam, sidewalk, sod, or other surface disturbed, furnishing all the new material necessary without extra compensation, except as herein provided. Whenever excavation is made for installing sewer pipe across private property, the topsoil disturbed by excavation operations shall be replaced as nearly as possible in its original position.

Bedding, placing, and backfilling of storm sewers within roadway limits shall be as provided in Section 530, using the type and strength of pipe specified on the plans.

3. COMPACTION AND DENSITY.

Compaction and density requirements shall meet that specified by Article 530.03. Ramming of material over, around, and to within 1 foot {300 mm} above the top of the sewer shall be done by careful use of approved mechanical tampers.

4. CLEAN UP.

After completing the backfill, the Contractor shall immediately remove all surplus material, dirt, rubbish, and all tools and other equipment or material, leaving the entire site and the whole area involved in the construction operations in a neat and presentable condition. All pipe lines shall be thoroughly cleaned out prior to final acceptance.

533.04 Method of Measurement.

Storm sewer pipe, excavation, and foundation backfill will each be measured in the same manner as specified in Article 530.04.

533.05 Basis of Payment.

(a) GENERAL.

The accepted length of a storm sewer pipe, measured as specified above, will be paid for at the respective contract unit price for the sizes and types of pipe provided in the proposal, complete in place, which shall be payment in full for all materials, equipment, labor, and incidentals necessary to complete the work, except that excavation and backfill will be paid for as provided in Section 214.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

533-A ___ inch {mm} Storm Sewer Pipe (*) - per linear foot {meter}
533-B ___ inch {mm} Span, ___ inch {mm} Rise Storm Sewer Pipe (*)
- per linear foot {meter}

* Show specific type, if required.

Example: P.C. or V.C., or Class ____ R.C., or Class ____ C.S.L.C.S., or Class ____ C.S.L.C.A., C.S.F.C.S., C.S.F.C.A., or C.C.L.C.S.

SECTION 535
SIDE DRAIN PIPE

535.01 Description.

This Section shall cover the work of furnishing and installing side drain pipe in conformity with these specifications. It shall cover only those pipes specifically designated on the plans as side drain; it shall not apply to other pipes laid parallel to the roadway. The kind, type, and size of each side drain pipe will be shown on the plans or in the proposal. The location of each will be shown on the plans or designated. This Section shall include furnishing and constructing such joints and necessary cutting to provide connections to other drainage facilities, and other incidentals necessary for completion of the work.

The word "pipe" in this Section shall include both round and arch pipe. Abbreviations shall be:

Side Drain	- S.D.
Concrete Pipe	- P.C. for plain concrete
	- R.C. for reinforced concrete
Vitrified Clay	- V.C.
Corrugated Metal	- C.M. for plain corrugated metal
	- C.C.M. for coated corrugated metal
Corrugated Aluminum	- C.A. for plain corrugated aluminum
	- C.C.A. for coated corrugated aluminum
Corrugated Steel	- C.S. for plain corrugated steel
	- C.C.S. for coated corrugated steel
Plastic Pipe	- A.B.S. for acrylonitrile butadiene styrene
	- P.E. for polyethylene
	- P.V.C. for polyvinylchloride

535.02 Materials.

Materials furnished for use shall conform to the appropriate requirements of Division 800, Materials, with specific reference made to Sections 846 and 851. Unless a specific type of pipe is specified by the plans or proposal, the Contractor will be permitted to use any of the optional types of pipe permitted by the following criteria:

Diameters up to and including 24 inches {600 mm} - P.C.; V.C.; 16 gage {1.6 mm} C.M. with minimum 24 inches {600 mm} of cover, 14 gage {2.0 mm} C.M. if cover is less than 24 inches {600 mm}; or P.V.C., A.B.S. or P.E. pipe with minimum of 12 inches {300 mm} of cover, and maximum of 50 feet {15 m} fill height.

Diameters over 24 inches {600 mm} - Class 2 R.C.; V.C.; 14 gage {2.0 mm} C.M. ; P.V.C. or P.E. (P.E. up to 36 inch {900 mm} diameter).

If a higher strength pipe and/or a coated finish for C.M. pipe is required, such will be specified by noting in the pay item.

The Contractor may, at his option, substitute a stronger grade pipe than specified or, with written approval, a Cast Iron or Ductile Iron Pipe meeting the appropriate requirements of Section 854, provided no additional cost is incurred by the State for such substitution.

Any installation, once started, shall be completed using the same type pipe throughout unless specifically designated otherwise by plan details or directed in writing.

535.03 Construction Requirements.

Construction details for installing side drain pipe shall be as specified in Section 530, except as modified in this Section.

The requirements of Subarticle 530.03(b) for partial construction of fills in advance of trenching will not apply. Trenches shall be excavated as specified in Section 214. No separate measurement or direct payment will be made for excavation and backfill of trenches for side drain pipes.

Special bedding will not be required; however, the pipe shall be bedded with ordinary care in the loosened soil foundation of the trench. Should the material at the elevation of the bottom of the pipe be ledge rock or other unsuitable bedding, it shall be excavated without additional compensation.

The pipe shall be installed so that it will not vary at any point more than 1 inch {25 mm} from established line and grade.

The pipe shall be backfilled in thoroughly compacted layers not more than 6 inches {150 mm} in thickness, using pneumatic tamps unless otherwise directed, but there will be no specific density requirements. Backfill shall be ordinary excavation material.

535.04 Method of Measurement.

Side drain pipe will be measured in the same manner as specified in Article 530.04. Excavation and foundation backfill for side drain pipe will not be measured separately for payment, but the cost thereof shall be included in the contract unit price bid for the side drain pipe.

535.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Accepted side drain pipe, measured as specified above, will be paid for at the contract unit price per foot {meter} for the respective items, which shall be payment in full for furnishing pipe, excavating trenches, placing pipe, backfilling trenches, and for all tools, equipment, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

535-A ___ inch {mm} Side Drain Pipe (_*_) - per linear foot {meter}

535-B ___ inch {mm} Span, ___ inch {mm} Rise Side Drain Pipe (_*_) - per linear foot {meter}

* Show specific type, class, or wall thickness, if required.

Example: V.C., or P.C., or Class ____ R.C., or ___ gage {mm} C.A., or ___ gage {mm} C.S., or ___ gage {mm} C.C.S., or ___ gage {mm} C.C.A.

SECTION 536
RELAID PIPE

536.01 Description.

This Section shall cover the work of relaying pipe, regardless of size, in accordance with the requirements of these specifications, at the locations shown on the plans or designated and in accordance with established lines and grades. The item shall include furnishing and construction of such joints, necessary cutting and connections to other pipes, the removal and preservation of that portion of pipe culverts, in place, which are to be replaced by new or relaid pipe; it shall also include furnishing and construction of such joints, necessary cutting and connections to other pipes, catch basins, endwalls, etc., as may be required to complete the work shown on the plans or directed.

536.02 Materials.

(a) SALVAGED PIPE.

Pipe to be relaid shall be selected salvaged pipe which is approved for relaying.

(b) JOINT MATERIAL.

An applicable type of joint sealer required by Article 530.02 shall be used.

536.03 Construction Requirements.

(a) REMOVING PIPE IN PLACE.

With respect to removal of pipe, attention is directed to Article 206.03, the provisions of which are applicable to this Section.

(b) LAYING PIPE.

Pipe shall be handled so that there will be no loss or damage, before relaying. Pieces or sections of pipe found satisfactory by the Engineer shall be relaid in accordance with the requirements of the appropriate sections governing culvert pipe. Special reference is made to construction details of Section 530 which are applicable to side drain pipe relaid.

536.04 Method of Measurement.

Relaid pipe will be measured in the same manner as specified in Article 530.04. Excavation and foundation backfill for relaid pipe will not be measured separately for payment, but the cost thereof shall be included in the contract unit price bid for the relaid pipe.

536.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. The accepted length of relaid culvert pipe, measured as noted above, will be paid for at the contract unit price bid for either roadway pipe relaid or side drain pipe relaid, regardless of size or type of pipe. Said unit costs shall be full compensation for the salvaging of the pipe in conditions for reuse and the re-installation of the pipe in accordance with the provision for roadway pipe as covered by Section 530 and Section 535 for side drain pipe including all equipment, tools, labor, and incidentals necessary to complete the work.

2. No payment will be made for the removal of existing pipe lines replaced by new or relaid pipe, except for that portion of the old pipe removed outside the limits of excavation provided by Subarticle 214.04(a).

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

536-A Roadway Pipe Relaid - per linear foot {meter}
536-B Side Drain Pipe Relaid - per linear foot {meter}

DIVISION 600
INCIDENTALS

SECTION 600
MOBILIZATION

600.01 Description.

This Section shall cover the preparatory work and operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of all offices, buildings, and other facilities necessary for work on the project; and for all other work and operations which must be performed or costs incurred prior to beginning work on the various items on the project site.

The lump sum bid for mobilization shall be so distributed among the various pay items of the contract that an overrun of a particular pay item will not adversely affect the unit price of that item.

600.02 Materials.

Not applicable.

600.03 Construction Details.

Not applicable.

600.04 Method of Measurement.

(a) PARTIAL PAYMENT.

Measurement of the item of Mobilization will be on a unit basis for each project or combination of projects included in a single contract. When more than one project is included in one contract, the amount of payment to be made will be based on the percent complete and amount of the entire contract, not the percent complete and amount of each individual project. Once the amount of payment is determined, based on the entire contract, this amount will then be prepared for payment on each individual project based on the percentage of the total contract of which the project is a part.

Payment of 20% of the mobilization bid amount or 2% of the Original Contract Amount, whichever is less, will be made on the first estimate.

Payment of an additional 50% of the mobilization bid amount or 8% of the Original Contract Amount, whichever is less, will be made when 5% of the Original Contract Amount is earned, excluding any payment previously made for the item of Mobilization.

Payment of the remainder of the mobilization bid amount or 12% of the Original Contract Amount, whichever is less, will be made when 50% of the Original Contract Amount is earned, including any payment previously made for the item of Mobilization.

Any remaining balance of the mobilization bid amount will be paid on the Final Estimate.

The total sum of all payments shall not exceed the original contract amount bid for the item of Mobilization, regardless of the fact that the Contractor may have, for any reason, shut down his work on the project or moved equipment away from the project and then back again.

(b) WHEN NO SEPARATE PAYMENT IS SHOWN IN THE PROPOSAL.

When the proposal does not include a separate item for Mobilization, all work and incidental costs specified as being covered under this Section shall be included for payment under the several scheduled items of the overall contract, and no separate payment will be made therefor.

600.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The item of Mobilization, measured as noted above, will be paid for at the contract lump sum price bid. Said lump sum price bid shall be full compensation for organizing and moving all labor, tools, equipment, supplies, and incidentals to the project site and for disbanding, disorganizing, and removing all labor, tools, equipment, supplies, and incidentals from the project site, regardless of number of times such moves are made, including all preconstruction costs exclusive of bidding costs.

(b) PARTIAL PAYMENT.

Partial payments may be made in accordance with schedule noted in Article 600.04, subject to the regular retainage noted in Article 109.07.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

600-A Mobilization - per lump sum

SECTION 601
FIELD LABORATORIES

601.01 Description.

This Section shall cover furnishing for the duration of the contract, base, soil, and structure laboratories, and asphalt and concrete plant laboratories as specified on the plans and in these Specifications.

601.02 Materials.

Laboratories and equipment furnished shall be in satisfactory usable condition, and shall be maintained in that condition throughout the contract.

601.03 Equipment.

(a) BASE, SOIL, AND STRUCTURE LABORATORIES.

Laboratories for testing soil type bases, soils, structures, and similar work shall comply in all details with the requirements of Article 106.03.

(b) ASPHALT AND CONCRETE PLANT LABORATORIES.

Asphalt and concrete plant laboratories for testing bituminous plant mixes or portland cement concrete and similar work shall comply in all respects with the requirements of Article 106.03.

601.04 Number of Laboratories Required.

The number of Base, Soil, and Structure laboratories specified in the contract is approximate only. The number actually required will depend on the scope of the Contractor's operations and may be expected to vary from the specified number. Only the number of Base, Soil, and Structure laboratories actually furnished as directed in writing will be paid for at the contract unit price, and no claim will be allowed for extra compensation on account of overrun or underrun in these items.

Each Asphalt and Concrete Plant furnishing materials to the project must have a laboratory meeting the requirements of Article 106.03 for use by the Department; however, no direct compensation will be made for these laboratories.

601.05 Method of Measurement.

Measurement will be by the unit for each Base, Soil, and Structure laboratory furnished, as directed in writing.

No measurement for payment will be made for asphalt and concrete plant laboratories.

601.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. BASE, SOIL, AND STRUCTURE LABORATORIES.

The number of laboratories, furnished as specified above, will be paid for at the contract unit price per each, which shall be payment in full for use of the laboratory and equipment; for locating, relocating on the same contract if desired, maintaining, and removing same; for furnishing utilities (water, electricity and heat); and for all equipment, tools, labor, and incidentals necessary to complete the work.

The unit price covers the use or rental of the laboratory and equipment for the duration of the contract. Laboratories ordered by the Engineer shall be furnished promptly within the time limit designated by the Engineer; failure to provide the facility when required shall be cause for the Engineer to order the work stopped until such time as the facility is furnished. Should working conditions on the project be such that a previously ordered laboratory is not needed temporarily or permanently in certain cases, the Contractor may be allowed to remove a laboratory from the project with the written permission of the Engineer. However, it shall be expressly understood that temporary removal is for the Contractor's convenience and when work progresses to the stage that the laboratory

is needed, the Engineer will give written notice to return or replace the facility. The Contractor will be given 48 hours to comply with this order; failure to comply shall be cause for the Engineer to order the work stopped. In addition, any time a laboratory is away from the job site without authorization shall be deducted from the Contractor's estimate in an amount per day, equal to the unit price bid per unit divided by the number of working days or calendar days provided by the contract. Cost of the removal and return to a facility shall be classified as incidental to furnishing the laboratory and no extra compensation for such will be allowed,

Laboratory and equipment remains the property of the Contractor and shall be removed by him upon completion of the work.

2. ASPHALT AND CONCRETE PLANT LABORATORIES.

The Contractor will be responsible for providing a satisfactory laboratory meeting the requirements of Article 106.03 for each asphalt or concrete plant supplying materials to the project. The cost of providing these laboratories shall be included in the contract items for which asphalt or concrete materials are being furnished and no direct compensation will be made.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

601-A Furnishing Base, Soil, and Structure Laboratories - per each

SECTION 602
RIGHT OF WAY AND LAND SURVEY MARKERS

602.01 Description.

This Section shall cover the work of furnishing and installing reinforced concrete markers of the types, sizes, shapes, and markings in accordance with the details shown on the plans and these specifications. Such markers are for marking designated points on the right of way and land surveying reference points for future reference. Markers shall be installed at locations designated on the plans or directed.

602.02 Materials.

Materials furnished for use in the construction of the markers shall conform to the appropriate Section of the Specifications for the type material used and the details shown on the plans with special attention directed to Section 831. Specific reference is made to:

Section 501, Structure Concrete
Section 502, Steel Reinforcement

602.03 Construction Requirements.

(a) CONSTRUCTION MARKERS.

Markers shall be constructed of Class "A", Type 1a concrete in conformity with Section 501 with forms complying with the requirements of Subarticle 501.03(i).

(b) LOCATION.

Markers shall be set at such locations as provided by the plans or directed.

(c) ERECTION OF MARKERS.

These markers shall be set in the ground to such depths as directed. They shall be set plumb and, where lettered, with the lettered side facing the roadway. Markers located in lawns, walkways or roads shall be set with their tops flush with or slightly below the surface. Any marker damaged prior to final acceptance shall be replaced. Bronze or aluminum discs shall be marked in accordance with the plan details with the remainder of the markings placed by State Forces.

All markers shall be set in stable, compacted soil on a firm foundation. The space around the marker shall be backfilled with selected approved moist material, rammed in place so that the marker, when completed, will be rigid and secure in correct position.

602.04 Method of Measurement.

The number of markers of the type designated, measured for payment, will be the actual number ordered, completed, and accepted.

602.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Accepted markers will be paid for at the contract unit price bid for each type marker, ordered and placed, measured as noted above. Said unit price shall be full compensation for furnishing all materials, fabrication of the markers, installation of the markers including excavation and backfill thereof, and for all material, tools, labor, equipment, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

602-A Right of Way Markers - per each
602-B Land Survey Markers - per each
602-C Permanent Easement Markers - per each

SECTION 603
ENGINEER'S FIELD OFFICE

603.01 Description.

(a) GENERAL.

This Section shall cover the work of furnishing and maintaining or setting up a field office for the exclusive use by the Engineer during the life of the contract.

The field office shall be in reasonably close conformity with the type specified by the plans in accordance with the following type classifications:

Type	Approximate Floor Space	Number of Offices	Work Rooms	Rest Rooms	Outside Doors	Windows
1	200 square feet {19 m^2}	1	1	1	2	4
2	400 square feet {37 m^2}	2	1	2	2	6
3	600 square feet {56 m^2}	3	1	2	2	8
NOTE: Site installation of mobile offices or trailers will require the use of tie down straps in accordance with local or state requirements for mobile homes, whichever are more stringent. For used or relocated mobile offices or trailers, the Contractor shall provide and install new tie down straps meeting the above requirements.						

(b) ITEM 603-A, "Furnishing Type ___ Field Office".

The field office shall be available and ready for use within 15 days after the date of the "Notice to Proceed" and will be vacated by the Engineer no later than 30 days after the date of final acceptance of all work on the project. The field office shall remain the property of the Contractor. Field offices provided under this item may be a building, house, mobile office, or trailer approved by the Engineer in reasonably close conformity with these specifications.

This Section shall also cover the work of furnishing security of the field office as required in Item 603.02(a)4. Security of the field office under Pay Item No. 603-A shall be considered a subsidiary obligation of furnishing the field office. In lieu of this security requirement, when required on the plans or in the contract, the Contractor shall furnish and install a security fence around the field office. This required fence will be paid for under Pay Item No. 603-B, Furnishing Security Fence.

(c) ITEM 603-C, "Furnishing Type ___ Field Office (State Retained)".

The field office shall be available and ready for use within 15 days after the date of the "Notice to Proceed". The field office, along with all furnishings, facilities, and appurtenances, shall become the property of the Department upon completion of the project. Field offices may be a new mobile office or trailer approved by the Engineer and in reasonably close conformity with these specifications.

This Section shall also cover the work of furnishing and installing a new security fence around the field office when required on the plans or in the contract. This fence will be paid for under Pay Item No. 603-B. The fence shall become the property of the Department upon completion of the project.

(d) ITEM 603-D, "State Furnished Field Office".

This Section shall cover the work of moving and setting up a State-furnished field office. The field office shall be available and ready for use within 15 days after the date of the "Notice to

Proceed". The field office (mobile office or trailer) along with all furnishings, facilities, and appurtenances, shall be relocated from its present location to a site designated by the Engineer.

This Section shall also cover the work of furnishing and installing a new security fence around the field office when required on the plans or in the contract. This fence will be paid for under Pay Item No. 603-B. The fence shall become the property of the Department upon completion of the project.

603.02 Field Office Requirements.

(a) ITEM 603-A.

1. LOCATION.

A site for the location of the field office shall be arranged for and provided by the Contractor subject to the approval of the Engineer. The site shall be on or near the right of way and readily accessible by automobile over an all-weather road, with all-weather parking facilities for at least eight vehicles adjacent to the building. If no adequate site is available on the project right of way, or the Contractor selects a site off the right of way, he shall assume all expenses in connection with obtaining and leasing the site.

2. BUILDING.

The field office building shall be separate and apart from any buildings occupied by the Contractor. The building shall be weather-tight and insulated, suitable for year-round use with heating, air conditioning, electric power, and indoor sanitary facilities (complete with lavatory and running water). Heat shall be forced hot air from a thermostat-controlled gas, oil, or electric heating unit, properly vented, and capable of furnishing sufficient heat to maintain an inside temperature of 72 °F ± 5 °F {22 °C ± 3 °C}. The air conditioning system shall be thermostat-controlled and capable of furnishing sufficient cooling to adequately maintain an inside air temperature 25 °F {14 °C} cooler than the outside temperature. Electrical outlets shall be provided on at least two walls of any office or work room and sufficient ceiling light fixtures furnished to provide a minimum of 70 footcandles {755 lx} of light on all working surfaces. All windows shall be fitted with locking devices, hung to open and close, and fitted with screens. Outside doors shall be fitted with cylinder locks and all keys turned over to the Engineer. A closet or locker with means for locking shall be provided for storage of survey equipment. One fire extinguisher (minimum size 10# {4.5 kg} CO_2 shall be provided for each 200 square feet {19 m^2} of floor space.

The size and configuration of the working space within each office and work room of the field office shall be such as to provide room for working and movement of personnel that is acceptable to the Engineer. Ceiling height shall not be less than 7 feet {2.13 m}.

Entrance doors to restrooms shall be equipped with door locks.

3. OFFICE FURNISHINGS.

Office furnishings shall be supplied with the field offices in accordance with the following schedule:

Minimum Furniture	
per office	1 desk, 3 chairs
per work room	1 plan table, 1 work table (drafting), 2 stools, 3 chairs, 1 water cooler dispenser, 1 4-drawer file cabinet, 20 feet {3 m} of book shelving, 1 plan storage rack, appropriate fire extinguishers

Furniture need not be new but must be clean, sturdy, in good repair, and acceptable to the Engineer.

4. AREA SECURITY.

The Contractor shall be responsible for the security of the field office and its immediate area against vandalism and entry by unauthorized persons. Such security shall be in the form of a guard service for non-work hours or a security fence (min. 8 feet {2.4 m} high) enclosure with a 14 foot {4 m} wide, minimum, lockable gate. See Subarticle 603.01(b) for additional requirements.

(b) ITEM 603-C.

1. LOCATION.

Unless shown otherwise by the plans, the site for the location of the field office shall meet the requirements of Item 603.02(a)1. above.

2. BUILDING.

The field office building shall be separate and apart from any buildings occupied by the Contractor. The building shall be weather tight and insulated, suitable for year-round use with heating, air conditioning, electric power, and indoor sanitary facilities (complete with lavatory and running water). Heat shall be forced hot air from a thermostat-controlled heating unit, properly vented, capable of furnishing sufficient heat to maintain an inside temperature of 72 °F ± 5 °F {22 °C ± 3 °C}. The heating unit shall be a new heat pump having heating and cooling capabilities. The air conditioning system shall be thermostat-controlled and capable of furnishing sufficient cooling to adequately maintain an inside air temperature 25 °F {14 °C} cooler than the outside temperature. Electrical outlets shall be provided on at least two walls of any office or work room and sufficient ceiling light fixtures furnished to provide a minimum of 70 footcandles {755 lx} of light on all working surfaces. All windows shall be fitted with locking devices, hung to open and close and fitted with screens. Outside doors shall be fitted with cylinder locks and all keys turned over to the Engineer. A closet or locker with means for locking shall be provided for storage of survey equipment. One fire extinguisher (minimum size 10# {4.5 kg} CO_2) shall be provided for each 19 m^2 of floor space.

The size and configuration of the working space within each office and work room of the field office shall be such as to provide room for working and movement of personnel that is acceptable to the Engineer. Ceiling height shall not be less than 7 feet {2.13 m}.

Each office shall be furnished with an acceptable set of steps for each outside door. A 6 foot by 6 foot {2 m x 2m} deck shall be provided at the top of each set of steps. Such steps and decks shall be safe, sturdy, and suitable for the intended purpose. They shall be constructed from 2 inch {50 mm} (nominal size) thick lumber treated with one of the timber preservatives listed in Section 816.

All restrooms shall be vented to the outside through the use of power ventilators. Entrance doors to restrooms shall be equipped with door locks.

3. OFFICE FURNISHINGS.

Unless shown otherwise on the plans, office furnishings shall be supplied with the field offices in accordance with the following schedule:

Minimum Furniture	
per office	1 desk, 3 chairs
per work room	1 plan table, 1 work table (drafting), 2 stools, 3 chairs, 1 water cooler dispenser, 1 4-drawer file cabinet, 20 feet {3 m} of book shelving, 1 plan storage rack, appropriate fire extinguishers

Furniture shall be new, sturdy, and acceptable to the Engineer. Water cooler dispensers shall be UL listed, shall have a rated capacity of 8.0 gallons {3 L}, minimum, per hour of 50 °F {10 °C} water, and shall be connected to the office plumbing facilities. Any special requirement office furnishings shall be as shown on the plans.

4. AREA SECURITY.

When required, a security fence shall be installed around the office. Such security fence shall be a chain link fence, meeting the requirements of Section 871, minimum 8 feet {2.4 m} high, with a 14 foot {4 m} wide, minimum, lockable gate. See Subarticle 603.01(c) for additional requirements.

5. PROJECT COMPLETION.

Unless shown otherwise on the plans, the Contractor will not be required to remove the field office, its appurtenances, and security fence upon completion of the project.

(c) ITEM 603-D.

1. LOCATION.

A site for the location of the field office will be arranged for by the Engineer.

2. RELOCATION OF THE FIELD OFFICE.

The field office (a mobile office or trailer) along with various appurtenances (i.e., steps, decks, electric service pole, wiring from pole to office, plumbing, existing security fence, etc.) shall be moved from its present location (shown on the plans) to the location designated by the Engineer. The mobile office or trailer shall be installed with required new tie down straps and connected to utilities.

3. DECKS.

If existing decks are not included with the field office to be relocated, a 6 foot by 6 foot {2 m x 2 m} minimum size deck shall be provided at the top of each set of steps by the Contractor. The

decks shall be safe, sturdy, and suitable for the intended purpose constructed from 2 inch {50 mm} (nominal size) thick lumber treated with one of the timber preservatives listed in Section 816.

4. AREA SECURITY.

If an existing security fence is included with the field office to be relocated, the Contractor shall remove and reinstall the fence. The cost for the existing fence relocation and its removal (if required upon completion of the project) shall be included as part of Item 603-D.

When Item 603-B is included on the plans or in the contract. the Contractor shall install a new security fence around the office. Such new security fence shall be a chain link fence, meeting the requirements of Section 871, minimum 8 feet {2.4 m} high, with a 14 feet {4 m} wide, minimum lockable gate.

5. PROJECT COMPLETION.

Unless shown otherwise on the plans, the Contractor will not be required to remove the field office, its appurtenances, and relocated security fence upon completion of the project.

603.03 Utilities and Services.

(a) ITEM 603-A.

The field office shall be provided with adequate lighting, heating, sanitary, drinking water, and telephone facilities. All installation and monthly maintenance charges for the utilities, except for the monthly telephone billing, shall be paid for by the Contractor. The Department will pay the monthly telephone billing.

Unless more stringent local or State regulations specify otherwise, sanitary facilities shall include a septic tank, min. 750 gallon {2839 L}, and adequate field lines where connection to a sanitary sewer system is unavailable.

All utility installations shall be in accordance with applicable local or State codes, ordinances, rules, and regulations.

The field office and its facilities shall be maintained in a satisfactory state of repair until released by the Engineer.

(b) ITEM 603-C.

The field office shall be provided with adequate lighting, heating, sanitary, drinking water, and telephone facilities. All installation charges for the utilities shall be paid for by the Contractor. The Department will pay all utility usage bills.

Unless more stringent local or State regulations specify otherwise, sanitary facilities shall include a septic tank, min. 750 gallon {2839 L}, and adequate field lines where connection to a sanitary sewer system is unavailable.

All utility installations shall be in accordance with applicable local or State codes, ordinances, rules, and regulations.

All electrical wiring shall be in accordance with applicable local or State codes, ordinances, rules, and regulations.

The field office and its facilities shall be maintained in a satisfactory state of repair throughout the life of the project.

(c) ITEM 603-D.

The State furnished field office will be provided with adequate electrical, sanitary, and telephone facilities. All installation charges for the utilities shall be paid for by the Contractor. The Department will pay all utility usage bills.

Unless more stringent local or State regulations specify otherwise, sanitary facilities shall include furnishing and installation of a septic tank, min. 750 gallon {2839 L}, and adequate field lines where connection to a sanitary sewer system is unavailable.

All utility installations shall be in accordance with applicable local or State codes, ordinances, rules, and regulations.

603.04 Method of Measurement.

Measurement of Field Offices will be in units of the type specified by the plans, ordered and accepted.

Measurement of the security fence will be in linear feet {meters}, to the nearest foot 0.1 foot {0.1 m}, of fence, including the gate, ordered and accepted.

603.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. ITEM NO. 603-A.

The ordered and accepted Field Offices, measured as noted above, will be paid for at the contract unit price bid for the type Field Office specified, which shall be full compensation for the furnishing of the office and its related facilities, security, and services for exclusive use of the Engineer throughout the life of the contract, all as noted in this Section and the satisfactory disposal thereof after the offices are released.

No additional compensation will be allowed for furnishing field office units larger than the type specified in the contract.

Partial payments for the field offices will be made on monthly estimates in accordance with the following schedule:

a. 75% of the unit price bid upon satisfactory installation and acceptance of the facility.

b. 15% of the unit price bid when 1/2 of the anticipated construction time has expired.

c. 10% of the unit price bid when the semi-final or final estimate is paid.

2. ITEM NO. 603-B.

The ordered and accepted security fence, measured as noted above, will be paid for at the contract unit price bid for the security fence which shall be full compensation for the furnishing and installing the fence and gate and for the maintenance of such throughout the life of the contract. The security fence, shall become the property of the Department upon completion of the project. When required on the plans, this item shall also be full compensation for removal and delivery of the fence and gates to a plan designated location.

3. ITEM NO. 603-C.

The ordered and accepted Field Office (State Retained), measured as noted above, will be paid for at the contract unit price bid for the type Field Office specified, which shall be full compensation for the furnishing of the office, its furnishings, related facilities, appurtenances, and installations for the exclusive use of the Engineer and for the maintenance of such throughout the life of the contract. The office, along with all furnishings, facilities, and appurtenances, shall become the property of the Department upon completion of the project. When required on the plans, this item shall also be full compensation for removal and delivery of the field office and appurtenances (including security fence) to a plan designated location.

No additional compensation will be allowed for furnishing field office units larger than the type specified in the contract.

Partial payments for the field offices will be made on monthly estimates in accordance with the following schedule:

a. 75% of the unit price bid upon satisfactory installation and acceptance of the facility.

b. 15% of the unit price bid when 1/2 of the anticipated construction time has expired.

c. 10% of the unit price bid when the semi-final or final estimate is paid.

4. ITEM NO. 603-D.

The ordered and accepted State Furnished Field Office, measured as noted above, will be paid for at the contract unit price bid for the relocation of the Field Office specified, which shall be full compensation for the breakdown, moving, and installation of the Office, its furnishings, related facilities, and appurtenances (including existing security fence when shown on the plans). When required on the plans, this item shall also be full compensation for removal and delivery of the field office and appurtenances (including relocated security fence) to a plan designated location.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

603-A Furnishing Type ___ Field Office - per each
603-B Furnishing Security Fence - per linear foot {meter}
603-C Furnishing Type ___ Field Office (State Retained) - per each
603-D State Furnished Field Office - per each

SECTION 604
GEOTEXTILES IN PERMEABLE ASPHALT TREATED BASE APPLICATION

604.01 Description.

This Section shall cover the furnishing and placing of geotextiles for use as a means to prevent clogging of the permeable base layer due to the migration of fine material from the underlying roadway layer. The geotextile shall be designed to allow passage of water while retaining untreated base or subbase course soils without clogging.

604.02 Materials.

The geotextile used in this work shall be one constructed of non-woven synthetic fibers meeting the requirements of AASHTO M 288 for Separation Geotextile Class 3 and Section 810 of these specifications with the exception that geotextiles manufactured with polyamide will not be allowed. The geotextile filter shall be resistant to the heat and temperature range expected during placement of the Permeable Asphalt Treated Base. The geotextile shall be selected from List II-3, of the Department's manual titled "Materials, Sources, and Devices With Special Acceptance Requirements". Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

604.03 Construction Requirements.

(a) GENERAL.

The surface area on which the geotextile fabric is to be placed shall be free of loose aggregate, foreign debris, and all sharp objects during placement of the fabric.

(b) INSTALLATION.

The geotextile filter shall be installed immediately prior to placement of the permeable asphalt treated base layer and extended full width between the inside and outside edge drains according to the manufacturer's specifications and as shown on the plans or in the proposal. Exposure of geotextile filter to the elements between lay down and cover shall not exceed three days.

Adjacent geotextile rolls, seamed or unseamed, shall be overlapped in the direction of placement of the Permeable Asphalt Treated Base a minimum of 2 feet {600 mm} at all longitudinal and transverse filter fabric joints.

The geotextile shall be held in place prior to Permeable Asphalt Treated Base placement by pins, staples, or other means as approved by the Engineer.

(c) SEAMS.

Both factory and field sewn or sealed seams, if applicable, shall conform to the strength requirements of Table 1 as outlined in AASHTO M 288 for separation applications. All seams shall be subject to the approval of the Engineer.

(d) DAMAGE REPAIR.

Damaged geotextiles, as identified by the Engineer, shall be repaired immediately. Any geotextile filter which is ripped or torn during the construction process shall be replaced or repaired with a patch which extends 3 feet {1 m} beyond the perimeter of the tear or damage.

604.04 Method of Measurement.

The geotextile will be measured by the square yard {square meter} computed from the width (from pavement edge drain to pavement edge drain) and the length as shown on the plans, or established in writing by the Engineer. This excludes seam overlaps.

604.05 Basis of Payment.

(a) GENERAL.

The accepted quantities of geotextiles will be paid for at the contract unit price per square yard {square meter} in place.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

604-A Separative Geotextile - per square yard {square meter}

SECTION 605
PAVEMENT EDGE DRAINS

605.01 Description.

This Section shall cover the work of (1) furnishing of all materials and constructing a pavement edge drain line, (2) furnishing all materials and constructing special outlets for the pavement edge drain lines or for shoulder drainage plane through the roadway front slopes, or (3) furnishing all materials and constructing underdrain collection systems, all of which shall be constructed in accordance with the provisions noted herein and the details provided on the plans, at the locations shown by the plans or directed by the Engineer.

Unless shown otherwise by the plans, the pavement edge drain may be either an aggregate filled underdrain line or a prefabricated drainage mat underdrain line. The aggregate filled underdrain shall consist of a trench filled with a selected aggregate wrapped in a geotextile filter. The prefabricated drainage mat underdrain shall consist of a flexible rectangular hollow mat having a supporting drainage core encased in a geotextile filter. The pavement edge drain line shall be drained by one of the methods noted in this Section.

Outlets for a pavement edge drain line or a shoulder drainage plane layer (constructed under Section 315) shall consist of an outfall pipe which either extends through the roadway front slope and has a slope paved headwall or is connected to a drainage structure (inlet, junction box, etc.) or is connected to an underdrain collection system. Outlets to an underdrain collection system, as well as the collection system, will be classified as "Special Underdrain Pipe." Other outlets will be classified as "Special Underdrain Outlets" according to Types in accordance with the following:

Type A - Designated for connecting an aggregate filled or prefabricated drainage mat underdrain line to a roadway front slope and requires a slope paved headwall.

Type B - Designated for connecting an aggregate filled or prefabricated drainage mat underdrain line to a drainage structure (inlet, junction box, etc.).

Type C - Designated for providing an outfall from a drainage plane layer to a front slope and requires a slope paved headwall.

Other types may be added as designated by plan details.

605.02 Materials.

Materials furnished for use shall conform to the appropriate requirements of Division 800, Materials, and the following:

(a) GEOTEXTILE FILTER.

1. GENERAL.

The geotextile filter for aggregate filled underdrain shall be a non-woven material meeting the requirements of AASHTO M 288 for Class 2 Subsurface Drainage Geotextile and Section 810 of these specifications. The geotextile shall be selected from List II-3, of the Department's manual titled "Materials, Sources, and Devices With Special Acceptance Requirements". Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

2. SECURING PINS.

Securing pins for anchoring the filter, if necessary, shall be of such size and design to adequately serve the intended function.

(b) PIPE.

The pipe may be of any of the non-corrugated pipe underdrain or smooth lined corrugated pipe underdrain provided in Section 853, perforated or non-perforated as required.

Pipe fittings shall be of the same material as the pipe or of a compatible material providing a crush strength equal to or greater than that of the type pipe being used.

(c) AGGREGATE FILLER.

Aggregate filler shall meet the requirements for Coarse Aggregate, Section 801, for ALDOT size #4, #5, or #57 modified to have a minimum permeability of 150 mm/sec. as determined by the ALDOT Permeability Test.

(d) PREFABRICATED DRAINAGE MAT.

1. GENERAL.

The prefabricated drainage mat shall be a flexible hollow mat consisting of a supporting drainage core encased in an envelope made of a non-woven geotextile filter material conforming to the requirements of AASHTO M 288 for Class 3 Subsurface Drainage Geotextile. The geotextile shall be affixed to the core in a manner as to prevent the geotextile from sagging into the core and thus impeding the flow of water through the core. The drainage mat shall be the depth and width shown on the plans. The core shall permit unobstructed inflow through the pavement side face of the mat and the shoulder side face of the mat. The core shall show no fungus growth when tested in accordance with ASTM G 21. The water absorption into the core material shall be less than .05% at 24 hours when tested in accordance with ASTM D 570. The drainage mat shall have a minimum flow rate of 15 gallons/min per foot of width {57 L/min per 300 mm of width} using ASTM D 4716 at 10 psi {69 kPa} load after 100 hours at a hydraulic gradient of 0.10. The core of the drainage mat shall be fabricated from a polyolefin and shall have a minimum compressive strength of 60 psi {415 kPa} at 20% maximum deflection when tested in accordance with ASTM D 1621 for cuspated or post type cores, or tested in accordance with ASTM D 2412 for elongated pipe type cores.

The Department's Product Evaluation Board has established a list (II-18, "Materials, Sources, and Devices with Special Acceptance Requirements" manual) for Prefabricated Drainage Mat for Edge Drains. The Contractor shall choose from any of these products, unless otherwise noted. Refer to Subarticle 106.01(f) and ALDOT-355, "General Information Concerning Materials, Sources, and Devices with Special Acceptance Requirements" for further information.

2. CERTIFICATION REQUIREMENTS.

The Contractor shall furnish manufacturer's certified test reports, on a per project basis, which shall include all test results for the requirements listed in Item 1. above, the quantity of material represented, and the project number. The material tested shall be taken from the actual production run of material to be supplied to a specific project. The lot size shall be equivalent to the total amount of drainage mat required on the specific project.

(e) SLOPE PAVING.

Slope paving for outlet headwalls shall meet the requirements noted in Section 614.

605.03 Construction Requirements.

(a) GENERAL.

Correlation of this work with other work must be made to prevent undue damage to final section.

Trenches shall be excavated at the location indicated on the plans or directed to the section shown by the plan details.

Materials from the excavation may be deposited outside the trench work area for reuse in the work. Excess material shall be removed and disposed of as shown by the plan details or as directed.

(b) AGGREGATE FILLED UNDERDRAIN WITH A GEOTEXTILE.

Exposure of geotextiles to the elements between lay down and cover shall be a maximum of 14 days to minimize damage potential.

The geotextile filter shall be installed in such a manner that all splice joints are provided with a minimum overlap of 3 feet {1 m}. In trenches, after placing the backfill material, the geotextile filter shall be folded over the top of the filter material to produce a minimum overlap of 12 inches {300 mm} for trenches greater than 12 inches {300 mm} wide. For trenches less than 12 inches {300 mm} in width, the overlap shall be equal to the width of the trench. All overlaps shall be firmly secured with mechanical ties.

Where seams are required in the longitudinal trench direction, they shall be joined by either sewing or overlapping as outlined in Article 608.05 of these specifications. All seams shall be subject to the approval of the Engineer. Overlapped seams shall have a minimum overlap equal to the width of the trench and shall be anchored with securing pins as directed to insure the required overlap is maintained.

Where a filter repair is required, a piece of filter shall be placed over the damaged area and extend 3 feet {1 m} beyond the perimeter of the tear or damage.

When an outlet pipe passes through the filter, a separate piece of filter of sufficient size to be wrapped around the pipe and flared against the side of the filled drain filter shall be used.

Care shall be taken during the aggregate filler placement operation as well as the pipe installation, when required, to prevent damage to the filter.

The aggregate filler shall be placed and compacted by methods acceptable to the Engineer before making the geotextile filter closure at the top of the trench.

The aggregate filled underdrain requires the use of a 4 inch {100 mm} perforated pipe in the last 10 feet {3 m} of the underdrain line which shall be connected to a non-perforated pipe of the outlet system, designated for use, by means of an elbow.

The completed aggregate filled underdrain line requires the capping of the underdrain trench with a layer of selected material to a depth specified by plan details. This selected material may be any of the bituminous patching and leveling mixes provided by the Standard Specifications unless otherwise specified by plan details. The placement and compaction of this layer shall be by a method acceptable to the Engineer; no specific density will be required. The furnishing, placing, and compaction of this capping material is considered incidental to construction of the underdrain line; hence, no additional compensation will be allowed.

(c) PREFABRICATED DRAINAGE MAT UNDERDRAIN.

The prefabricated drainage mat underdrain line shall be installed as shown on the plans, recommended by the manufacturer, specified herein, and approved by the Engineer. The drainage mat shall be installed in a trench immediately adjacent to the highway pavement edge. The trench shall be a minimum of 3.5 inches {90 mm} and a maximum of 5 inches {125 mm} in width. If nodes project from only one side of the drainage mat, it shall be placed such that the nodes are in contact with the pavement side of the trench.

Backfill for the trench shall be the excavated material from the trench except that only material passing a 2 inch {50 mm} sieve will be allowed as backfill. The backfilling operation shall be done in two approximately equal layers. Compaction of each lift shall be performed by vibratory wheel or plate compactors having a minimum compaction force of 5000 pounds {22 kN}. The installation operation shall be performed in such a manner as to insure that the drainage core remains immediately adjacent to the side of the trench nearest the roadway. The backfilled and compacted trench shall be left in a condition ready to receive an asphalt cap of the depth shown on the plans without any further preparation being required except for the application of a tack coat material. This asphalt cap may be any of the bituminous mixes provided by the Standard Specifications. The placement and compaction of this cap shall be by a method acceptable to the Engineer; no specific density will be required. The furnishing, placing, and compaction of this capping material is considered incidental to construction of the underdrain line; hence, no additional compensation will be allowed.

All fittings and material necessary to make splices of the drainage mat and to make connections of the drainage mat core to outlet piping shall be furnished. All fittings and material shall be designed and installed in such a way as to preclude soil intrusion into the drainage mat core or outlet piping. Appropriately designed fittings shall be provided to allow for outletting the drainage system whether on a slope or in a sag area. At locations where the drainage mat is terminated without an outlet, a fitting shall be provided to preclude soil intrusion into the end of the drainage mat.

A technically trained, experienced employee of the manufacturer of the drainage mat shall be present at all times during the installation of the prefabricated drainage mat, unless approved otherwise by the Engineer.

(d) SPECIAL UNDERDRAIN OUTLETS.

Where an underdrain outlet is constructed for a pavement edge drain, a 2 foot {600 mm} soil plug may be required to be left in place to prevent the flow of water from one section of the underdrain to another.

The width of the outfall trench requiring non-perforated pipe shall be kept to a minimum. The pipe shall be installed with ordinary care and the backfill material placed in layers and compacted to the satisfaction of the Engineer.

For Type "A" and "C" outlets, the end of the outfall pipe shall be protected by a slope paved headwall. The end of the outfall pipe shall be modified as necessary to fit the headwall. Should the outlet end of the pipe or the headwall fall within the limits of ditch paving, that portion of the ditch paving within the headwall limits shall be removed to neat lines and the headwall made to blend with the ditch paving.

For a Type "B" outlet, the end of the outfall pipe shall be drained into a designated drainage structure. The wall of the structure to which the pipe is to connect shall be modified, adjusted, or

replaced as necessary to provide a suitable connection. Any special fitting necessary to accomplish this connection will be considered incidental to the work.

For other types of special outlets, the construction requirements will be as noted by plan details.

Unless approved otherwise by the Engineer, all special underdrain outlets shall have a rodent protection screen made of galvanized hardware. The screens shall be as detailed on the plans; however, slight modifications to the configurations shown on the plans may be used if approved by the Engineer.

(e) SPECIAL UNDERDRAIN PIPE.

Special underdrain pipe is basically non-perforated pipe; hence, trench widths shall be kept to a minimum. The pipe shall be installed with ordinary care, with bells, etc., laid upgrade and all joints sealed. Pipe connections shall be made using appropriate, approved fittings. Connections to drainage structures shall be as detailed on the plans or approved by the Engineer. Backfilling of the pipe trench shall be made by placing the backfill material in layers and compacting the layer as directed.

Underdrain collection systems for pavement edge drains and/or shoulder drainage planes, when specified, shall be constructed using special underdrain pipe of the appropriate size, all in accordance with plan details.

605.04 Method of Measurement.

(a) ITEM 605-A.

The ordered and accepted pavement edge drain will be measured in linear feet {meters} along the center of each line or lateral for each edge drain actually installed.

(b) ITEM 605-B.

1. TYPE A AND B OUTLETS.

The ordered and accepted Type A and B special underdrain outlets measured in units of 20 feet {6 m} with measurements made along the center of the outfall pipe from the center of the pavement edge drain to the centroid of the outfall end.

Adjustments to the 20 feet {6 m} units will be made for pay purposes as provided in Subitem 605.05(a)2.b.

2. TYPE C OUTLETS.

The ordered and accepted Type C outlets will be measured individually as one complete unit.

3. OTHER TYPES OF OUTLETS.

The method of measurement of outlets other than the types of outlets noted above will be as noted by plan details.

(c) ITEM 605-C.

The ordered and accepted special underdrain pipe will be measured in linear feet {meters} along the center of each line or lateral, center to center of fittings.

605.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. ITEM 605-A.

The accepted quantity of pavement edge drain, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the edge drain complete in place. Said unit price covers the furnishing of all materials, excavation of the trench, disposal of excess material, installation of the geotextile filter, placement of the aggregate or prefabricated drainage mat, installation of the perforated underdrain pipe and elbow at the outlet end of the drain line, sealing and capping of the drain trench and for all labor, tools, equipment, fittings, and incidentals necessary to complete this item of work.

2. ITEM 605-B.

a. The accepted special underdrain outlet for the designated type, measured as noted above, will be paid for at the contract unit price bid per each, which shall be full compensation for the outlet complete in place. Said unit price includes excavation of the trench, backfill and compaction thereof, furnishing and installation of the pipe and any fittings necessary thereto, furnishing and

placing concrete for headwall or connection of outfall pipe to a structure, the disposal of excess material, and for all tools, equipment, labor, and incidentals necessary to complete this item of work.

b. When the length of the outfall pipe for Type A and B outlets exceeds or is less than the 20 foot {6 m} unit, an adjustment to the unit price bid will be made in accordance with the following:

Length of Outfall Pipe	% Unit Price To Be Paid
Over 6 feet {2 m} but less than 12 feet {4 m}	50 %
Over 12 feet {4 m} but less than 19 feet {6 m}	75 %
20 feet ± 1 foot {6 m ± 300 mm}	100 %
Over 21 feet {6 m} but less than 27 feet {8 m}	125 %
Over 27 feet {8 m} but less than 33 feet {10 m}	150 %
Over 33 feet {10 m} but less than 39 feet {12 m}	175 %
Over 39 feet {12 m} but less than 45 feet {14 m}	200 %

3. ITEM 605-C.

The accepted length of special underdrain pipe, measured as noted above, will be paid for at the contract unit price bid, which shall be full compensation for the pipe complete in place. Said unit price covers the furnishing of all pipe, fittings, and miscellaneous materials, excavation of the trench, installation of all materials, backfilling of the trench, disposal of excess materials, and for all tools, equipment, labor, and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

605-A Pavement Edge Drain - per linear foot {meter}
605-B Special Underdrain Outlet, Type _____ - per each
605-C Special ____ inch {mm} Diameter Underdrain Pipe - per linear foot {meter}

SECTION 606
PIPE UNDERDRAIN

606.01 Description.

This Section shall cover the work of furnishing pipe underdrain of the type and sizes provided on the plans or in the proposal in accordance with the requirements of these specifications, and installing such pipe at the locations shown on the plans or designated and in substantial conformity with the established lines and grades. The work shall include the furnishing and construction of such joints and connections to other pipes, catch basins, endwalls, etc., as may be required to complete the work, as shown on the plans or directed, together with filter material as shown on the plans.

Designations for the various types of pipe shall be as follows:

Type	Kind	Abbreviations
1	Concrete Pipe	C.P.
2	Corrugated Steel	C.S.
3	Coated Corrugated Steel	C.C.S.
4	Vitrified Clay	V.C.
5	Corrugated Aluminum	C.A.
6	Coated Corrugated Aluminum	C.C.A.
7	Bituminous Fiber	B.F.
8	Poly (Vinyl Chloride)	P.V.C.
9	Acrylonitrile Butadiene Styrene	A.B.S.
10	Polyethylene	P.E.

Unless specific types of pipe are specified by the plans or proposal, the Contractor may, at his option, use any of the approved types provided herein. However, an installation once started shall have the same type pipe unless otherwise noted in the plans or directed in writing.

606.02 Materials.

Materials shall meet the requirements specified in Section 853, Pipe Underdrain, including filter material.

All materials will be subject to further inspection for acceptance as to condition at the latest practicable time the Engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

606.03 Construction Requirements.

(a) STANDARD PIPE INSTALLATION.

Trenches shall be excavated to the dimensions and grade required by the plans or as directed. A minimum 3 inch {75 mm} bedding layer of filter material of the size shown on the plans shall be placed in the bottom of the trench for its full width and length and compacted as directed.

Subdrainage pipe of the type and size specified shall be embedded firmly in the bedding material.

Perforated pipe shall normally be placed with the perforations down, and the pipe sections shall be joined securely with the appropriate coupling fittings or bands.

Non-perforated pipe shall be laid with the bell end upgrade and with open joints, wrapped with acceptable material which will permit entry of water, yet prevent loss of filter material or unwrapped if so specified. Upgrade ends of all subdrainage pipe installations shall be closed with suitable plugs to prevent entry of soil materials.

After the pipe installation has been inspected and approved, filter material meeting the requirements of Article 853.10 shall be placed as specified on the plans to a height of 12 inches {300 mm} above the top of the pipe. Care shall be taken not to displace the pipe or the covering at open joints. The remainder of the filter material shall then be placed and compacted to the required height. Any remaining portion of trench above the filter material shall be filled with granular or impervious material, as may be directed, and thoroughly compacted, consistent with the location of the trench within the work.

(b) UNDERDRAIN OUTLETS.

Trenches for underdrain outlets shall be excavated to the width and depth shown on the plans. Pipe shall be laid in the trench with all ends firmly joined by applicable methods and means. Perforated pipe shall be laid with holes up and covered with roofing paper, or non-perforated pipe meeting the same requirements of the perforated pipe may be used. After inspection and approval of the pipe installation the trench shall be backfilled with suitable soil in layers and compacted as provided for drainage pipe. Filter material will not be required for outlet trenches unless specified on the plans, or ordered by the Engineer.

606.04 Method of Measurement.

The accepted length of pipe underdrain, complete in place, of each specified size and type will be measured in linear feet {meters} along the center of each line or lateral, center to center of junctions and fittings.

606.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. The accepted quantity of each kind and size of pipe underdrain will be paid for at the contract unit price for pipe underdrain, complete in place for a depth of 3 feet {1 m} and less below existing ground line to bottom of trench which shall be payment in full for all excavation and its disposal, foundation preparation, backfilling, furnishing, hauling and placing of all materials including fittings, cutting for connections, joint material, bands, and filter (or cover and bedding layer materials.)

2. Accepted quantity of pipe underdrain complete in place at depths greater than 3 feet {1 m} below the ground line shall have an adjusted unit price, arrived at by increasing the contract price bid by the percentage indicated in the table below. The unit price coverage provided in Item 1 above shall govern for such adjusted unit price.

Depth Underdrain Installed Below Existing Ground Line	Extra Percentage Contract Unit Price Bid to be Increased
More than 3 feet {1 m}, but less than 6 feet {2 m}	20
6 feet {2 m} and more, but less than 9 feet {3 m}	50
9 feet {3 m} and more, but less than 12 feet {4 m}	75
12 feet {4 m} or more	100

3. No separate payment will be made for excavation. The provisions of Article 214.04 are not applicable to this Section.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

606-A ___ inch {mm} Underdrain Pipe, Type __* - per linear foot {meter}

* Note specific type or types of pipe if required. See Article 606.01 for approved types.

SECTION 607
PAVING GEOTEXTILES

607.01 Description.

(a) GENERAL.

This section shall cover the work of furnishing and placing a geotextile between pavement layers for the purpose of incorporating a waterproofing and stress relieving membrane within the pavement structure. This specification is applicable to geotextile membranes used for full coverage of the pavement, or as strips over transverse and longitudinal pavement joints. It is not intended to describe membrane systems specifically designed for pavement joints and localized (spot) repairs.

607.02 Materials.

(a) PAVING GEOTEXTILES.

The geotextiles used in this work shall be constructed of non-woven synthetic fibers meeting the requirements of AASHTO M 288 for Paving Fabric, Class 2, and Section 810 of these specifications. The geotextile shall be selected from List II-3, of the Department's manual titled "Materials, Sources, and Devices With Special Acceptance Requirements". Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

(b) ASPHALT SEALANT.

The material used to impregnate and seal the geotextile, as well as bond it to both the base pavement and overlay, shall be a paving grade asphalt recommended by the geotextile manufacturer and approved by the Engineer.

Cutbacks and emulsions which contain solvents shall not be used. Uncut asphalt cements or cationic and anionic emulsions may be used provided these emulsions are used as outlined in Article 607.04 of these specifications.

(c) AGGREGATE.

If the ambient temperature is high enough to cause a bleed-through of the asphalt sealant, washed concrete sand may be spread over asphalt-saturated geotextiles to facilitate movement of equipment during construction or to prevent tearing or delamination of the geotextile. Excess quantities shall be removed from the geotextile prior to placing the surface course. A hot asphalt mix broadcast in front of construction vehicle tires may also be used.

607.03 Equipment.

(a) ASPHALT DISTRIBUTOR.

The distributor shall be capable of spraying the asphalt sealant at the prescribed uniform application rate. No streaking, skipping, or dripping will be permitted. The distributor shall also be equipped with a hand spray having a single nozzle and positive shut-off valve.

(b) GEOTEXTILE HANDLING EQUIPMENT.

Mechanical or manual laydown equipment may be used provided the laydown is smooth and without wrinkles or creases.

(c) MISCELLANEOUS EQUIPMENT.

Stiff bristle brooms or squeegees shall be provided to smooth the geotextile, scissors or blades for cutting same, and brushes for applying asphalt sealant at the geotextile overlaps.

When the ambient temperature is so low that the normal wicking of the asphalt sealant into the geotextile does not occur, a pneumatic roller may be used to ensure geotextile bond to the adjoining pavement layers, especially where thin lifts or chip seals are being placed.

607.04 Construction Requirements.

(a) WEATHER LIMITATIONS.

Neither the asphalt sealant nor geotextile shall be placed when weather conditions, in the opinion of the Engineer, are not suitable. Air and pavement temperatures shall be sufficient to allow the asphalt sealant to hold the geotextile in place. For asphalt cements, the minimum air temperature shall be 50 °F {10 °C} and rising. When using asphalt emulsions, the minimum air temperature shall be 60 °F {15 °C} and rising.

(b) SURFACE PREPARATION.

The surface on which the geotextile is to be placed shall be free of dirt, water, vegetation, or other debris. Cracks exceeding 1/8 inch {3 mm} in width shall be filled with a rubberized joint sealer meeting the requirements of ASTM D 3405 and potholes shall be properly repaired as directed by the Engineer. The joint sealer shall be allowed to cure prior to geotextile placement.

(c) APPLICATION OF ASPHALT SEALANT.

The asphalt sealant shall be spray applied uniformly to the prepared dry pavement surface at the rate of 0.20 to 0.30 gallons per square yard {0.9 to 1.36 L/m^2} or as recommended by the geotextile manufacturers and approved by the Engineer. The recommended application for asphalt cements is 0.20 gallons per square yard {0.9 L/m^2} with rough and ravelled surfaces requiring a higher application. When using emulsions, the application rate shall be increased to offset the water content of the emulsion.

Application of the sealant shall be by distributor spray bar, with hand spraying kept to a minimum. Temperature of the sealant shall be sufficiently high to permit a uniform spray pattern.

For asphalt cements, the minimum temperature shall be 290 °F {143 °C}. To avoid damage to the geotextile, however, distributor tank temperatures shall not exceed 325 °F {163 °C}. Spray patterns for asphalt emulsion can be improved by heating. Temperatures in the 130 to 150 °F {54 to 71 °C} range are recommended. A temperature of 160 °F {71 °C} shall not be exceeded since higher temperatures may break the emulsion.

The target width of asphalt sealant application shall be 6 inches {150 mm} wider than the geotextile width. The sealant shall not be applied any farther in advance of geotextile placement than the distance which the Contractor can maintain free of traffic.

Asphalt spills shall be cleaned from the road surface to avoid flushing and geotextile movement.

When asphalt emulsions are used, the emulsion shall be cured (essentially no water remaining) prior to placing the geotextile and final wearing surface.

(d) GEOTEXTILE PLACEMENT.

The geotextile shall be placed into the asphalt sealant with minimum wrinkling prior to the time the asphalt has cooled and lost tackiness. As directed by the Engineer, wrinkles or folds in excess of 1 inch {25 mm} shall be split and laid flat. Brooming and/or pneumatic rolling will be required to maximize geotextile contact with the pavement surface.

Overlap of geotextile joints shall be sufficient to ensure full closure of the joint, but should not exceed 6 inches {150 mm}. Transverse joints shall be lapped in the direction of paving to prevent edge pickup by the paver. A second application of asphalt sealant to geotextile overlaps will be required, if in the judgement of the Engineer, additional asphalt sealant is needed to ensure proper bonding of the double geotextile layer. Removal and replacement of damaged geotextile will be the responsibility of the Contractor.

Trafficking the geotextile will be permitted for emergency or construction equipment only.

(e) ASPHALT OVERLAY.

Placement of the hot mix overlay shall closely follow geotextile laydown. The temperature of the mix shall not exceed 325 °C {163 °C}. In the event asphalt bleeds through the geotextile causing construction problems before the overlay is placed, the affected areas shall be blotted by spreading sand or hot-mix. To avoid movement or damage to the geotextile membrane, turning of the paver and other vehicles shall be gradual and kept to a minimum.

(f) SEAL COATS.

Prior to placing a seal coat (or thin overlay such as an open-graded friction course), the geotextile shall be lightly sanded at a spread rate of 1.5 to 2.0 pounds per square yard {0.8 to 1.1 kg/m^2} and pneumatically rolled so as to embed the geotextile tightly into the sealant.

607.05 Method of Measurement.

The paving geotextile will be measured by the square yard {square meter}.

Asphalt sealant for the paving geotextile will be measured by the gallon {liter}.

607.06 Basis of Payment.

(a) GENERAL.

The accepted quantities of paving geotextiles will be paid for at the contract unit price per square yard {square meter} in place. Accepted quantities of asphalt sealant for the paving geotextile will be paid for at the contract unit price per gallon {liter} complete in place.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

607-D Paving Geotextile - per square yard {square meter}

607-E Asphalt Sealant - per gallon {liter}

SECTION 608
GEOTEXTILES IN SEPARATION APPLICATIONS

608.01 Description.

This section shall cover the furnishing and placing of geotextiles for use as a permeable separator to prevent mixing of dissimilar materials such as subgrades and surfaced and unsurfaced pavement structures, zones in embankments, foundations, and select fill materials. The geotextiles shall be designed to allow passage of water while retaining in situ soil without clogging.

When used as a soil stabilizer, a detailed design process shall be followed taking into consideration the separation function of the geotextile, along with its filtration and reinforcement functions.

608.02 Materials.

The geotextile shall meet the requirements of AASHTO M 288 for Separation Applications, Class 2, and Section 810 of these Specifications. The geotextile shall be selected from List II-3, of the Department's manual titled "Materials, Sources, and Devices With Special Acceptance Requirements". Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

608.03 Construction Requirements.

The installation site shall be prepared by clearing and grading the area as required. All sharp objects and large stones shall be removed and trees and shrubs shall be cut flush with the subgrade. The removal of top soil and vegetation is not necessary.

When appropriate, soft spots and unsuitable areas shall be identified during site preparation or subsequent proof rolling. These areas shall be excavated and backfilled with select material which is compacted to a depth such that the area provides equal stability as the adjacent area. Stabilization of these areas may be enhanced by use of a geotextile at the bottom of the excavation before backfill.

608.04 Installation.

The geotextile shall be unrolled as smoothly as possible on the prepared subgrade in the direction of the construction traffic. Adjacent geotextile rolls shall be overlapped in the direction of subbase placement using the following guide:

Required Overlaps		
Soil Strength (CBR)	Unsewn Overlap (inches {mm})	Sewn Overlap (inches {mm})
< 1	- -	9 {225}
1 - 2	38 {950}	8 {200}
2 - 3	30 {750}	3 {75}
> 3	24 {600}	- -

Unless shown otherwise on the plans, the required overlap shall be as shown for a CBR value of 1 - 2.

The geotextile may be held in place prior to subbase placement by pins, staples, or piles of fill or rock. Geotextiles may be folded or cut to conform to any curvature of the area. A fold or overlap shall be in the direction of construction and held in place as prescribed above.

608.05 Seams.

Both factory and field sewn or sealed seams shall conform to the strength requirements of Table 1 as outlined in AASHTO M 288 for Separation Applications. All seams shall be subject to the approval of the Engineer.

608.06 Subbase Placement.

The subbase shall be placed by end dumping onto the geotextile from the edge of the geotextile, or over previously placed subbase aggregate. On subgrades having a CBR of 1, the subbase aggregate shall be spread simultaneously with dumping to minimize the potential of a localized subgrade failure. Direct traffic on the geotextile, along with any sudden stops, starts, or turns on the subbase material by construction equipment, shall be avoided where possible. Using whatever means, the subbase material shall be spread from the back dumped pile. Except in the case of low volume roads (ADT < 200), a minimum thickness of 6 inches {150 mm} shall be maintained. In the case of low volume roads, this thickness shall be 4 inches {100 mm}. A smooth drum roller shall be used to achieve the specified density. Any ruts occurring during construction shall be filled with additional subbase material and compacted to the specified density. The use of vibratory compaction will not be allowed as it may cause damage to the geotextile.

608.07 Damage Repair.

Damaged geotextiles, as identified by the Engineer, shall be repaired immediately. The damaged area, plus an additional 3 feet {1 m} around the area, shall be cleared of all fill material. This area shall be covered with a geotextile patch extending 3 feet {1 m} beyond the perimeter of the damage. The removed subbase material shall be replaced and compacted to the specified density.

608.08 Method of Measurement.

The geotextile will be measured by the square yard {square meter} from the payment lines shown on the plans, or from the payment lines established in writing by the Engineer. This excludes seam overlaps.

Excavation, backfill, bedding, and cover material are separate pay items.

608.09 Basis of Payment.

(a) GENERAL.

The accepted quantities of geotextiles will be paid for at the contract unit price per square yard {square meter} in place.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

608-A Separation Geotextile - per square yard {square meter}

SECTION 609
AGGREGATE SLOPE PROTECTION

609.01 Description.

This Section shall cover the work of furnishing and constructing a slope protection layer of graded aggregate on slopes as shown on the plans or directed in accordance with these Specifications. This Section shall also cover the work, if shown on the plans, of furnishing and installing a geotextile filter blanket on slopes which are to receive the aforementioned aggregate protection layer.

609.02 Materials.

Materials furnished for use shall conform to the appropriate requirements of Division 800, Materials, and the following:

(a) GEOTEXTILE FILTER.

1. GENERAL.

The geotextile shall meet the requirements of AASHTO M 288 for Permanent Erosion Control Geotextile, Class 2, and Section 810 of these specifications. In addition, the fabric shall have a minimum coefficient of friction of the wet fabric on wet aggregate of 0.4 as determined by the Department's Central Lab. The geotextile shall be selected from List II-3, of the Department's manual

titled "Materials, Sources, and Devices With Special Acceptance Requirements". Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

2. SECURING PINS.

Securing pins for anchoring the filter shall be 3/16 of an inch {5 mm} steel bars, pointed at one end and fabricated with a head to retain a steel washer having an outside diameter of not less than 1.5 inches {38 mm}. The length of the pin shall not be less than 18 inches {450 mm}.

(b) AGGREGATE.

The aggregate shall be crushed stone of either ALDOT #3, #4, #357, or #467, unless a specific size is specified by the plans, meeting the requirements of Section 801 modified to require a minimum permeability of 150 mm/sec. as determined by the ALDOT Permeability Test.

609.03 Construction Requirements.

(a) PREPARATION OF SURFACE.

The slope to be treated shall be prepared by removing vegetation, topsoil, and dressing the slope to reasonable line and grade. The surface shall then be compacted, if necessary, by the use of mechanical tampers to the satisfaction of the Engineer before placement of the geotextile filter and aggregate blanket. The dressing and preparation of the slope shall be considered incidental to the placement of the Aggregate Protection Blanket and no direct payment for such will be made.

Where grading has been completed under another contract and regrading is necessary to obtain the desired uniform slope, such regrading shall be considered incidental to the placement of the aggregate protection blanket and no direct payment for such will be made.

(b) PLACEMENT OF GEOTEXTILE FILTER.

The geotextile filter, if required, shall be placed in the manner and at the locations shown on the plans or as directed by the Engineer. Exposure of the geotextile to the elements between lay down and cover shall be a maximum of 14 days to minimize damage potential. At the time of installation, filter shall be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage. The filter shall be placed with the long dimension horizontal with the natural ground line, unless otherwise directed by the Engineer, and shall be laid smooth and free of tension, stress, folds, wrinkles or creases. The strips shall be placed to provide a minimum width of 3 feet {1 m} of overlap for each joint. Overlap joints and seams shall be measured as a single layer of cloth. Securing pins with washers shall be inserted through both strips of overlapped cloth at not greater than the following intervals along a line through the midpoint of the overlap.

Pin Spacing	Slope
2 feet {0.6 m}	Steeper than 1:3
3 feet {1.0 m}	1:3 to 1:4
5 feet {1.6 m}	Flatter than 1:4

The filter shall be turned down and buried approximately 12 inches {300 mm} at all exterior limits.

Additional pins, regardless of location, shall be installed as necessary to prevent any slippage of the geotextile filter. Each securing pin shall be pushed through the filter until the washer bears against the filter and secures it firmly to the foundation. The filter shall be protected at all times during construction from contamination by surface runoff and any filter so contaminated shall be removed and replaced with uncontaminated filter. Any damage to the filter during its installation or during placement of riprap shall be replaced by the Contractor. The work shall be scheduled so that 30 days does not expire between placement of the filter and the covering of the filter with the graded aggregate. Aggregate shall not be dropped on the filter from a height greater than 1 foot {300 mm}. Greater drop heights will be permitted if the Contractor provides a cushioning layer of sand on top of the filter before dumping of stone. The combination of drop height for stone and sand cushion layer thickness to be approved shall be demonstrated to not puncture or damage the filter. No measurement or separate payment shall be made for a sand cushion layer placed for the purpose of allowing an increased drop height of stones. Any damage to the geotextile filter during placement of aggregate shall be corrected prior to proceeding with the work.

(c) PLACEMENT OF AGGREGATE.

The method of placement of the aggregate shall be at the option of the Contractor provided it produces uniform coverage and depth without damaging the geotextile filter, if present.

Any damage to the filter shall be cause for ordering the aggregate cleaned from the damaged area and the repair of the filter by an additional layer of filter covering the damaged area overlapping at least 3 feet {1 m} onto undamaged filter and securing the patch with adequate securing pins.

If uniformity of coverage is not obtained by the method of placement, such shall be corrected in a manner satisfactory to the Engineer.

No compaction of the aggregate blanket is required.

609.04 Method of Measurement.

Accepted aggregate slope protection and geotextile filter for aggregate slope protection, if applicable, will each be measured in square yards {square meters}, complete in place, computed from actual measurements taken along the top surface of the treated area to the nearest 0.1 square yard {0.1 m^2}.

609.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted Aggregate Slope Protection and geotextile filter for aggregate slope protection, measured as noted above, will each be paid for at the contract unit price bid per square yard {square meter}. Said unit price bid shall be full compensation for the item complete in place and includes the furnishing of all materials, the preparation of the slope (excavation, backfill, compacting slope, disposal of surplus material), placement of materials and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

609-A Aggregate Slope Protection - per square yard {square meter}

609-B Geotextile Filter for Aggregate Slope Protection - per square yard {square meter}

SECTION 610
RIPRAP

610.01 Description.

This Section shall cover the work of furnishing and constructing the several classes or types of Riprap, each of which shall consist of a protective course of stone or other approved materials on embankment slopes, in channels and ditches, wave protection for causeways and shoreline roadway embankments, bridge piers and abutments, or other work as shown on the plans or directed, with or without a geotextile filter, all in accordance with these specifications and in conformity with the lines, and grades noted in the plan details.

610.02 Materials.

If a geotextile filter is required, it shall meet the requirements of AASHTO M 288 for Permanent Erosion Control Geotextile, Class 1, and Section 810 of these specifications. All other materials shall conform to the requirements of Division 800, Materials. Specific reference is made to Section 814, Riprap Materials. The geotextile shall be selected from List II-3, of the Department's manual titled "Materials, Sources, and Devices With Special Acceptance Requirements". Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

610.03 Construction Requirements.

(a) GENERAL.

All slopes to be treated with riprap shall be trimmed to the lines and grades indicated by the plans or directed; loose material shall be compacted by methods approved by the Engineer or removed.

Slopes which require a geotextile blanket under the riprap shall, in addition to the above, be prepared as noted in Subarticle (b) below.

Placement of any riprap on a filter blanket shall be by such means that will not damage or destroy the blanket. Any damage to the blanket shall be repaired without additional compensation.

Unless otherwise authorized or directed by the Engineer, riprap protection for bridge ends shall be placed immediately following the grading operations. The bridge Contractor shall protect any slope protection material in place during the bridge construction and shall be responsible for any damage due to negligence on the part of his operations.

If directed by the Engineer or shown by plan details, all outer edges and the top of riprap where the riprap terminates shall be formed so that the surface of the riprap will be embedded and even with the surface of the ground and/or slope.

All riprap construction shall begin at the bottom of the slope and progress upward.

(b) FILTER BLANKET.

1. GENERAL.

Unless otherwise specified by the plans or ordered in writing, the Contractor may select one of the filter blanket materials provided in Article 814.03 for construction of the filter blanket except that a geotextile blanket will not be allowed for soils with 85% by weight {mass} passing the #200 {75 µm} sieve.

If an aggregate blanket is used, the blanket shall be constructed using the designated material to a minimum thickness of 6 inches {150 mm}, unless otherwise shown by the plans, all in accordance with the provisions noted in this Subarticle and the plan details.

If a geotextile filter is used, it shall conform with Article 610.02 of this Section.

2. FOUNDATION PREPARATION.

Areas on which filter blankets are to be placed shall be uniformly trimmed and dressed to conform to cross sections shown by the plans within an allowable tolerance of plus or minus 3 inches {75 mm} from the theoretical slope lines and grades.

3. PLACEMENT.

a. Aggregate Blankets (Gravel or Crushed Stone).

Filter blanket material shall be spread uniformly on the prepared base, in a satisfactory manner, to a thickness of not less than 1/2 of an inch {10 mm} from that specified and to neat lines as indicated on the plans. Placing or spreading of material by methods which will tend to segregate particle sizes within the filter layer will not be permitted. Any damage to the surfaces of the filter blanket foundation during the placing of the filter blanket shall be repaired before proceeding with the work. Compaction of the filter material will not be required, but shall be finished to present a reasonably even surface free from mounds, depressions, or windrows.

b. Geotextile Filter.

Exposure of geotextiles to the elements between lay down and cover shall be a maximum of 14 days to minimize damage potential.

The geotextile shall be placed and anchored on a smooth graded surface approved by the Engineer. The geotextile shall be placed in such a manner that placement of the overlying materials will not excessively stretch or tear the filter. Anchoring of the terminal ends of the geotextile shall be accomplished through the use of key trenches or aprons at the crest and toe of the slope. In certain applications, 18 inch {450 mm} long anchoring pins, placed on 2 to 6 foot {1 to 2 m} centers, depending on the slope of the covered area, should be used to expedite construction.

Successive geotextile sheets shall be overlapped in such a manner that the upstream sheet is placed over the downstream sheet and/or upslope over downslope. In underwater applications, the geotextile and required thickness of backfill material shall be placed the same day. The backfill placement shall begin at the toe and proceed up the slope.

Riprap and heavy stone filling shall not be dropped onto the geotextile from the height of more than 1 foot {300 mm}. Slope protection and smaller sizes of stone filling shall not be dropped onto the geotextile from a height exceeding 3 feet {1 m}. Any geotextile damaged during placement shall be replaced as directed by the Engineer at the Contractor's expense.

The geotextile shall be joined by either sewing or overlapping. All seams shall be subject to the approval of the Engineer.

Overlapped seams shall have a minimum overlap of 12 inches {300 mm} except where placed underwater where the overlap shall be a minimum of 3 feet {1 m}.

A geotextile patch shall be placed over the damaged area and extend 3 feet {1 m} beyond the perimeter of the tear or damage.

(c) STONE RIPRAP.

1. GENERAL.

Unless otherwise shown by the plan details or directed, stone riprap shall not be placed on slopes steeper than the natural angle of repose of the riprap material.

Placement of stones may, unless otherwise noted in this Subarticle, be placed by methods and equipment approved by the Engineer suitable for the purpose of placing the riprap in

accordance with the requirements for the class riprap involved without damaging any existing facility or construction feature.

2. CLASS 1.

Class 1 riprap is essentially designed for hand placement and use with minimal water currents. Stones shall be laid with close broken joints and resting on the embankment slope. The stones shall be of such shape and shall be so laid as to produce a single layer of stone of the thickness shown on the plans, measured perpendicular to the slope. The bottom course shall be laid in a trench excavated to such depth below the toe of the slope that all parts of the bottom course will be 3 feet {1 m} below the toe. Trenching will not be required where the toe of the slope is below water level. The back of the trench shall be on the same slope as the fill. The laying of the courses shall progress upward, the larger stones being placed in the lower courses. The individual pieces of stone in each horizontal course shall be laid so that they will break joints with the stones in the course below the tops sloped to drain away from embankment. Open joints shall be filled with spalls, or small stones in such manner that all stones are tightly wedged or keyed. The finished surface shall present a reasonably uniform appearance and shall not vary more than 6 inches {150 mm} from the average surface. The finished surface at the ends of the riprap shall be flush with the adjacent earth fill surface.

3. CLASS 2 AND 3.

Class 2 and 3 riprap is designed for use in areas with minimal to medium water currents and wave action. The stones shall be placed in such a manner as to produce a reasonably well graded mass of rock with the minimum practical percentage of voids. The riprap shall be constructed to the lines, grades and thickness shown by the plans or directed within a tolerance of plus 15 inches {375 mm} or minus 3 inches {75 mm} from the designated finish surface of the riprap, except that either extreme of such tolerance shall be reached as a uniform rate over an area greater than 200 square feet {19 m^2}. Riprap shall be placed in its full course thickness in one operation and in such a manner as to avoid displacing the filter blanket material, where filter blanket is required. The larger stones shall be well distributed and the entire mass of stones in their final position shall conform to a reasonable uniform gradation. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Placing riprap by dumping into chutes or by other methods likely to cause segregation of sizes will not be permitted. The desired distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the source, by controlled dumping of successive loads during final placing, or by other methods of placement which will produce the specified results. Rearranging of individual stones by mechanical equipment, or by hand, will be required to the extent necessary to obtain a reasonably well graded distribution of stone as specified above.

4. CLASS 4 AND 5.

Class 4 and 5 riprap is designed for use in medium to high water currents and wave actions for the protection of bridge piers and abutments, and protection of channel slopes. Stones may be placed without strict gradation controls provided sufficient small sizes are included to choke the larger stones. Dumping of the stones will be allowed; however, mechanical equipment to dress the material to a reasonable uniform slope will be required. Stones deposited contrary to directions will be considered wasted and will not be paid for.

(d) CONCRETE SACKED RIPRAP.

Immediately following mixing, as noted in Article 814.02, the mixture shall be placed in the bags, tied (so that when laid in position they will flatten out and give a thickness of not less than 6 inches {150 mm} and placed flat on the area designated. Bags shall be rammed against each other to form closed joints, with tied ends of sacks all laid in the same direction. When required to be placed under water, special care shall be taken to see that bags are closely jointed to give the same tight joints as required on dry slopes. After the riprap is placed, it shall be sprinkled with water as directed and kept damp for not less than three days. No Concrete Sacked Riprap shall be mixed in freezing weather.

(e) MAINTENANCE.

The Contractor shall maintain all riprap until the contract is accepted, and shall replace, without additional compensation, any damaged or lost riprap.

610.04 Method of Measurement.

Loose Riprap of the class designated by the plans or proposal will be measured in square yards {square meters}, computed from measurements taken parallel to the surface of the riprap or in tons {metric tons} as specified in Subarticle 109.0l(h), whichever is specified by the plans or proposal.

Concrete Sacked Riprap and Filter Blanket will be measured in square yards {square meters} computed from measurements taken parallel to the outer surface of the riprap or the filter blanket, whichever is applicable.

610.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The contract unit price for Loose Riprap, Concrete Sacked Riprap and Filter Blanket shall be full compensation for furnishing and hauling all materials, preparation of the placement area, placing materials and for all equipment, tools, labor and incidentals necessary to complete these items of work.

The preparation of the area for the placement of riprap includes excavation, dressing the placement area and surrounding area, and the disposal of any excess excavated material. Payment for this preparation shall be included in the contract unit price for the riprap unless otherwise noted on the plans.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

610-A Loose Riprap, Class ____ , ____ inches {mm} Thick - per square yard {square meter}
610-B Concrete Sacked Riprap - per square yard {square meter}
610-C Loose Riprap, Class ____ - per ton {metric ton}
610-D Filter Blanket, __*__ (__**__) - per square yard {square meter}

* If a specific type of blanket is required, so designate (aggregate or geotextile).
** If a specific kind of geotextile blanket is required, so designate (woven or non-woven).

SECTION 611
MORTAR FOR MASONRY

611.01 Description.

This Section shall cover the work of furnishing mortar made in accordance with these specifications, for the various classes and kinds of masonry when its use is required.

611.02 Materials.

Materials shall conform to the provisions of Division 800, Materials. Specific reference is made to the following:

Masonry Cement	Article 815.06
Sand	Article 802.03
Water	Article 807.01
Hydrated Lime	Section 805

611.03 Construction Requirements.

The mortar shall be composed of one part of cement and two parts of sand by volume, on basis of dry sand, and sufficient water to make a mortar of such consistency that it can be easily handled and spread with a trowel. If directed, hydrated lime, not to exceed 15 percent of cement by weight {mass}, shall be added, except that if masonry cement is used hydrated lime will not be required. Mortar shall be mixed only in quantities required for immediate use. Unless an approved mortar mixing machine is used, the sand and cement shall be mixed dry in a watertight box until the mixture assumes a uniform color, after which water shall be added as the mixing continues until the mortar attains the proper consistency. Mortar which is not used within 45 minutes after water has been added shall be wasted. Retempering of mortar will not be permitted.

611.04 Method of Measurement.

No measurement will be made for mortar for masonry.

611.05 Basis of Payment.

Payment for mortar for masonry shall be included in unit prices of pay items for various kinds of masonry, and no direct payment will be made for mortar.

SECTION 612
RUBBLE MASONRY

612.01 Description.

This Section shall cover the work of furnishing and constructing Rubble Masonry consisting of approved stones laid in mortar as a means of constructing structures or parts of structures in accordance with these specifications to the lines and dimensions shown on the plans or designated.

Rubble Masonry as herein specified shall include the Types commonly known as Coursed Rubble, Uncoursed Rubble, and Rustic Rubble.

612.02 Materials.

Materials shall conform to the provisions of Division 800, Materials. Specific reference is made to Type I and Type III, Masonry Stone, Subarticles 812.01(a) and (c), respectively.

Mortar shall meet the requirements of Section 611, Mortar for Masonry.

612.03 Construction Requirements.

(a) SHAPING STONE.

1. COURSED AND UNCOURSED MASONRY STONE.

The stones shall be roughly squared on joints, beds and faces. All shaping or dressing of stone shall be done before the stone is laid and no dressing or hammering which will loosen the stone will be permitted after it is placed.

2. RUSTIC MASONRY STONE.

Only shaping required will be that to eliminate sharp points and projections.

(b) WEATHER LIMITATIONS.

Stone masonry shall not be constructed in freezing weather or when fresh mortar may be subject to freezing.

(c) LAYING DETAILS.

1. The masonry shall be laid to line and in courses roughly leveled. The bottom or foundation courses shall be composed of large, selected stones, and all courses shall be laid with bearing beds roughly parallel to the natural bed of the material. The stone and the layers shall decrease in thickness from bottom to top of wall. Stones of each color shall be uniformly distributed in exposed surfaces so that walls do not present a patched appearance. Selected stone, roughly squared and pitched to line, shall be used at all angles and ends of walls. Headers shall be evenly distributed and preferably arranged to interlock. Each stone shall be cleaned and saturated with water and shall be damp while being set, and the bed which is to receive it shall be cleaned and well moistened. All stones shall be well bedded in freshly made mortar. The mortar joints shall be full and the stones carefully settled in place before the mortar has set. No spalls will be permitted in the beds. Joints and beds shall have an average thickness of not more than 1 inch {25 mm}. The minimum thickness of mortar between stones shall be at least 1/2 inch {13 mm}. Whenever possible the face joints shall be properly pointed before the mortar becomes set. Joints which cannot be so pointed shall be prepared for pointing by raking them out to a depth of 1.5 inches {38 mm} before the mortar has set. The face surfaces of stones shall not be smeared with the mortar forced out of the joints or that used in pointing. The vertical joints in each course of coursed masonry shall break joints with those in adjoining courses at least 6 inches {150 mm}. In case any stone is moved or the joint broken, the stone shall be removed, the mortar cleaned from bed and joints, and the stone reset in fresh mortar. Weepholes shall be constructed where indicated on the plans or designated. Immediately after laying and while the mortar is fresh, all face stones shall be cleaned of all mortar, and mortar stains and kept clean and free from mortar stains.

2. In Coursed and Uncoursed Rubble Masonry, headers shall hold in the heart of the wall the same or larger size than shown in the face. They shall extend not less than 12 inches {305 mm} into the

core or backing and in walls 12 inches {610 mm} or less in thickness shall extend entirely through the wall. They shall occupy not less than 1/5 of the face of the wall.

3. In Rustic Rubble Masonry, stone shall be laid without regard to courses or patterns, have close joints and reasonably smooth faces and, if not coped, reasonably true lines on top of structure.

(d) COPINGS, BRIDGE SEATS, AND BACKWALLS.

Copings, bridge seats and backwalls shall be of the materials and size shown on the plans and when not otherwise specified shall be Minor Structure Concrete which shall conform to the requirements for Section 620. Concrete copings shall be made in sections extending the full width of the wall, not less than 8 inches {200 mm} in thickness and from 5 to 10 feet {1.5 to 3 m} long. The sections may be cast in place or precast and set in place in full mortar beds.

(e) POINTING.

Pointing shall not be done in freezing weather or when the stone contains frost. Joints not pointed at the time the stone is laid shall be wet with clean water and filled with mortar. The mortar shall be well driven into the joints and finished with an approved pointing tool. The wall shall be kept moist while pointing is being done and in hot dry weather the pointed masonry shall be protected from the sun and kept wet for a period of at least three (3) days after the mortar has set, or be cured as provided by Subarticle 450.03(m). After the pointing is completed and the mortar set, the wall shall be satisfactorily cleaned and left in a neat and workmanlike condition.

612.04 Measurement.

Accepted Rubble Masonry will be measured complete in place, and the volume actually constructed within the neat lines of the work shown on the plans or designated will be computed in cubic yards {cubic meters}.

612.04 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted volume of rubble masonry measured as above described will be paid for at the respective unit prices bid per cubic yard {cubic meter} for Coursed Rubble Masonry, Uncoursed Rubble Masonry, and Rustic Rubble Masonry, complete in place, which shall be payment in full for all material, equipment, tools, labor and incidentals necessary for the satisfactory completion of the work.

(b) CONCRETE.

Concrete used in conjunction with the Rubble Masonry will be paid for as provided under Minor Structure Concrete, Section 620.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

612-A Type Rubble Masonry - per cubic yard {cubic meter}

SECTION 613
BRICK AND CONCRETE BLOCK MASONRY

613.01 Description.

This Section shall cover the work of constructing Brick or Concrete Block Masonry in accordance with these specifications at the locations and to the dimensions, lines, and grades as shown on the plans or established.

613.02 Materials.

All materials shall conform to the requirements of Division 800, Materials. Specific reference is made to the following:

Section 805 - Building Brick (Grade MW clay or shale brick unless otherwise specified on the plans or Concrete Brick and Concrete Block.)

Section 611 - Mortar for Masonry.

613.03 Construction Requirements.

(a) BRICK MASONRY.

The foundation shall be constructed firm and dry. All brick shall be damp at the time of laying. Bricks shall be laid in courses in full, close, uniform joints of mortar. Adjoining courses shall break joints by one-half length as nearly as practicable. The courses shall be level in all places, except

where otherwise directed. All exposed surfaces shall be smooth and clean and the tie joint shall not exceed 1/2 inch {13 mm} in width. Broken or chipped bricks shall not be used in the faces of the masonry. The joints shall be cleaned and pointed before the mortar sets. The exposed surfaces of the bricks shall not be smeared with mortar forced out of the joints or that used in pointing, but shall be kept clean and free from mortar stains. For straight masonry walls, at least one course in seven shall be a header course. No masonry work shall be done in freezing weather.

(b) CONCRETE BLOCK MASONRY.

When so specified on the plans and/or in the proposal, masonry walls may be constructed of hollow concrete blocks instead of bricks. Applicable construction details shall be the same as for brick masonry.

(c) MANHOLES, INLETS and CATCH BASINS.

Brick masonry for manholes, inlets, and catch basins shall conform to details shown on the plans. Construction details shall be as specified in Subarticle 613.03(a). Where shown on the plans, the faces of these and similar structures shall be given a plaster coat. Mortar for this coat shall be of the same mix as used in laying the brick and the coat shall be not less than 1/4 of an inch {6 mm} in thickness. Before applying the plaster coat, the brick shall be thoroughly wetted and the surface allowed to dry sufficiently to insure proper bond of the plaster coat.

Full mortar beds shall be provided for setting castings required by the plans. Castings shall be set carefully to the specified elevations.

613.04 Method of Measurement.

The quantity of Brick or Concrete Block Masonry will be measured in cubic yards {cubic meters} of completed and accepted masonry, except that when the proposal specifies payment by the unit for manholes, inlets, and the like, measurement will be by the completed and accepted units.

613.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of cubic yards {cubic meters} of Brick Masonry or Concrete Block Masonry, measured as provided above, will be paid for at the respective contract unit prices for these items, which shall be payment in full for excavating except as specified in Section 214, laying, backfilling and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

Manholes, inlets, catch basins, and the like will be paid for as specified in Section 620.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

613-A Brick Masonry - per cubic yard {cubic meter}
613-B Concrete Block Masonry - per cubic yard {cubic meter}

SECTION 614
SLOPE PAVING

614.01 Description.

This Section shall cover the work of paving with concrete any fill or cut slopes as shown on the plans or designated. The slope paving shall be laid to line, grade, and dimensions shown on the plans or directed.

Slope paving shall include, but not be limited to, paving of slopes at bridge ends, under grade separation structures, concrete slope drains, paving of side ditches, median ditches, special ditches, and other designated areas for control of erosion. Slope paving shall include wire mesh or other type of reinforcement when and as shown on the plans.

614.02 Materials.

The concrete shall be Class B, Type 3 meeting the requirements of Section 501. Consideration will be given to the use of local or manufactured fine aggregate meeting the requirements of Section 826; if approved, the aggregate proportions shall be varied as directed. With approval of the Engineer, a Class A concrete may be substituted for the Class B concrete.

Steel reinforcement shall meet the appropriate requirements of Section 835.

Joint filler and sealers shall meet the appropriate requirements of Section 832.

Job Control test cylinders will not be required for slope paving concrete.

614.03 Construction Requirements.

The slope to be paved shall be uniformly dressed and compacted with mechanical tampers to the satisfaction of the Engineer before placing the concrete. Where grading has been completed under another contract and regrading is necessary to obtain correct grades for the slope paving, such regrading shall be considered incidental to the placement of the slope paving and no measurement or direct payment for such will be made. The concrete shall be mixed, placed, and cured in accordance with the requirements of Section 501, which is applicable to this work. Weep holes approximately 3 inches {75 mm} in diameter shall be placed in alternate runs of the pavement where deemed necessary by the Engineer. After placing, the concrete shall be finished smooth and unless otherwise directed, when partially set, shall be cut with a finishing tool as shown on the plans. Where reinforced concrete slope paving is specified on the plans, reinforcement shall be placed in accordance with details shown on the plans, and in conformity with requirements of Section 502.

Unless otherwise shown on the plan details, joints for slope paved areas shall be in accordance with the following:

1. Contraction Joints.

This type joint is essentially provided to control cracking and may be formed by tooling, sawing or other approved methods for not less than 1/5, nor more then 1/4 the depth of the concrete. Except for sawed joints, all joints shall be finished with a 1/4 inch {6 mm} edging tool.

For flumes and ditch paving not adjacent to other paving, the transverse contraction joint spacing shall be as approved by the Engineer, but generally not in excess of 30 feet {9 m}. Longitudinal contraction joints may be ordered by the Engineer for paving widths in excess of 30 feet {9 m}, but are not to be placed where joint cracking will cause excessive seepage into subgrade.

For medians, islands, and ditches paved adjacent to curbs, gutters, or other paving, transverse contraction joint spacing shall be located wherever possible so as to line up with existing joints. Longitudinal contraction joints may be ordered for paving widths in excess of 20 feet {6 m} to control pavement cracking.

2. Construction Joints.

The use and spacing of construction joints shall be as approved by the Engineer, consistent with the planned contraction and expansion joints for the paved area and the Contractor's paving plan. The edges of all construction joints shall be finished with a 1/4 inch {6 mm} edging tool unless otherwise ordered by the Engineer.

3. Expansion Joints.

Unless otherwise shown by plan details or directed by the Engineer, expansion joints 3/8 of an inch {9 mm} wide shall be placed as follows:

Where the slope paving joins drainage structures and other rigid structure supports.

To line up with expansion joints of adjoining pavement curbs, gutters, etc., but in no instance more than 80 feet {24 m} between joints.

Where continuous runs of slope paving are 80 feet {24 m} or longer, transverse expansion joints shall be provided; one joint for each additional 80 feet {24 m}, or fraction thereof, of length.

Where slope paving is confined longitudinally by other concrete units and the width of the slope paving is in excess of 15 feet {5 m}, one longitudinal expansion joint will be required for each additional 15 feet {5 m}, or fraction thereof, of width.

Paved islands of 200 square feet {19 m^2} or less may be poured as a monolith if approved by the Engineer.

Expansion joints shall be formed using a filler and sealer specified in Articles 832.01 and 832.02.

Unless shown otherwise by plan details, the joint filler shall be from the bottom of the slope paving to 1 inch {25 mm} from the top; the sealer shall be 3/4 of an inch {19 mm} thick and shall be recessed 1/4 of an inch {6 mm} from the top.

614.04 Method of Measurement.

Slope paving will be measured in cubic yards {cubic meters} of paving, complete in place. Regrading in excess of 12 inches {300 mm} depth as described in Article 614.03 will be measured and paid for as Structure Excavation, Section 214.

614.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted quantity as determined above shall be paid for at the contract unit price for slope paving, which shall be payment in full for all excavation, backfilling, compacting slopes to be paved, disposal of surplus material, furnishing all materials, mixing, curing, hauling, and placing all materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

614-A Slope Paving - per cubic yard {cubic meter}

614-B Reinforced Slope Paving - per cubic yard {cubic meter}

SECTION 615
GROUTED RUBBLE SLOPE DRAIN

615.01 Description.

This Section shall cover the work of constructing gutter slope drain of grouted rubble masonry in accordance with the plans and these specifications and to the established lines, grades, and cross section shown on the plans and designated.

615.02 Materials.

(a) GENERAL.

The materials shall conform to the requirements of Division 800, Materials. Specific reference is made to Subarticle 812.0l(b), Type II, Masonry Stone.

(b) GROUT.

Grout shall meet the requirements of Section 611, Mortar for Masonry, except that it shall be of wetter consistency to flow as indicated in Subarticle 615.03(c).

(c) BASE COURSE MATERIAL.

Material shall be taken from sources shown on the plans or other approved sources of equal quality.

615.03 Construction Requirements.

(a) FOUNDATION.

The foundation shall be formed at a depth of not less than 8 inches {200 mm} below and parallel to the finished surface of the slope drain. All soft or other unsuitable material shall be removed, and the foundation shall be compacted and finished to a smooth, firm surface.

(b) BEDDING STONE.

The approved foundation material shall be prepared to form a bed as provided by the plans. The slope drain stone shall be bedded in the foundation perpendicular to the finished surface, flat face up, with the longest dimension parallel to the slope drain. The stone shall be fitted and laid in close contact and shall break joints satisfactorily.

Each stone shall be tamped into place until the stones are firm and the surface conforms to the finished grade and cross section.

(c) FINISHING.

While the slope drain stones are being tamped, the spaces between stones shall be filled and rammed with backfill material selected from unclassified excavation, to within 3 inches {75 mm} of the top and any irregularities in the slope drain corrected. The cement grout shall be poured and broomed into the spaces between and over the stones. This operation shall be continued until the grout remains flush with the tops of the stones. The slope drain shall be protected by wet burlap until the grout hardens, then kept moist for at least three days after grouting. No grout shall be poured in freezing weather.

615.04 Method of Measurement.

Accepted Grouted Rubble Masonry Slope Drain will be measured in square yards {square meters} complete in place, along the finished surface both longitudinally and transversely, and computed to the nearest 0.1 square yard {0.1 m^2}.

615.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted Grouted Rubble Slope Drain will be paid for at the contract unit price per square yard {square meter}, complete in place, which shall be payment in full for excavating and preparing the foundation bed, placing and grouting the stone and for furnishing all materials, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

615-A Grouted Rubble Slope Drain - per square yard {square meter}

SECTION 616
SOIL CEMENT FLUMES

616.01 Description.

This Section shall cover the work of constructing soil cement flumes at locations designated in accordance with details shown on the plans.

616.02 Materials.

All materials shall conform to the requirements of Division 800, Materials. Specific reference is made to the following:

Cement, Section 815.
Water, Subarticle 807.01(b).
Local Sand, Sand-Gravel, and Stone Screening
for Miscellaneous Construction, Use Section 826.
Preformed Joint Filler, Article 832.01.

Test specimens will not be required for soil cement flume.

616.03 Construction Requirements.

(a) SUBGRADE.

Subgrade shall be finished and compacted to the section as shown on the plans or as designated. Side forms and transverse forms of the size and shape necessary to secure the desired section shall be placed prior to the placing of the mix and at such intervals which will insure a true finished grade and section by screeding with a straightedge.

(b) MIX.

The mix shall be one part Portland cement and six parts, by loose moist volume, local sand or sand-gravel and shall be mixed in an approved concrete mixer or by approved hand methods to a consistency dry enough to stand on the slopes without subsequently settling and sloughing, and tamped, rough graded, and finished by means of a hand float. After screeding, the surface shall be finished by hand float methods.

(c) CURING.

As soon as the soil cement has hardened sufficiently to prevent marring of the surface, and not later than the morning following its placement, it shall be cured for a period of 72 hours using one of the methods provided in Article 450.03.

(d) JOINTS.

Transverse expansion joints shall be constructed at maximum intervals of 40 feet {12 m}. They shall be filled with either preformed joint filler or acceptable yard lumber board of 1 inch {25 mm} (nominal size) pine, S4S. The finished surface shall be scored transversely with a grooving tool to a depth of at least 1/2 inch {13 mm} so as to form a weakened plane joint at intervals of 6 feet {2 m}.

(e) TOE WALLS.

Toe walls shall be constructed across the ends of each flume as follows:

On upper end a toe wall of 6 inches {150 mm} in thickness and 12 inches {300 mm} in minimum depth below subgrade of the flume; on the lower end a toe wall 6 inches {150 mm} in thickness and 12 inches {600 mm} in minimum depth below subgrade.

(f) SOLID SOD STRIP.

A strip of solid sod shall be placed along each edge of the flume.

616.04 Method of Measurement.

Accepted soil cement flume will be measured in square yards {square meters}, complete in place, along the finished top surface both longitudinally and transversely and computed to the nearest 0.1 square yard {0.1 m^2}.

616.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Accepted Soil Cement Flume, measured as provided above, will be paid for at the contract unit price per square yard {square meter}, complete in place, which shall be payment in full for excavating and preparing the subgrade and foundation bed, furnishing and erecting forms, furnishing all materials, mixing and placing the mix, curing, backfilling, and for all other materials, tools, labor, and incidentals necessary to complete the work. Aggregate, available from the right-of-way, may be obtained by the Contractor without any charge for royalty and such material will not be included in excavation items. No direct payment will be made for toe walls. The solid sod strip will be paid for under Item 654, Solid Sod.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

616-A Soil Cement Flume - per square yard {square meter}

SECTION 617
BITUMINOUS TREATED GLASS FIBER FLUMES

617.01 Description.

This Section shall cover the work of furnishing and placing a layer of bituminous treated glass fibers on planted ditch slopes and other areas as shown on the plans or directed.

617.02 Materials.

(a) GLASS FIBERS.

Glass fiber material used for mulching shall consist of continuous fibers drawn from molton glass, coated with a chrome-complex sizing compound; collected into strands and lightly bound together without the use of clay, starch or like deleterious substances. The glass fibers shall be formed or wound into a cylindrical package in such a manner that the glass fibers can be continuously fed through an ejector driven by compressed air and expanded into a mat of glass fibers on the soil surface. The material shall contain no petroleum solvents or other agents known to be toxic to plant or animal life.

The glass fibers shall conform to the following specific requirements:

Property	Limits	Test Method
fiber diameter	0.00035 to 0.00053 inches {8.89 to 13.46 μm}	ASTM D 578
yards/pound {m/kg} of fibers	340 - 600	ASTM D 578
organic content	1.65% Max.	ASTM D 578
pkg. weight {mass}	30 - 45 pounds {14 - 20 kg}	ASTM D 578

(b) BITUMINOUS ASPHALT.

Asphalt shall be one of the emulsified type permitted by Subitem 860.03(b)7.b and complying with the requirements noted therein.

617.03 Construction Requirements.

(a) GENERAL.

The surface to be treated shall have been installed and prepared by one of the methods provided in Section 652, 653, or 654, unless otherwise directed by the Engineer.

Application of the Bituminous Treated Glass Fibers shall be accomplished within 24 hours after completion of planting operations.

(b) APPLICATION OF THE GLASS FIBERS.

The glass fibers shall be dispersed by equipment specifically designed for the purpose of using compressed air as the moving force. The glass fibers shall be spread over the area to be treated at a rate of approximately 0.4 to .05 pounds per square yard {217 to 271 g/m^2}.

Where water is expected to enter the flume, the fiber blanket shall be anchored into the natural ground a minimum of 9 inches {225 mm}.

(c) BITUMINOUS TREATMENT OF GLASS FIBERS.

After application of the glass fibers, the area shall be treated with emulsified asphalt (undiluted) at the approximate rate of 0.25 to 0.35 gallons per square yard {1.13 to 1.58 L/m²}.

After application of the asphalt and the emulsion has broken and become tacky, a light application of sand or pulverized soil shall be applied to the treated area, if so directed by the Engineer, so as to prevent adherence of objects which may come in contact with the asphalt. Care shall be taken not to apply sand or soil in an amount detrimental to the newly planted area.

(d) MAINTENANCE.

The Contractor shall maintain and repair the treated area to the satisfaction of the Engineer until final acceptance.

617.04 Method of Measurement.

Accepted Bituminous Treated Glass Fiber Flumes will be measured in square yards {square meters} computed from surface measurements to the nearest 0.1 square yard {0.1 m²}.

Erosion control treatment required under the Bituminous Treated Glass Fiber Flumes will be measured and paid for under the appropriate item of erosion control ordered used.

617.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted Bituminous Treated Glass Fiber Flumes, measured as noted above, will be paid for at the contract unit price bid per square yard {square meter} which shall be full compensation for the furnishing of all materials, the placing of materials and includes furnishing of all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

617-A Bituminous Treated Glass Fiber Flumes - per square yard {square meter}

SECTION 618
CONCRETE SIDEWALKS AND DRIVEWAYS

618.01 Description.

This Section shall cover the work of constructing a portland cement concrete sidewalk or driveway, with or without reinforcement as shown on the plans, in one course on a prepared subgrade in accordance with these specifications, and of the thickness and typical cross-section shown on the plans. Lines and grade shall be as shown on the plans or established. "Subgrade" in this Section shall mean the prepared foundation on which the sidewalk or driveway is constructed.

618.02 Materials.

All materials furnished for use shall comply with the appropriate requirements of Division 800, Materials, and the following:

Concrete shall meet the requirements for a Class A, Type 2 mix as provided in Section 501.

Reinforcing steel shall meet the requirements of Section 502 and plan details.

618.03 Construction Requirements.

(a) EQUIPMENT.

The equipment used for mixing concrete shall conform to the requirements of Section 501.

The Contractor may use forms or, if requested in writing and approved by the Department, an approved automatic extrusion type paving machine.

Forms shall be of wood, or metal, and shall be sufficiently staked to hold them true to line and grade while concrete is being deposited against them. If of wood, they shall be 2 inch {50 mm} or 3 inch {75 mm} (nominal size) stock lumber surfaces on all sides. If of metal, they shall be of approved section having a base width of at least 4 inches {100 mm} and shall have a flat surface on top. The depth of the forms shall equal the depth of the sidewalk or driveway. Adequate means shall be provided for securely fastening the ends of forms together.

Any automatic extrusion machine considered must be demonstrated to produce a consolidated concrete section conforming to the dimensions, crosssection, line, and grades shown on the plans or directed within the requirements noted herein in this Section.

(b) SUBGRADE.

All soft or other unsuitable material in the subgrade shall be removed and replaced with suitable material. All fills and filling material shall be placed and compacted by rolling with an approved roller or hand tamped with approved tamping devices in layers not exceeding 6 inches {150 mm} in thickness. Any existing areas that have been previously compacted by traffic to a greater degree than the remainder of the subgrade, shall be loosened and the whole subgrade uniformly compacted as directed.

(c) FOUNDATION BACKFILL.

Where provided by the plans and/or proposal, foundation backfill shall be placed and constructed as provided in Section 214. No direct payment will be made for foundation backfill except when Item 214-B is provided in the proposal and such is ordered placed by the Engineer.

(d) SETTING FORMS.

Forms shall be set to true line and grade and rigidly held in place by stakes or braces. Ends of adjoining form sections shall be flush. Forms and division plates shall be cleaned and oiled before placing concrete against them. Unless otherwise shown on the plans or designated, the finished surface of the sidewalks or driveways shall slope toward the roadway pavement at the rate of 1/4 inch per foot {20 mm/m}.

(e) HANDLING, MEASURING, PROPORTIONING, AND MIXING MATERIALS.

The method of handling, measuring, proportioning, and mixing concrete materials shall conform to Section 501, Structure Concrete. Where metal reinforcement is shown on the plans and/or provided in the proposal, it shall be placed in accordance with Section 502.

(f) PLACING CONCRETE.

A template resting upon the side forms and having its lower edge at the exact elevation of the subgrade shall be drawn along the forms and the subgrade shaped true before any concrete is deposited. The subgrade shall be moist and shall be free of debris and all foreign material when concrete is deposited upon it. The freshly mixed concrete shall be placed promptly on the prepared subgrade to the depth required to complete the sidewalk or driveway in one course. It shall then be vibrated and/or tamped and struck off with an approved straightedge resting upon the side forms and drawn forward with a sawing motion. The concrete shall then be floated with a wooden float until the surface is true. Concrete laid during cold weather shall conform to the requirements of Subarticle 501.03(d).

(g) JOINTS.

Unless otherwise shown by plan details, the surface of sidewalks and driveways shall be marked in squares or rectangles not exceeding 36 square feet {3.5 m^2} in area by using an approved marking tool. The marking tool shall provide a groove approximately 1/2 inch {13 mm} in depth and with rounded edges.

Unless otherwise directed by the Engineer, expansion joints 3/8 of an inch {9 mm} (min.) wide shall be placed as follows:

At all curb returns and where the walks or drives join other concrete units.

To line up with expansion joints of adjacent curbs, drives, etc., but in no instance more than 80 feet {24 m} between joints.

Where continuous runs of walks or drives are 80 feet {24 m} or longer, transverse expansion joints shall be provided; one joint for each additional 80 feet {24 m} or fraction thereof, of length.

Where walks or drives are confined longitudinally by other concrete units and the width of the walk or drive is in excess of 15 feet {5 m}, one longitudinal expansion joint will be required for each additional 15 feet {5 m}, or fraction thereof, of width.

Expansion joints shall be formed using a filler and sealer specified in Articles 832.01 and 832.02.

Unless shown otherwise by plan details, the joint filler shall be from the bottom of the walks or drives to 1 inch {25 mm} from the top; the sealer shall be 3/4 of an inch {19 mm} thick and shall be recessed 1/4 of an inch {6 mm} from the top.

(h) CURING AND PROTECTING.

Immediately after the finishing operations have been completed, the entire surface of the newly laid concrete shall be protected against rapid drying out and cured as provided in Subarticle 450.03(m), unless the Contractor elects to use Type III portland cement, in which case the total curing time will be reduced. No vehicles shall be permitted on the new concrete for seven days and pedestrians shall not be permitted thereon for at least 72 hours unless the Contractor elects to use Type III portland cement, in which case the time limit will be reduced to 24 hours for walks and four days for driveways.

(i) BACKFILLING.

After the concrete has set sufficiently, the side forms shall be removed and the spaces on both sides shall be backfilled with suitable material. This backfill shall be compacted to a level 1 inch {25 mm} below the walk or driveway and left in a neat and workmanlike condition.

618.04 Method of Measurement.

The quantity of accepted sidewalks or driveways will be measured, complete in place, and the area computed in square yards {square meters}. Measurement for separate payment for foundation backfill will only be made when Item 214-B is provided in the proposal and such is ordered by the Engineer.

618.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted quantity of sidewalk or driveway will be paid for at the contract unit price for Concrete Sidewalks or Concrete Driveways, complete in place, which shall be payment in full for furnishing all materials (including joints), for the hauling, preparation, and placing of all materials, for the preparation of the subgrade backfilling and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

618-A Concrete Sidewalk, ____ inch(es) {mm} Thick - per square yard {square meter}
618-B Concrete Driveway, ____ inch(es) {mm} Thick - per square yard {square meter}

SECTION 619
PIPE CULVERT END TREATMENTS

619.01 Description.

This Section shall cover the work of constructing a pipe culvert end treatment in accordance with these specifications and the plan details, at the locations shown on the plans or directed.

Unless specified otherwise on the plans or in the proposal, the Contractor may, for the required end treatment, either furnish and install a prefabricated pipe culvert concrete end section or construct a slope paved headwall, all in accordance with plan details and these specifications.

Class 1 shall designate those end treatments which do not require a grate. Class 2 shall designate those end treatments which do require a grate.

619.02 Materials.

All materials furnished for use shall conform to the appropriate requirements of Section 614, Division 800, Materials, plan details, and the following:

Concrete end sections shall comply with the requirement shown by plan details and Section 850 for Class 3 pipe except that the three-edge-bearing test will not be required.

Concrete end sections with metal sleeves shall comply with the provisions noted above. The metal sleeve shall comply with the appropriate provisions of Articles 850.02 and 850.03. Metal sleeves used in conjunction with coated and/ or paved invert pipe shall be coated using the same coating, with the exception of paved invert, used in the pipe culvert to which the sleeves are attached. In lieu of the bituminous coating, the Contractor may substitute a polymeric coating meeting the requirements specified in Item 850.02(c)2.

Safety grates, when required, shall be fabricated in accordance with plan details.

619.03 Construction Requirements.

(a) EXCAVATION AND BACKFILL.

All excavation involved shall be in accordance with the provisions of the Sections for the type pipe involved and Section 214. Backfilling shall be as specified under Sections 210, 214 and the applicable Pipe Culvert Section.

(b) INSTALLATION OF END TREATMENTS.

When prefabricated end sections are used, they shall be installed and securely affixed to the pipe line as shown on the plans or directed, all in conformity with the established lines and grades for the structure.

When slope paved headwalls are used, they shall be constructed as shown on the plans.

619.04 Method of Measurement.

The number of end treatments measured for payment will be the actual number of end treatments of the designated size and class, complete in place, on each designated pipe culvert.

619.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The ordered and accepted pipe culvert end treatment of the designated class for each size and appropriate type of pipe to which the end treatment is attached, measured as noted above, will be paid for at the contract unit price bid for the end treatment. Such price shall be full compensation for the furnishing of all materials and the installation and construction thereof, except for the items of Structure Excavation and Foundation Backfill, necessary for the complete construction of the end treatment, and for all labor, tools, equipment, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

619-A ___ inch {mm} _*_ Pipe End Treatment, Class ____ - per each

619-B ___ inch {mm} Span, ___ inch {mm} Rise _*_ Pipe End Treatment, Class ____ - per each

* Specify Roadway or Side Drain.

SECTION 620
MINOR STRUCTURE CONCRETE

620.01 Description.

This Section shall cover the work of constructing minor concrete structures such as pipe culvert headwalls, inlets and junction boxes, concrete steps, coping walls, and other miscellaneous items. All of which shall be constructed in accordance with the details shown on the plans and these specifications to the lines and grades established by the plans or directed.

620.02 Materials.

All materials furnished for use shall conform to the requirements of Division 800, Materials, and the following:

Section 501	Structure Concrete
Section 502	Reinforcing Steel

620.03 Construction Requirements.

(a) GENERAL.

The concrete mix used for minor structure work shall be Class "A", Type 2 unless otherwise provided by plan details, all in accordance with the appropriate provisions of Section 501.

(b) EXCAVATION AND BACKFILL.

Excavation and backfill shall be in accordance with the provisions of Sections 210 and 214.

(c) FORMING AND PLACING OF CONCRETE.

Construction, forming, placing, etc. of the structures shall be in accordance with the appropriate requirements of Article 501.03.

(d) FINISHING AND CURING.

Attention is directed to the provisions of Subarticle 501.03(1) requiring that all surfaces receive a Class 1 surface finish and that all exposed surfaces receive a Class 2 surface finish, unless otherwise specified in the proposal or by plan requirements.

In order to permit proper surface finishing, forms may be removed as soon as the concrete has set sufficiently that form removal will not damage the green concrete, but in no event less than 12 hours after completion of the placing. Immediately after the pouring operations, surfaces not covered by forms shall be covered with one of the curing materials specified in Section 830. Immediately after the removal of the forms, the surface finishing operations noted in Subarticle 501.03(1) shall commence, and the curing operations continued for at least 72 hours after the finishing operation, using one of the curing materials specified in Section 830 and the related curing method required with the material used. Failure to apply the initial surface finish or perform the curing operation as noted herein shall be just cause for rejection of the concrete. Removal and replacement of rejected concrete shall be at no additional cost to the Department.

(e) CONCRETE SURFACE TOLERANCES

The finished concrete shall be within reasonably close conformity to the lines, grades, and dimensions shown on the plans or directed, and free from objectionable cavities or projections.

620.04 Method of Measurement.

The volume of accepted concrete within the neat lines of the structure as shown on the plans or revised at the written direction of the Engineer will be computed in cubic yards {cubic meters}. The method of average end areas will not be used where results obtained differ from those obtained by more accurate mathematical computation.

No deduction will be made for the volume of concrete displaced by steel reinforcement, weep holes, conduits, anchor bolts, or for chamfers of less than 3 inch {75 mm} leg measurements.

Attention is directed to Section 502 for Reinforcing Steel, and Sections 210 and 214 for Excavation and Foundation Backfill.

620.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted Minor Structure Concrete, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the concrete complete in place including furnishing all materials (except reinforcing steel), form work, finishing and for all equipment, tools, labor, and incidentals necessary to complete the item in accordance with plan details and these specifications. In case of modification to an existing structure, the breaking away of the concrete to the approximate lines shown on the plans and the disposal of the broken concrete and the preparation of the retained steel reinforcement for splicing as required shall be considered incidental to the work and the cost thereof absorbed in the unit price bid.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

620-A Minor Structure Concrete - per cubic yard {cubic meter}

SECTION 621
INLETS, JUNCTION BOXES, MANHOLES, AND MISCELLANEOUS DRAINAGE STRUCTURES

621.01 Description.

This Section shall cover the work of furnishing and installing miscellaneous drainage structures including necessary metal frames, grates, covers, etc. in accordance with the plan details and these specifications at the locations and to the grades shown on the plans or directed by the Engineer.

The various units will be further designated by type to distinguish shape, size, etc. by plan details. Certain units or portions of units may be constructed of cast-in-place concrete, precast concrete, and/or masonry as specified by plan details.

This Section shall also include the furnishing and installing of grates on new or existing structures when the Item of 621-G is provided on the plans, otherwise, inlet grates are classified as an integral part of the inlet or catch basin.

This Section shall also include the furnishing and installing of stilling basins when the Item of 621-I is provided on the plans.

621.02 Materials.

All materials shall conform to the appropriate requirements of Division 800, Materials, and the following.

Concrete and steel for cast-in-place units and for precast units or parts of units not covered by other requirements shall conform to the requirements of Sections 620 and 502.

Precast concrete units or portions of units shall conform to the appropriate requirements of ASTM C 478, and Section 831 unless otherwise provided by plan details or by Department approval.

Masonry materials shall conform to the requirements of Section 613 utilizing brick or block meeting the following requirements:

Clay or Shale - ASTM C 32 Grade SS, MS, or MM.
Concrete brick - ASTM C 55, Type I, Grade N.
Concrete block - ASTM C 90, Type I or II, Grade N.

Castings shall conform to the requirements of Section 836 with attention directed to Articles 836.04, 836.05, 836.06, and 836.07. They shall be sound, smooth, clean, and free from blisters and other defects and, where necessary, planed to provide flat true surfaces.

Welded grates, grate seats, etc. shall be fabricated from ASTM A 36 material, unless otherwise denoted by plan details.

Inlet and outlet pipe shall conform to the appropriate requirements of the section of the specifications covering the kind of pipe to which they are to connect.

Galvanization of grates, grate seats, nuts, bolts, and miscellaneous metal hardware, when specified on the plans, shall be hot-dipped galvanized after fabrication by one of the following methods:

Casting, grates, and seats fabricated from rolled, pressed, or forged steel shapes - ASTM A 123.

Nuts, bolts, and miscellaneous hardware - ASTM A 153.

Grates, grate seats, etc. which are required for existing structures and are formed by welding of rolled or shaped iron shall, unless otherwise specified by plan details, comply with the following: Plates, angles, bars, etc. - ASTM A 36, Pipe - ASTM A 53; Type F, E, or S, black extra strong (X5), hydrostatic test not required.

621.03 Construction Requirements.

(a) EXCAVATION.

Excavation shall be performed in accordance with the appropriate requirements set forth under Section 214, Structure Excavation and Backfill for Drainage Structures and Minor Structures.

(b) CONCRETE UNITS.

Concrete units may be either poured-in-place or precast. Construction requirements relative to the two types shall conform to the following:

1. Poured-in-place units:

Construction shall conform to the requirements of Section 620.

2. Precast Concrete Units:

Holes for connector pipes in base section shall be cast with connector pipe holes of the specific number and dimensions necessary to incorporate the unit into the drainage system as shown by the plans. Should installation conditions require additional pipe holes for which no holes were cast, the Contractor may make such holes as necessary provided he performs said work in a manner approved by the Engineer, and he replaces or repairs any damaged unit to the satisfaction of the Engineer.

Pipe connections to the base sections shall be made using either concrete or masonry mortar.

Precast bases shall be set to within 1/4 of an inch {± 10 mm} of grade on a bed of compacted foundation backfill material approximately 4 inches {100 mm} thick.

Sectional precast sections used to form units shall have all joints sealed and wiped clean using one of the appropriate type sealers noted in Subitem 530.03(d)3.a.

(c) MASONRY.

Bricks shall be laid with full mortar joints not more than 1/2 inch {10 mm} thick. Courses shall be level and at least one course in every seven shall be a header course, unless otherwise directed. All units shall be plastered on the inside of the unit with not less than 1/2 inch {10 mm} of mortar (same as used in the laying) to a height of at least 6 inches {150 mm} above the top of the outfall structure. When specified, the outside of the structure shall be plastered with 1/2 inch {10 mm} of mortar for the height of the masonry. All brick shall be dampened during laying and plastering to insure proper bond with mortar. The masonry shall be cured by approved methods which will insure the mortar has sufficiently set before allowing backfilling operations.

When so specified on the plans and/or in the proposal, masonry units may be constructed of concrete blocks instead of bricks. Applicable construction details shall be the same as for brick masonry.

(d) INLET AND OUTLET PIPE.

Pipe shall be laid in accordance with the appropriate requirements of the Section of these specifications covering the kind of culvert pipe used. Pipe placed in masonry for inlet or outlet connections shall extend through the walls and beyond the outside surface of the walls a sufficient distance to allow for connections, and the masonry shall be carefully constructed around them so that there will be no leakage around the outer surface of the pipe.

Pipe connections to masonry or precast units shall be made using either concrete or masonry mortar.

(e) PLACING CASTINGS.

Castings shall be set in full mortar beds or otherwise secured as shown on the plans. The mortar used for setting castings shall conform to Section 611, Mortar for Masonry. Castings shall be set below the finished grade of the pavement about 2 mm.

(f) BACKFILLING.

Backfilling shall be performed in accordance with the appropriate requirements of Sections 210 and 214.

(g) CLEANING.

All junction boxes, inlets, manholes, and similar structures shall be cleaned of all form material, excess mortar, and all foreign matter and shall be free from such at the time of final inspection and acceptance.

(h) PLACING OF METAL GRATES AND SEATS ON STRUCTURES.

Grates and seat frames shall be set in full mortar beds or otherwise secured to the masonry unit as shown by plan details. Mortar used for setting grates shall conform to the requirements of Section 611, Mortar for Masonry.

Grates installed on drainage units constructed under a previous contract shall be fitted to the unit and affixed to the structure in accordance with the details shown on the plans.

621.04 Method of Measurement.

(a) INLETS AND JUNCTION BOXES.

Inlets and junction boxes will be measured as individual units including footings, bottom slab, walls, cover, lid, grating, etc., of the type, size, and shape shown on the plans. If the height of the base unit is not shown on the plans, 4 feet {1 m} will be used as the height of the base unit. Measurements will be from the top of the bottom slab to the top of the cover, grating, or lid. Structures of greater height will have the additional height measured as noted in Subarticle (c) below.

(b) MANHOLES.

Manholes will be measured as an individual unit including footings, bottom slab, walls, cover, lid, grating, etc. of the type, size, and shape shown on the plans except that the maximum height of the base units of the structure shall be limited to 6 feet {2 m}, measured from the top of the bottom slab to the top of cover, grating, or lid. Structures of greater height will be measured as noted in Subarticle (c) below.

(c) JUNCTION BOX, INLET, AND MANHOLE UNITS.

Where structures of greater height than the base units noted above are provided by the plans or ordered, measurement for the additional height will be in junction box units, inlet units, or manhole units of the particular type specified by the plans or proposal. Such units will be complete wall sections

of the respective type structure measured in increments of 2 feet {600 mm} in height; ordered increments of less than 2 feet {600 mm} will be considered as a complete unit.

(d) ITEM 621-G.

When Item 621-G is provided on the plans or proposal, the kind of inlet on which the grate will be used will be shown on the plans and the "Type" grate to be used will be designated on the plans and proposal. The accepted grates will be measured in individual units of each type ordered and accepted.

(e) ITEM 621-I.

When Stilling Basins, Item 621-I, are provided on the plans or proposal, measurement will be as individual units including footings, bottom slab, walls, etc., of the type, size, and shape shown on the plans.

621.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. The accepted number of junction boxes, inlets, and manholes, measured as provided above, will be paid for at the respective contract unit prices for each, which shall be payment in full for furnishing all materials including gratings, covers, and other fittings and for all form work, disposal of surplus material, and for all labor, equipment, tools, and incidentals necessary to complete the work.

2. The accepted number of junction box units, inlet units, and manhole units, measured as provided above, will be paid for at the respective contract unit price for each type, complete in place, which shall be payment in full for furnishing all materials, for all form work, disposal of surplus materials, and for all labor, equipment, tools, and incidentals necessary to complete the work.

3. The ordered and accepted grates under Item 621-G, measured as provided above, will be paid for at the respective unit price bid for each type specified. Said unit price shall be full compensation for the grate complete in place on the structure and includes furnishing of all materials, fabrication of the grate, installation of the grate, and for all equipment, tools, labor, and incidentals necessary to complete the work.

4. The accepted number of stilling basins, measured as provided above, will be paid for at the respective contract unit price for each type, complete in place, which shall be payment in full for furnishing all materials, for all form work, disposal of surplus materials, and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) EXCAVATION AND BACKFILL.

Excavation and backfill will be paid for as provided in Section 214.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

621-A Junction Boxes, Type ____ - per each
621-B Junction Box Units, Type ____ - per each
621-C Inlets, Type ____ - per each
621-D Inlet Units, Type ____ - per each
621-E Manholes, Type ____ - per each
621-F Manhole Units, Type ____ - per each
621-G Inlet Grates, Type ____ - per each
621- I Stilling Basins, Type ____ - per each

SECTION 622
RESETTING GRATINGS AND COVERS FOR CATCH BASINS, INLETS, AND MANHOLES

622.01 Description.

This Section shall cover the work of raising or lowering the covers or gratings of existing inlets, catch basins, or manholes, all in accordance with plan details and these specifications at the locations shown on the plans or directed.

622.02 Materials.

All new materials used shall be in accordance with the requirements of Section 621, plan details, and Division 800, Materials.

622.03 Construction Requirements.

Heads, covers, and/or gratings of existing manholes, inlets, or catch basins that are raised, lowered, or moved in elevation without moving the structure proper will be considered reset. All work shall be done in a workmanlike manner by competent workmen and the unit re-established in proper working order at its new elevation. Any manhole, inlet, or catch basin heads, covers, gratings, or other material broken, destroyed, lost, or rendered unfit for reuse through carelessness, negligence, or improper handling of the work, shall be replaced by the Contractor without extra compensation. Concrete and brick masonry work shall conform to requirements of Sections 620 and 613, respectively.

When adjustments to manholes, inlets, or catch basins require the removal of a portion of the existing facility, the Engineer will designate that portion of the structure to be removed. The removal of such is considered incidental to the work and the cost included in the unit price bid for the reset item. Should the Contractor remove any portions of the structure in excess of that directed by the Engineer, he shall restore the structure to the designated removal line without additional compensation.

622.04 Method of Measurement.

Manhole covers reset and gratings reset will be measured individually as one complete unit of the base height or less as provided by the plan details. Where adjustments to the manhole covers or gratings reset exceed the base unit height, measurement and payment for the excess height will be made as provided in Articles 621.04 and 621.05 for Manhole or Inlet Units.

622.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. Accepted manhole covers reset, measured as provided above, will be paid for at the contract unit price for Manhole Covers Reset, which shall be payment in full for all material, equipment, tools, labor, and incidentals necessary to complete the work.
2. Accepted gratings reset, measured as provided above, will be paid for at the contract unit price for Gratings Reset, which shall be payment in full for all material, equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

622-A Manhole Covers Reset - per each
622-B Gratings Reset - per each

SECTION 623
CURB, GUTTER, AND COMBINATION CURB AND GUTTER

623.01 Description.

This Section shall cover the work of constructing Portland cement concrete gutter, curb, or combination curb and gutter, constructed with or without metal reinforcement. All of which shall be constructed in accordance with the plan details and these specifications at the locations shown on the plans or established in conformity with the lines, grades, dimensions, and cross sections shown on the plans or designated.

623.02 Materials.

All materials shall conform to the requirements of Division 800, Materials. Concrete shall conform to the requirements of Section 501. Expansion joint filler shall be as specified in Section 832.

623.03 Construction Requirements.

(a) CONCRETE MIXES.

Concrete mixes shall be provided by Section 501, with a Class A, Type 2 mix being used with standard forms and either a Class A or Class C mix, modified as deemed necessary by the Testing Engineer, to fit the type curbing machine being used.

(b) FOUNDATION.

The foundation shall be constructed or excavated to the required depth below the finished surface in accordance with the cross section shown on the plans or as designated. All soft or other unsuitable material shall be removed and replaced with suitable material, in layers not to exceed 4 inches {100 mm} compacted. The foundation shall be compacted as provided for the applicable types of material involved.

(c) FOUNDATION BACKFILL.

If provided by the plans and/or proposal, foundation backfill to replace unsuitable material shall be placed and constructed as provided in Section 214. No direct payment will be made for foundation backfill, except when the proposal includes a unit price for this pay item.

(d) FORMS.

1. GENERAL.

The Contractor shall use standard type metal forms as noted herein or, if requested in writing and approved by the Department, an approved automatic extrusion type curb and/or gutter machine.

2. STANDARD FORMS.

These forms shall be metal, except for radial sections, straight, and free from warps and of sufficient strength, when staked, to hold the concrete true to line and grade without distortion. They shall provide the approved typical section and depth of the section shown on the plans. Radial or curved forms may be of flexible metal or a wood form of approved design. Bent or damaged forms shall not be used.

All forms shall be securely staked, braced, and held together to the exact lines and grades established and shall be kept sufficiently tight to prevent leakage of mortar. All forms shall be cleaned and oiled with a suitable oil immediately before concrete is placed against them.

3. MACHINE FORMED.

Any automatic extrusion type curb and/or gutter machine considered for approval must be demonstrated to produce a section conforming to the dimensions, cross-section, lines, and grades shown on the plans within the tolerances provided in Item 623.03(h)2 for formed curbs and/or gutters. Failure to consistently produce an acceptable product shall be cause to withdraw approval of the machine and order the use of standard forms. All types of curbs, gutter, and combinations shall be placed in one operation, to the depth of cross section specified on the plans. The use of a two stage operation will not be permitted.

(e) SECTIONS.

Gutter, curb, and combination curb and gutter shall be constructed in sections of the lengths shown on the plans. The length of section may be reduced where necessary to form closure.

(f) HANDLING, PROPORTIONING, AND MIXING MATERIALS.

The handling, storage, proportioning, and mixing of concrete shall conform to the requirements of Section 501.

(g) JOINTS.

All expansion, contraction, and construction joints shall be constructed as shown on the plans and in accordance with the requirements of Article 501.03. If not shown on the plans, joints shall be placed as follows:

1. Expansion joints shall be placed in curb and/or gutter to match those in concrete pavement where the two are adjacent.

2. Expansion joints 3/4 of an inch {20 mm} wide shall be placed where curb and/or gutter terminates against rigid objects.

3. Expansion joint filler and sealer shall meet the requirements of Articles 832.01 and 832.02. Expansion joint filler shall extend from the bottom of the curb and/or gutter to within 1 inch {25 mm} of the top; the sealer shall be 3/4 of an inch {20 mm} thick and shall be recessed 1/4 of an inch {6 mm} from the top.

4. Contraction joints shall be placed in curb and/or gutter to match those in concrete pavement where the two are adjacent, but in no instance more than 1/4 of an inch {6 mm} between joints. The contraction joints shall be sawed or otherwise cut 2 inches {50 mm} deep by 1/8 of an inch {3 mm} wide and shall extend 2 inches {50 mm} below the pavement surface.

(h) PLACING AND FINISHING CONCRETE - STANDARD METHOD.

1. PLACING.

The subgrade and forms shall be checked and approved just prior to placing concrete against them. All debris or other foreign material shall have been removed from the space to be occupied by the concrete. The subgrade shall be moist but not wet or muddy. After mixing, the concrete shall be placed in the forms and shall be tamped, spaded, or vibrated sufficiently to produce a dense homogeneous mass and to bring the mortar to the surface. Particular attention shall be given to spading the concrete along and against the surface of the forms to prevent honeycombing and secure a smooth, uniform surface.

2. STRIKE-OFF AND FINISHING.

When the forms are filled, the concrete shall be struck off with a template, cut to the curb edge design. The exposed concrete surface shall then be finished smooth with a wooden float in a manner that will compact the mass and produce a true, even top surface. Plastering with mortar to build up or finish will not be permitted. The surface of the gutter and the face and top of the curb shall be checked with a 10 foot {3 m} straightedge and any irregularities more than 1/4 of an inch in 10 feet {6 mm in 3 m} corrected. The alignment and grade shall not at any point vary more than 1/2 of an inch {10 mm} from that established by the elevation control stakes. Excessive troweling with a steel trowel will not be permitted. A textured finish shall be provided on the exposed surface just before the concrete becomes nonplastic by the use of a burlap or cotton fabric drag, brush, or broom which will produce a uniform gritty texture along the length of the curb, gutter, or combination curb and gutter. The upper edges of curb and gutter shall be rounded with an approved edging tool to the radius shown on the plans. The joint templates shall be set during the placing of the concrete and allowed to remain in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

The forms shall be left in place until the concrete has set sufficiently so that they can be removed without damage to the work, but, unless otherwise directed, they shall be removed within 24 hours after the concrete has been placed. Immediately after the removal of the forms, the repair of any minor defective areas shall be accomplished.

(i) PLACING AND FINISHING CONCRETE - MACHINE LAID.

The requirements of Subarticle 623.03(h) are applicable except that fixed forms are not required.

(j) CURING AND PROTECTION.

Immediately after the finishing operation is completed, the concrete shall be cured as provided by Subarticle 450.03(m). If mats are used, they shall be kept continuously moist for a period of at least 72 hours. During this period, and until completion and acceptance of the work, it shall be protected from damage by the elements or other cause.

(k) BACKFILLING.

After the concrete has set sufficiently, spaces along the front and back sides of the gutter, curb, or combination curb and gutter, shall be backfilled to the required elevation with suitable material which shall be compacted by tamping with approved metal tamps or mechanical tamps in layers not more than 4 inches {100 mm} thick until firm and solid.

623.04 Method of Measurement.

Accepted Concrete Gutter, Concrete Curb, and Combination Curb and Gutter will be measured in linear feet {meters}, complete in place, to the nearest 0.1 foot {0.1 m} along the base of the curb face or along the flow line of the gutter continuing on such line extended across driveways, alleyways, and other entrances. Measurement for separate payment for Foundation Backfill will only be made when Item 214-B is provided in the proposal.

623.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted length of Concrete Gutter, Concrete Curb, and Combination Concrete Curb and Gutter, measured as provided above, will be paid for at the respective contract unit prices, complete in place, which shall be payment in full for all excavation, backfilling, disposal of surplus material, all joints, all special construction at driveways and other entrances and other points, furnishing all materials, hauling and placing materials, and for all labor, equipment, tools, and incidentals necessary

to complete the work in accordance with the specifications including all approaches through curb and gutter indicated on the plans.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

623-A Concrete Gutter - per linear foot {meter}
623-B Concrete Curb, Type ____ - per foot {meter}
623-C Combination Curb & Gutter, Type ____ - per linear foot {meter}

SECTION 626
CONCRETE MEDIAN STRIP

626.01 Description.

This Section shall cover the work of constructing a concrete median strip of the size, shape, and dimensions shown on the plans, at the locations, to the lines and grades shown on the plans or designated.

626.02 Materials.

All materials furnished for use shall conform to the requirements of Division 800, Materials, and Section 501.

626.03 Construction Requirements.

Concrete used in the construction of the median strip shall be Class A, Type 2 mix complying with the requirements of Section 501, except that when the median strip is placed on concrete pavement, the concrete may be of the same type used in the pavement.

The median strip shall be constructed on any approved surface, normally a subbase, base, or pavement layer.

Forming, placing, finishing, and curing of the concrete shall be in accordance with the provisions of Article 623.03.

Expansion joints shall be provided as specified in Subarticle 618.03(g) for concrete driveways, unless shown otherwise by the plans or directed by the Engineer.

626.04 Method of Measurement.

Ordered and accepted concrete median strip will be measured either by linear measurement by the linear foot {meter} or volumetric measurement by the cubic yard {cubic meter} in accordance with the method of measurement designated by the pay item.

Median strips on bridges will not be measured for payment, but the volume of concrete shall be included in the concrete volume for the bridge structure.

Linear measurement of a median strip shall be the actual length of the median strip measured along the center line of the strip.

Volumetric measurement of a median strip shall be by the cross sectional average end area method unless a more accurate method of measurement is derived.

626.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The quantity of the Concrete Median Strip, measured as provided above, will be paid for at the contract unit price per foot {meter} or per cubic yard {cubic meter} for Concrete Median Strip, which price and payment shall be full compensation for furnishing all materials, equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

626-A Concrete Median Strip - per linear foot {meter}
626-B Concrete Median Strip - per cubic yard {cubic meter}

SECTION 629
CONCRETE MEDIAN AND SAFETY BARRIER

629.01 Description.

This Section shall cover the work of constructing a concrete median or safety barrier at the location shown on the plans, proposal, or directed. Barriers shall be basically classified as to "Type" which will designate the size, shape, height, etc. all in accordance with details shown in the plans. Barriers may be cast in place, extruded by slip form equipment, or precast and installed in a permanent manner.

629.02 Materials.

All materials furnished for use shall conform to the appropriate requirements of Division 800, Materials, and the following:

Concrete, unless otherwise specified by plan details, shall meet the requirements of Section 501 for Class A, Type 1 concrete.

Steel reinforcement shall meet the requirements of Section 502.

629.03 Construction Requirements.

(a) GENERAL.

The concrete mix, construction, placing of the concrete, curing, and finishing shall be in accordance with the appropriate provisions of Section 501, unless otherwise provided in this Section or noted in the plan details.

(b) EXCAVATION AND BACKFILL.

Excavation and backfill for permanent barriers shall be in accordance with the provisions of Section 214.

(c) SLIP FORM METHOD.

Barriers constructed by the use of a slip form extrusion machine shall be well compacted, dense concrete meeting all the requirements of Section 501, except for the requirement for fixed forms.

The forming portion of the extrusion machine shall be readily adjustable vertically during the forward motion of the machine so that the top of the barrier can be maintained at the predetermined grade.

(d) CONCRETE SURFACE TOLERANCES AND FINISHING.

The finished concrete shall be within reasonably close conformity to the lines, grades, and dimensions shown on the plans or directed; the barrier shall present a smooth uniform appearance free from objectional cavities or projections. A 10 foot {3 m} straightedge, laid on the top faces of the barrier, shall not vary more than 0.02 foot {6 mm} from the edge of the straightedge except at grade changes and curves and be free of humps, sags or other irregularities.

Concrete surfaces shall be finished in accordance with the provisions of Subarticle 501.03(l) for Class 1 with exposed surfaces receiving a Class 2 finish, unless otherwise specified by the proposal or by plan requirements.

(e) JOINTS.

Joints shall be in accordance with the provisions of Section 501, except as follows:

Surface edges on exposed vertical contraction joints shall be rounded with a 1/4 inch {6 mm} edger or sawed.

Vertical expansion joints may be open or sealed in accordance with plan requirements.

629.04 Method of Measurement.

Concrete barriers will be measured for payment by the appropriate method designated by the plans or proposal in accordance with the following:

Item 629-A – linear foot {meter} measured to the nearest 0.1 foot {0.1 m} along the top surface barrier.

Item 629-B – cubic yards {cubic meters} of concrete with volumetric measure computed by the average end area method except where results obtained differ from those obtained by a more accurate mathematical computation.

Item 629-C - unit measurement where each end section is in accordance with the size, shape, and length designated by the plans.

Excavation and backfill shall be measured in accordance with the provisions of Section 214.

629.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The various "Types" of Median or Safety Barriers and End Sections ordered and accepted, measured as noted above, shall be paid for at the appropriate unit price bid provided in the proposal. Said unit price bid shall be full compensation for the furnishing of all materials and the construction of the barrier complete in place, including all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

629-A Concrete Median or Safety Barrier, Type ___ - per linear foot {meter}
629-B Concrete Median or Safety Barrier, Type ___ - per cubic yard {cubic meter}
629-C Concrete Median or Safety Barrier End Section - per each

SECTION 630
GUARDRAIL AND BARRIER RAIL

630.01 Description.

This Section shall cover the work of the furnishing and installation of complete sections of steel or aluminum beam guardrail, guardrail end anchor systems, and shaped tube type barrier rail, at the locations shown on the plans or designated and in conformity with the detailed requirements of the plans and these specifications. The plans will designate the Class of guardrail to be used and, in the case of steel rail, also the Type to be used. When it is optional as to the choice of either steel or aluminum, the alternate once selected shall be used throughout the contract. Unless specified otherwise, Class A guardrail will be used for roadways and Class B guardrail will be used for bridges.

630.02 Materials.

Materials shall conform to the requirements set forth in Division 800, Materials. Specific reference is made to Section 864, Guardrail and Barrier Rail Materials, and detail drawings provided in the plans. Material will be accepted by Brand Registration and Guarantee, as provided by AASHTO M 180, and List II-17 of Materials, Sources, and Devices with Special Acceptance Requirements. Spot checks will be made for material delivered to the project. The material may be accepted or rejected based on these tests.

630.03 Construction Requirements.

(a) ERECTION OF POSTS AND END ANCHORS.

1. GENERAL.

The Contractor shall place stakes to mark the location where guardrail is required. The Contractor shall not begin the installation of the guardrail posts until the Engineer has approved the staked location of the guardrail.

2. POSTS.

Unless otherwise provided by the plans or proposal, the Contractor may use one of the optional type posts shown on the plans; however, once selected, the same type shall be used throughout the contract. Posts shall be erected in such a manner that they shall be vertical with their top inside edges within 1/4 inch {6mm} of their correct position for both vertical and horizontal line. The posts shall be erected to the dimensions shown on the plans and compacted by tamping, puddling, or as directed, to obtain a rigid installation. Where posts are driven, the tops shall be protected by a suitable driving cap and the adjacent area compacted, if deemed necessary by the Engineer. If raising or other movement of the post is required, the earth shall be compacted to fill any voids caused by such movement. All posts damaged in any way during erection shall be removed and replaced without additional compensation.

3. END ANCHORS

The Contractor shall use one of the Type End Anchors provided by the plans, or directed. The anchor assemblies shall be erected to the dimensions shown on the plans, and the area backfilled with suitable material and compacted as provided in Item 2 above. Posts that are attached to the anchor assembly shall be erected to the requirements for individual posts as provided in Item 2 above.

(b) ERECTION OF RAIL.

1. All metal except concrete reinforcement shall be fabricated in the shop. No punching, cutting, burning, or welding shall be done in the field. Holes for special details in exceptional cases may be made in the field when approved, after it has been demonstrated that punching will not result in damage to the surrounding metal.

2. The rail may be erected in any manner resulting in a smooth continuous rail closely conforming to the established line and grade of the surface the rail parallels. The top of the rail shall be constructed to the height designated on the plans.

3. Rail shall be erected so that the bolts at expansion joints shall be located at the centers of the slotted holes. Bolts may be rethreaded after galvanizing if necessary. All bolts, except where otherwise required at expansion joints, shall be drawn tight; however, bolts through expansion joints shall be drawn up as tight as possible without being tight enough to prevent the rail elements from sliding past one another longitudinally. Bolts shall be sufficiently long to extend at least 1/4 of an inch {6 mm} beyond the nuts. Except where required for adjustments, bolts shall not extend more than 1/2 of an inch {13 mm} beyond the nuts. Bolts through variable thickness posts shall be cut off 1/4 of an inch {6 mm} beyond the nuts and burred.

(c) METAL TREATMENTS.

1. GENERAL.

All steel elements (posts and rail), including all accessories used in the construction of guardrail and barrier rails shall be galvanized, except when otherwise provided by the plans or proposal. Aluminum elements (posts and rail) and accessories will require no special treatment, except where otherwise noted on the plans or proposal.

2. STEEL.

a. Galvanized.

Painting of galvanized steel will not be required except that any damage to galvanizing or any bare areas developed during construction shall be painted with two coats of approved galvanizing repair paint, Section 855, or approved zinc spelter paint. However, should any galvanized metal be required by the plans or proposal to be painted, the surface shall be treated with a wash of 8 ounces {60 g} of copper or zinc sulphate dissolved in one gallon {liter} of water prior to the application of the required paint surface.

b. Not Galvanized.

All metal not galvanized shall be cleaned and painted with one primer coat and two coats of paint, Structural Steel Second and Third Coats (Section 855), unless otherwise provided on the plans or in the proposal.

3. ALUMINUM.

Aluminum elements of guardrail or barrier rail require no special preservative treatment unless otherwise noted on the plans.

(d) SAFETY OF TRAVELING PUBLIC.

At locations where public traffic is adjacent to the guardrail or barrier rail work, all materials required to complete the work at any one location shall be available before beginning the work at that location.

Posts shall be erected only far enough in advance to permit the construction to progress consistently, uniformly, and continuously. All posts shall have the rail attached to them the same day that the posts are erected. For installations in which neither end adjoins a fixed object, the installation of the rail shall progress in the same direction as the traffic in the adjacent lane.

The intent of this specification is that each guardrail or barrier rail installation erected under traffic be completed, including end anchors and/or attenuating devices, before nightfall of the day on which work on that installation began. In the event that unforeseen conditions prevent the completion of an installation before nightfall, the Contractor will be required, at his expense, to protect and delineate the uncompleted installation by the use of reflectorized devices or other acceptable means.

The minimum requirement for this protection and delineation will be one or more reflectorized drums with a Type B warning light on each drum.

If the existing guardrail or barrier rail is to be removed and reset, replaced, or relocated, then only one installation ahead of the placing operation may be removed. At any site where the rail has been removed and the new installation has not been completed, the Contractor will be required at his expense to protect the site with reflectorized drums, with a Type B warning light on each drum, as shown on the plans or directed by the Engineer.

630.04 Method of Measurement.

Posts will not be measured for payment separately. The length of the beam guardrail or barrier rail constructed and accepted will be measured in linear feet {meters} to the nearest 0.1 foot {0.1 m} from the end of each continuous installation, exclusive of designated anchor assemblies along the centerline of the top of the rail posts for guardrail and of the rail element for barrier rail.

Standard guardrail installations cover one rail element, its supports (post) and accessories. When installations are to cover special installations such as double faced rail (two rail elements) mounted on a single post, a separate pay item will be provided and the special condition so noted in the description of the pay item.

End Anchor Assemblies shall be measured separately in individual unit assemblies, complete in place, including all hardware and accessories to complete the type anchor assembly ordered placed in accordance with plan details.

630.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Accepted guardrail or barrier rail, measured as provided above, will be paid for at the contract unit price bid per linear foot {meter} for Beam Guardrail or Barrier Rail which shall be payment in full for excavating, backfill, disposal of surplus material; for furnishing, transporting, erecting of posts and rail; for all incidental material, bolts, brackets, etc., as shown on the plans; and for all equipment, tools, labor, and incidentals necessary to complete the work.

Accepted Guardrail End Anchor Assemblies, measured as provided above, will be paid for at the contract unit price per each, which shall be full compensation for excavating, backfilling, disposal of surplus materials, for furnishing, erecting the anchor assembly, and all incidental materials necessary to install the assembly, complete in place, as shown on the plans, and for all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

630-A Steel Beam Guardrail, Class ____ , Type ____ - per linear foot {meter}
630-B Aluminum Beam Guardrail, Class ____ - per linear foot {meter}
630-C Guardrail End Anchor, Type ____ - per each
630-D Barrier Rail, Steel Rectangular Tubing - per linear foot {meter}
630-E Barrier Rail, Extruded Aluminum Tubing - per linear foot {meter}

SECTION 631
GUARDRAIL OR BARRIER RAIL RESET

631.01 Description.

This Section shall cover the work of resetting guardrail or barrier rail and anchor systems, salvaged under Section 206, to the established lines and grades at the locations shown and grades shown by the plans or directed, in conformity with the detailed requirements of the plans and these Specifications.

This Section shall also cover the work of relocating guardrail or barrier rail and end anchor systems to the established lines and grades at the locations shown by the plans or directed, in conformity with the plans and these Specifications. The relocation shall include the removal, reconditioning, and reinstallation of the rail, posts, hardware, and anchor systems.

631.02 Materials.

(a) SALVAGED MATERIAL.

All portions of the rail elements, posts, and other hardware designated to be reset or relocated shall be cleaned and inspected. Damaged portions shall be discarded or repaired as directed.

Damage to galvanization on metal (steel) portions shall be repaired with approved galvanizing repair paint.

Posts and rail elements shall be cut or drilled to conform to the requirements of the current plan requirements for the type rail being used.

Timber posts shall be coated with one liberal coat of the type preservative used in the original treatment, unless the use of another type preservative is authorized by the Engineer. Galvanized steel posts which cannot be repaired satisfactorily with galvanized repair paint shall be painted with an approved aluminum paint.

(b) NEW MATERIALS.

New materials shall meet the requirements specified in Section 864, Guardrail and Barrier Rail Material. Paint shall meet the requirements of Section 855, Coatings, Paints, Enamels, and Varnishes For Metal or Wood Structures.

631.03 Construction Requirements.

(a) GENERAL.

The Contractor shall promptly replace, without extra compensation, any materials lost, damaged, or injured on account of carelessness, negligence, or failure to conduct the work properly. Any such replacements shall be with materials conforming to the original material requirements.

Should any of the rail, posts, or end anchors included in the relocation items be deemed, by the Engineer, unsuitable for reuse through no fault or negligence of the Contractor, the Engineer may either furnish materials acceptable for use or may require the Contractor to furnish new materials. Payment for such new rail, posts, or end anchors, but not hardware, will be made as for unused materials outlined in Subarticle 109.06(b).

Attention is directed to the fact that this type work will be performed under traffic requiring special care to expedite the work and prevent undue hazardous conditions to occur during the operation. Attention is directed to the requirements of Subarticle 630.03(d).

(b) POST REPLACEMENT.

Post replacements shall be made with salvaged posts from other sources until exhausted. All new replacement posts shall, if practicable, be placed together in selected sections of guardrail constructed in accordance with current standard plans, and shall, to the extent practicable, be of the same type and size as the salvaged posts.

(c) INSTALLATION.

Installation shall be in accordance with the provisions of Article 630.03.

631.04 Method of Measurement.

The number of Posts Reset will be the actual number reset to the satisfaction of the Engineer. New posts ordered and set will be the actual number of new posts furnished and set to the satisfaction of the Engineer.

Rail Elements Reset will be measured in linear feet {meters} along the face of the element to the nearest 0.1 foot {0.1 m} from end to end of each continuous portion of rail reset. New rail elements ordered and set will be measured in linear feet {meters} along the face of the element to the nearest 0.1 foot {0.1 m}, end to end of each continuous portion of rail element set.

Guardrail End Anchor Reset will be the actual number of anchor systems of the type designated, reset to the satisfaction of the Engineer.

Guardrail or Barrier Rail Relocated will be measured in linear feet {meters} along the face of the rail to the nearest 0.1 foot {0.1 m} from end to end of each continuous portion of rail relocated,

Guardrail End Anchors Relocated will be measured in individual unit assemblies, complete in place, of the type designated, relocated to the satisfaction of the Engineer.

631.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. POST.

Accepted posts reset, measured as noted above, will be paid for at the contract unit price bid for posts reset which shall be full compensation for preparation of the posts for resetting and setting of the post and its accessories (blockouts, etc. if a part of the original installation) as directed.

Accepted new post set, measured as noted above, will be paid for at the contract unit price bid for new post set which shall be full compensation for the furnishing of the required size and

type post including any accessories (blockouts, bolts and nuts, etc.) and the setting of the post as directed.

The above noted unit price bid shall include furnishing additional necessary hardware, equipment, tools, labor, and incidentals necessary to complete this item of work.

2. RAIL ELEMENTS.

Accepted rail elements reset, measured as noted above, will be paid for at the contract unit price bid for the type rail reset which shall be full compensation for the preparation of the element of resetting and the installation of the element complete in place on the posts.

Accepted new rail elements set, measured as noted above, will be paid for at the contract unit price bid for the type rail element set which shall be full compensation for the furnishing of the specified type of new rail element and the installation of such, complete in place on the posts.

The above noted unit prices shall include furnishing any additional necessary hardware, equipment, tools, labor, and incidentals necessary to complete these items of work.

3. GUARDRAIL END ANCHORS.

Accepted end anchors reset, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for preparation of the posts and elements for resetting, the resetting of the anchor system complete in place including the furnishing of any additional necessary hardware, all equipment, tools, labor, and incidentals necessary to complete this item of work.

4. GUARDRAIL AND BARRIER RAIL RELOCATED.

Accepted guardrail or barrier rail relocated, measured as provided above, will be paid for at the contract unit price bid per linear foot {meter} for the type rail to be relocated which shall be payment in full for removing the in place rail and posts, preparing the rail, posts, and hardware for relocation, and for the installation of the posts, rail, and accessories.

The above unit prices shall include furnishing any additional necessary hardware, equipment, tools, labor, and incidentals necessary to complete these items of work. Any new rail or posts required to replace damaged rail or posts, through no fault of the Contractor, shall be furnished by the Contractor with payment to be made the same as for unused materials outlined in Subarticle 109.06(b).

5. GUARDRAIL END ANCHOR

Accepted guardrail and anchors relocated, measured as provided above, will be paid for at the contract unit price bid per each, which shall be payment in full for removing the in place anchor system, preparing the anchor system and accessories for relocation, and for the installation of the complete assembly. The unit price bid shall include any additional hardware, equipment, tools, labor, and incidentals necessary to complete this item of work. Any new end anchor required to replace an unserviceable end anchor will be paid for as for unused materials outlined in Subarticle 109.06(b).

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

631-A Posts Reset - per each
631-B New __*__ Posts Set - per each
631-C ____**____ Reset - per linear foot {meter}
631-D New ____**____ Set - per linear foot {meter}
631-E Guardrail End Anchor _____***_____ Reset - per each
631-F ____**____ Relocated - per linear foot {meter}
631-G Guardrail End Anchor _____***_____ Relocated - per each

* Steel, or Wood

** Steel Beam Guardrail Class _____ , Type _____ ; Aluminum Beam Guardrail Class _____ Steel Rectangular Tube, Barrier Rail; Extruded Aluminum Tube, Barrier Rail

*** Type 1, 2, 3, etc.

SECTION 632
HEADLIGHT GLARE SCREEN

632.01 Description.

This Section shall cover the work of furnishing and erecting headlight glare screens in accordance with the details shown on the plans and as specified herein at the locations shown on the plans or designated. Where optional types are permitted, the same type, once selected, shall be used throughout the project.

632.02 Materials.

Materials furnished for use shall meet the requirements of Division 800, Materials, and the requirements noted in the plans.

632.03 Construction Details.

All construction methods and equipment employed in installation of the headlight glare screen shall be in accordance with the requirements shown on the plans and those of the manufacturer of the materials being used and good erection practices, so that the resulting structure will provide the expected service and be complete in every detail.

Headlight glare screen may be supported by ground-mounted posts or posts attached to guardrail posts, rectangular tubing barrier rail, along the top of the concrete median barrier wall or other special mounting as shown on the plans.

632.04 Method of Measurement.

Quantities of Headlight Glare Screen to be paid for will be determined by the linear foot {meter} from actual measurements along the line of the completed headlight glare screen.

632.05 Basis of Payment

(a) UNIT PRICE COVERAGE.

The accepted quantity of Headlight Glare Screen, measured as provided above, will be paid for at the respective contract unit bid price for each separate type of mounting. The said unit price shall be payment in full for furnishing all materials and for all labor, tools, equipment, and incidentals necessary for performing all work involved in constructing the headlight glare screens, complete in place, in accordance with the details shown on the plans.

When plans show the Headlight Glare Screen to be mounted on existing facilities, the unit bid price shall also include the necessary drilling, welding, and/or other special treatment of the existing facility for satisfactory attachment of the posts.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

632-A Headlight Glare Screen, (* Type of Mounting) - per linear foot {meter}

* Example: Ground mounted; Mounted on Guardrail Posts; Mounted on Barrier Rail Rectangular Tubing; or Mounted on Concrete Median Barrier.

SECTION 634
CHAIN LINK INDUSTRIAL FENCE

634.01 Description.

This Section shall cover the work of furnishing and installing, complete in place, commercial chain-link fence on posts and frames with either standard ground mounting or mounted on structures (bridges, retaining walls, etc.) as required by the plans, at locations shown on the plans or designated, all in accordance with the details shown on the plans and these specifications.

634.02 Materials.

(a) GENERAL.

All materials shall conform to the requirements of Division 800, Materials, and shall be in accordance with details shown on the plans. Special attention is directed to Section 871.

(b) SPECIAL MOUNTED FENCE.

When the fence is to be installed on structures which cannot utilize the standard method provided by the regular fence drawings, the type of post installation, etc., will be shown on the plans. Requirements for such installations will be shown on the plans. All miscellaneous steel used in such installations or mounting assemblies shall be of ASTM A 36 steel or approved equal and galvanized in accordance with ASTM A 123, unless such is otherwise provided by the plans.

634.03 Construction Requirements.

(a) GENERAL.

All construction methods and equipment employed in the setting of fence shall be in accordance with requirements of the specifications of the manufacture of the fence materials being used and such that the resulting structure will provide the expected service and be durable and complete in every detail.

(b) CLEARING FENCE LINE.

All brush, stumps, logs, large roots, humps of earth, boulders or debris which would interfere with proper construction of the fence in the required location and present a pleasing and acceptable profile along the tops of posts shall be removed before starting fencing operations. Sound standing trees in the fence line shall be removed or trimmed as directed to provide adequate working room. The clearing and/or grading of the fence line and the disposal of material removed shall be accomplished in such a way that trees and shrubs on the remainder of the right of way will not be damaged.

Breaks in profile of the fence shall be spread over vertical curves of sufficient length to insure a pleasing appearance.

(c) SETTING POSTS.

Posts and anchorages shall be set at intervals shown on the plans or directed. The posts shall be set plumb and true in alignment on the side which the fabric is to be attached. All end and corner posts, brace posts, pull posts and gate posts shall be set in concrete in accordance with plan details. Line posts may be set in place by one of the following methods: (1) set in concrete in the same manner detailed in the plans for brace posts, (2) driven, provided soil conditions are suitable and full embedment depth is obtained. When posts are driven, methods shall be used to protect the posts from damage due to driving operations. Damaged posts shall be repaired as directed or removed and replaced without additional cost to the State, Regardless of the installation method used, a stable fence frame shall be obtained. Where unstable soil is encountered, the use of longer posts, concrete anchorage or other approved post stabilization methods shall be required. Where fence is over solid rock or other hard unyielding material is encountered, special treatment may be authorized.

When installing fence through areas where other than ground installations are required, special attention shall be given to the attachment of the mounting assemblies to the structure. Anchor bolts, etc. shall be cast into structures wherever possible. Other types of attachments, if permitted by the plans, must be approved by the Engineer before use. In any event, anchorage must be so installed as to present a neat workmanlike appearance.

(d) CONSTRUCTING FENCE.

Chain link fence shall be stretched taut and securely fastened to each post by means of approved metal bands or No. 9 gage {3.75 mm} wire spaced not more than 12 inches {300 mm} apart on posts and not more than 15 inches {375 mm} apart on the rail. The method of attaching at end posts, gates, and corner posts shall be as shown on the plans.

If barbed wire is specified on the plans, the barbed wire, barbed wire arms, and method of attachment shall be as shown on the plans. Wires shall be stretched taut and spaced as shown on the plans.

634.04 Method of Measurement.

The quantity of chain link fence of each separate height and variation shall be the accepted lengths, exclusive of gates, measured along the top rail overall in linear feet {meters} to the nearest foot {0.1 m}, complete in place. The quantity of gates shall be the actual accepted number of gates classified according to type and width of gates.

When the item of Protective Cage (Industrial Fence) is provided in the Plans or Proposal, the accepted Protective Cage shall be the complete cage structure installed in accordance with plan details for the designated bridge type structure.

634.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted quantity of fence, measured as provided above, will be paid for at the respective contract unit prices of each separate height and variation, complete in place, which shall be payment in full for all preliminary clearing, grubbing, excavating, and filling; for all materials, including concrete for posts, hardware, fittings and appurtenances; for erecting, bracing and aligning, and for all equipment, tools, labor and incidentals necessary to finish and complete the work. The accepted number of gates of each size measured as provided above will be paid for at the respective contract unit prices, complete in place, which shall be payment in full for furnishing and erecting all materials, all hinges, braces and other necessary fittings, including lock, 2 keys and one master key for each gate, and for all equipment, tools, labor and incidentals necessary to finish and complete the work.

When the item of Protective Cage (Industrial Fence) is provided in the plans or proposal, the accepted complete unit, measured as noted above, will be paid for at the contract lump sum price for each respective unit, complete in place, which shall be payment in full for furnishing all materials, fabrication and erection of all pipe framework including the connectors and inserts necessary for the installation of the fabric, and for all equipment, tools, labor and incidentals necessary to finish and complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

634-A Industrial Fence, ___ feet {m} High - per linear foot {meter}
634-B Industrial Fence, ___ feet {m} High, plus Barbed Wire, (45° Arms) - per linear foot {meter}
634-C Industrial Fence, ___ feet {m} High, plus Barbed Wire (Vertical Arms) - per linear foot {meter}
634-D Gate, ___ feet {m} Wide, Complete with Fittings (With Barbed Wire) or (Without Barbed Wire) - per each
634-E Industrial Fence ___ feet {m} High, Special Mounting - per linear foot {meter}
634-F Protective Cage (Industrial Fence) - per lump sum

SECTION 635
WOVEN WIRE FENCE

635.01 Description.

This Section shall cover the work of furnishing and erecting fences of woven wire and barbed wire, together with appropriate gates. Posts shall be wood or metal in accordance with details shown on the plans and/or proposal. Fences shall be erected at the locations and elevations shown on the plans or designated and shall comply with these Specifications. When it is optional as to the choice of the post type to be used, the alternate, once selected, shall be used throughout the project.

635.02 Materials.

Materials shall conform to requirements of Division 800, Materials, with specific reference to Section 871, and the details shown on the plans.

635.03 Construction Requirements.

(a) GENERAL.

All construction methods and equipment employed in the setting of fence shall be in accordance with requirements of the Specifications of the manufacturer of the fence materials being used and such that the resulting structure will provide the expected service and be durable and complete in every detail.

(b) CLEARING FENCE LINE.

All brush, stumps, logs, large roots, humps of earth, boulders or debris which would interfere with proper construction of the fence in the required location and present a pleasing and acceptable profile along the tops of the posts shall be removed before starting fencing operations. Sound standing trees in the fence line shall be removed or trimmed as directed to provide adequate working room. The

clearing and/or grading of the fence line and the disposal of material removed shall be accomplished in such a way that trees and shrubs on the remainder of the right of way will not be damaged.

(c) SETTING POSTS.

All posts and anchorage shall be set at intervals shown on the plans, or directed. The posts shall be set plumb and in true alignment on the side on which the wire is attached. Holes shall be dug to the minimum diameter and depth shown on the plans except that special treatment may be authorized when the fence is over solid rock. Steel or wood posts, excluding posts that are to be set in concrete, may be driven if the soil conditions are suitable. Methods shall be used to protect the posts and galvanized coating or wood preservative during the driving operation. The heads of all posts shall be protected from damage by caps or driving heads of approved design. Heads of wood posts shall be protected by a suitable cushion of wood, rope or like material and by a metal driving head. Posts that are damaged in any way shall be removed and replaced without additional cost to the State.

(d) INSTALLING WIRE AND GATES.

The woven wire fabric shall be stretched taut and securely fastened to each post by use of wire and an approved fencing tool so that the top of the fabric and lines of barbed wire are properly spaced from the top of each post as shown on the plans. The stretching shall be done with an approved stretcher that will produce equal tension in each line of wire in the fabric. At each end, corner or gate post each strand or line of wire shall be wrapped around the post and securely fastened near the post by winding the end about the same wire.

Where the fence crosses short depressions, longer posts may be required and the space below the bottom of the fence filled in with additional strands of barbed wire tied to posts as directed.

Where the fence crosses deep depressions or ravines the Engineer shall require that posts likely to be lifted when the fence is stretched be anchored in concrete as required for corner posts.

The fence shall be connected to culvert and/or bridge wing walls in accordance with the details shown on the plans.

The Contractor, however, may submit for consideration by the Department an alternate method of attaching the fence to the wing walls, provided no additional cost to the project is incurred, the method submitted presents a pleasing appearance to the eye, and accomplishes the desired results.

635.04 Method of Measurement.

All woven wire fences completed in compliance with these specifications at designated locations and accepted will be measured in place, along the top of the posts overall between the extreme limits of each section, excluding gates, in linear feet {meters} to nearest foot {0.1 m}. Each gate completed in compliance with the plans and these specifications and accepted will be counted as a unit, complete in place.

635.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. Fences constructed and measured as above provided will be paid for at the contract unit price per linear foot {meter} for Woven Wire Fence completely in place, which shall be payment in full for clearing, grubbing, and preparatory shaping for the fence line; for disposing of waste materials; for excavating for posts and braces and pouring concrete foundations where required; for furnishing all materials; for setting posts and braces, installing wire and other incidentals and for all equipment, tools and labor required to complete the work.

2. The accepted number of gates of each width constructed and accepted as above provided will be paid for at the respective contract unit prices for each width, which shall be payment in full for furnishing and installing gates together with all necessary fittings, hinges, braces, locks, keys, and other specified accessories, and for all materials, equipment, tools and labor necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

635-A Woven Wire Fence - per linear foot {meter}
635-B Gate, ___ feet {m} Wide - per each

SECTION 636
BARBED WIRE FENCE

636.01 Description.

This Section shall cover the work of furnishing and erecting barbed wire fences of the type and size shown on the plans and/or proposal. Posts shall be wood in accordance with details shown on the plans and/or proposal. Fences shall be erected at the locations and elevations shown on the plans or designated and shall comply with these specifications.

636.02 Materials.

Materials shall conform to requirements of Division 800, Materials, with specific reference to Section 871 and the details shown on the plans.

636.03 Construction Requirements.

(a) CLEARING FENCE LINE.

All brush, stumps, logs, large roots, humps of earth, boulders or debris which would interfere with proper installation of fence in the required location and present a pleasing and acceptable profile along the tops of posts shall be removed before starting fencing operations. Sound standing trees in the fence line shall be removed or trimmed as directed to provide adequate working room. The clearing and/or grading of the fence line and the disposal of material removed shall be accomplished in such a way that trees and shrubs on the remainder of the right of way will not be damaged.

(b) SETTING POSTS.

All posts and braces shall be set to the required depths and intervals. The posts shall be set plumb and in true alignment on the side on which the wire is attached. Holes shall be dug to the minimum diameter and depth shown on the plans except that special treatment may be authorized when the fence is over solid rock. Posts may be driven if the soil conditions are suitable. Methods shall be used to protect the posts during the driving operations. The heads of all posts shall be protected by a suitable cushion of wood, rope or like material and by a metal driving head. Posts that are damaged in any way shall be removed and replaced without additional cost to the State. The backfill shall be well tamped into place.

(c) INSTALLING WIRE.

The barbed wire shall be stretched taut and securely fastened to each post by use of wire or staples and an approved fencing tool so that the lines of barbed wire are properly spaced on each post as shown on the plans. The stretching shall be done with an approved stretcher that will produce equal tension on each line of wire. At each end or corner post each strand or line of wire shall be wrapped around the post and securely fastened near the post by winding the end about the same wire.

Where the fence crosses short depressions, longer posts may be required and the space below the bottom strand of the fence filled with additional strands of wire tied to the posts as directed.

636.04 Method of Measurement.

All barbed wire fences completed in compliance with these specifications and details shown on the plans at designated locations, and accepted will be measured in place along the top of the posts in linear feet {meters} to the nearest 0.1 foot {0.1 m}.

636.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Barbed Wire Fences constructed and measured as provided above will be paid for at the contract unit price per linear foot {meter} for barbed wire fence complete in place, which shall be payment in full for clearing, grubbing and preparatory shaping for the fence line; for disposing of waste materials, for excavating for posts and braces; for furnishing all materials; for setting posts and braces, installing wire and other incidentals and for all equipment, tools, and labor required to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

636-A Barbed Wire Fence, ____ Strands ____ feet {m} High - per linear foot {meter}

SECTION 637
FENCE RESET

637.01 Description.

This Section shall cover the work of the resetting of fences, gates, stiles and cattle chutes, required to be removed from their original position inside the right of way, or erecting fence, gates, etc. using new material of the type furnished to the Contractor (usually by the owner of the abutting land) instead of materials removed from the right of way.

637.02 Materials.

Existing materials shall be utilized to the fullest extent possible; replacements for materials damaged or destroyed due to negligence on the part of the Contractor shall be of at least the same grade of material used in the original fence. Approval of the replacement material shall be made by the Engineer; no testing of this material will be required unless such is ordered by the Engineer.

637.03 Construction Requirements.

(a) GENERAL.

Attention is directed to the general construction requirements for construction of Chain Link Industrial Fence, Section 634; Woven Wire Fence, Section 635; and Barbed Wire Fence, Section 636.

The Contractor will be required to remove and reset the fence to the location on and beyond the right of way lines as designated, using the material from the original fences, and shall leave all fences in as good condition as before removal from their original location.

In case resetting of a fence will completely re-enclose a previously enclosed area, the Contractor shall be responsible for all damages of any nature arising from the removal of the fence or delay or negligence in resetting. No such fence shall be cut or disturbed until the Contractor has made adequate provision for immediate repair or reconstruction. Watchmen to control livestock where fence is being reset shall be provided by the Contractor as necessary without extra compensation.

In case resetting of a fence will not re-enclose a previously enclosed area, it shall not be cut or moved without a written order from the Engineer. Pending issuance of such written order, the Contractor will be permitted to install at his expense, temporary fences and gates or other means of access. The Contractor, provided reasonable caution is used, will not be held responsible for damage arising from removing and resetting fence after receiving a written order for its removal.

(b) INSTALLATION.

Reset fences shall be true to line and grade with all wires taut and well fastened, and shall present a workmanlike appearance.

(c) GATES.

All gates shall be moved and made serviceable at the new location. All damage to fence and gates due to moving operations shall be repaired by the Contractor. All posts and gates not in serviceable condition shall be replaced with posts and gates of serviceable materials. The cost of such replacements shall be included in the price bid for Fence Reset and no direct payment will be made for such replacements.

The Contractor will not be required to furnish any additional material, except posts and gates, as above provided, and such materials as may be necessary to replace any and all parts of the fence and gates unnecessarily damaged in removing and handling and resetting. Should the owners or the lessees of the abutting property desire to improve any fence or portion thereof which is designated to be reset, and the said owners or lessees agree to furnish the Contractor, at the site of the work, the necessary material similar in character to that in the original fence, the Contractor will be required to rebuild and reset such fence using the material furnished by the owners or lessees in lieu of the original material. The Contractor will be responsible for such materials delivered on the site until incorporated in the fence. The original material so replaced may be recovered by the owners or lessees.

(d) FENCE SET.

When the item of "Fence Set" is included in the plans or proposal, the Contractor shall use the fencing materials which have been placed along the right of way at designated locations, and construct a fence along the right of way making the necessary connections to existing or reset fences. Construction details shall be the same as required for reset fence.

637.04 Method of Measurement.

The quantity of fence reset or fence set shall be the accepted net length, including gates, of completed fence removed and reset or of fence set at the new location, measured along the top of the post line in linear feet {meters} to the nearest foot {0.1 m}. No measurement or direct payment will be made for fence removed only and not reset. The quantity of fence reset includes cattle chutes, stiles, and related fences.

637.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted quantity of fence reset will be paid for at the contract unit price bid per linear foot {meter} for Fence Reset, which shall be payment in full for furnishing all labor, material, equipment, tools, and incidentals necessary to complete the work.

The accepted quantity of fence set will be paid for at the contract unit price bid per linear foot {meter} for Fence Set, which shall be payment in full for furnishing all labor, equipment, tools and incidentals necessary to complete the work, including responsibility for the new materials furnished until used.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

637-A Fence Reset - per linear foot {meter}
637-B Fence Set - per linear foot {meter}

SECTION 640
MINOR UTILITY ADJUSTMENTS

640.01 Description.

This Section shall cover the work of minor adjustments and/or relocations of various types of public or private utilities, that may be encountered within the construction limits of the project, from their original location in order to clear the construction and comply with existing State laws.

640.02 Materials.

In the adjustment of utilities under this Section the Contractor shall use materials salvaged from the original facility plus new materials necessary to clear the construction of these facilities. All new materials and accessories necessary to adjust and/or relocate these facilities shall be furnished by the Contractor with like material of at least equal quality of that in place.

640.03 Construction Requirements.

The construction methods employed in the adjustment or relocation of the various types of utilities shall be in accordance with current local codes and practices of the type utility involved.

The Contractor shall be required to adjust and/or relocate the various types of utilities, which may be encountered, as shown on the plans or directed, using the material salvaged from the original facility plus any new material necessary to clear the construction.

All salvable and unsalvable material not used in the adjustment of the facility involved shall become the property of the Contractor, unless otherwise provided by the plans, and shall be disposed of by him off the limits of the right of way at his discretion.

Work required for this adjustment shall be performed by the Contractor in a manner that will limit interruption of the services for the utility involved a minimum period of time.

When adjusting, installing or otherwise working with non-metallic conduits for underground utilities, the Contractor shall install on the conduit a metallic tape or provide other suitable means whereby the installation can be relocated by electronic detection devices.

640.04 Method of Measurement.

Each type of utility, either overhead or underground, to be adjusted and/or relocated for which direct payment is to be made will be designated on the plans or in the proposal. For the purpose of measurement and payment each type of utility will be classified separately. The method of measurement shall be as noted herein with measurements either per linear foot {meter} or per lump sum with each being measured as complete in place. Measurements in linear feet {meters} will be to the nearest foot {0.1 m}, along the centerline of the type utility being measured.

640.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Payment for the utility adjustment, measured as noted above, will be made at the contract unit price bid per type utility which shall be payment in full for the adjustment as provided on the plans or proposal. Said contract unit price bid shall be payment in full for all materials, equipment, tools, labor and incidentals necessary to complete the adjustment of the utility and restore the service of the type utility involved.

The unit price bid for underground utility adjustment will be based on placing the facility at a depth of 3 feet {1 m} or less under the existing ground surface, unless otherwise noted on the plans.

The accepted footage of underground facilities complete in place at depths greater than 3 feet {1 m} below the ground surface shall have an adjusted unit price, arrived at by increasing the contract price bid by the percentage indicated in the table below. Unit price coverage noted in paragraph 1 above shall govern for such adjusted unit price.

Final acceptance of this work will be subject to approval by the Utility Company involved; therefore, the Engineer may withhold payment for this work until the Contractor has obtained the owner's written approval that the work performed complies with the local codes and requirements of the Utility Company.

Depth Utility Installed Below Existing Ground Line	Percentage Contract Unit Price Bid to be Increased
More than 3 feet {1 m}, but less than 6 feet {2 m}	20
6 feet {2 m} and more, but less then 9 feet {3 m}	50
9 feet {3 m} and more, but less than 12 feet {4 m}	75
12 feet {4 m} and more	100

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

640-A __*__ Utility Adjustment (__**__) - per linear foot {meter}

640-B __*__ Utility Adjustment (__**__) - per lump sum

* Overhead or Underground

** Electrical, Communication (Telephone/Telegraph), Gas, Water or Sewerage

NOTE: Types of Utilities in general will be classified as Electrical, Communication (telephone or telegraph), Gas, Water or Sewerage.

SECTION 641
WATER PIPE

641.01 Description.

This Section shall cover the work of either furnishing and installing new water pipe and water mains or removing and relaying existing water pipe and water mains as indicated on the plans or as directed, and substantially to the established locations, lines and grades.

Water pipe is defined here as lateral lines leading from water mains to buildings. The kind and size of pipe or main will be shown on the plans or in the proposal.

641.02 Materials.

All materials shall conform to the provisions of Division 800, Materials. Specific reference is made to Section 863, Water Pipe. Pipe to be removed and relaid shall in each case be that indicated on the plans or designated. Kinds of pipe, other than Galvanized Steel and Cast Iron Water Pipe to be relaid, shall have joint and other incidental materials in accordance with original installation unless otherwise required by local codes or regulations.

641.03 Construction Requirements.

(a) GENERAL.

1. All pipes to be removed and relaid shall be cleaned. The Contractor will be required to replace without extra compensation sections of pipe damaged through carelessness or use of improper methods. Pipe shall be approved before relaying.

2. The construction methods employed in the placement of the pipe shall be in accordance with the current codes and practices of the operating utility company. All work performed shall be under the supervision of an experienced supervisor for this type of work.

3. Reaction or thrust backing shall be required on all mains 4 inches {100 mm} in diameter or larger at all ties, plugs, caps and bends deflecting 22½ degrees or larger, or other approved anchorage provided. Cost of this anchorage shall be considered incidental to the work and the cost thereof absorbed in the unit price bid for the mains.

4. When installing non-metallic water pipe, the Contractor shall install a metallic tape on the pipe or provide other suitable means whereby the installation can be relocated by electronic detection devices.

(b) EXCAVATION, FOUNDATION PREPARATION AND BACKFILL.

1. EXCAVATION.

The trench shall be excavated to the designated line and grade. The trench width shall be sufficient to permit work on the pipe and inspection of the work. Mains shall have a trench width of 16 inches {400 mm} plus the outside diameter of the pipe with the depth sufficient to provide for foundation preparation as noted in item 2 below.

2. FOUNDATION PREPARATION.

Mains shall be placed on a firm foundation of sand or sandy loam either from approved selected portions of the excavation or an approved source obtained by the Contractor. This foundation shall consist of a minimum 6 inches {150 mm} of approved material, unless otherwise specified, which has been compacted to the satisfaction of the Engineer and which has been shaped to fit the pipe and joints to insure full bearing of the pipe section for its entire length on the trench floor.

3. BACKFILL.

After installation of the pipe the trench shall be backfilled with the best of the suitable material taken from the excavation, if this material is not suitable other acceptable material shall be obtained. The backfill shall be compacted to the density specified in Section 306 within the roadbed and as directed, consistent with the surrounding material for areas outside the roadbed. Any subbase, or base or pavement cut in the trenching for the pipe shall be backfilled with materials of the same quality as removed and the surface restored to its original smoothness.

All pipe shall be pressure tested as noted in Subarticle 641.03(c), or the method prescribed by the utility company whose system is involved, whichever is the more stringent, before complete backfilling of the pipe will be permitted.

(c) PRESSURE TESTING OF INSTALLED LINES.

1. GENERAL.

All lines installed under this Section shall be pressure tested as noted in this Subarticle. The Contractor shall have the option of testing the mains under one of the following conditions:

a. Lines uncovered.

b. Lines partially covered with joints and valves exposed. Partial cover shall be placed as noted in Item 641.03(b)3.

c. Lines completely covered.

Service lines to be tested as outlined below shall meet condition a or b.

2. TESTING.

a. Mains.

When a section of pipe is approved by the Engineer for testing, the Contractor shall furnish all materials, equipment, and labor to properly carry out the testing operation. This will include, as a minimum, a test pump and a means of accurate measurement of water necessary to maintain the required pressure during the prescribed time of testing. The Contractor shall furnish, install, and remove any temporary bulkheads, flanges, and plugs, as well as corporation stops at high points in the pipe line and at the test pump, when such are necessary for the testing operation.

Unless approved otherwise by the Engineer, all pipe mains, including corporation stops, shall be tested before service lines are installed. If, in the opinion of the Engineer, the high pressure testing of the mains must be done after service lines are in place, the service lines shall be shut off at the corporation stops.

After necessary joints, corporation stops, bulkheads, etc. have been installed, temporary corporation stops, if no other means can be provided, shall be placed in the high points of

the pipe line and at the pumps as required, and the pipe blown free from air according to accepted procedure.

The test pressure shall equal 150 percent of the working pressure, but not to be less than 100 psi {690 kPa} nor more than the pressure class of the pipe being tested. The minimum test period shall be six (6) hours. However, if the Engineer deems additional testing is necessary, the Contractor shall perform the procedure with no additional compensation. Leakage shall not exceed 4 gallons per inch of pipe diameter per mile per six hours {0.4 L/mm of pipe diameter per kilometer per six hours}. Suitable means shall be provided by the Contractor for determining the quantity of water lost by leakage under the test pressure.

When, in the opinion of the Engineer, service lines cannot be shut off from the section to be tested or other conditions exist where pressure testing as described above may cause damage, the Engineer may approve the line be tested under normal operating pressure.

The Contractor, at his expense, shall locate and repair defective joints, sections, or valves until the leakage is within the noted allowances. All observed leaks shall be repaired whether or not the leakage test results are within the requirements specified above. After the Contractor has made the necessary corrections, the main shall be retested as described above until the line passes the necessary requirements. All tests, and retests, shall be at the Contractor's expense.

b. Service Lines.

These lines shall be checked under normal operating pressures for at least six (6) hours and the line completely inspected for visible leaks unless checked along with the mains as noted in Item a. above. The Contractor, at his expense, shall locate and repair or replace any connection or joint until leakage has been stopped.

(d) STERILIZATION.

Pipe lines and appurtenances, both existing and new, which are the responsibility of the Contractor by reason of and within the overall limits of construction, shall be sterilized before being placed in service. The sterilization process shall be performed after all pressure tests have been completed.

The sterilization process shall, as a minimum, be that required by the governmental regulatory body having jurisdiction over the utility. The Contractor shall contact the utility owner or regulatory body to determine the acceptable sterilization treatment. The cost for this work shall be included in the unit price bid for the water pipe.

641.04 Method of Measurement.

The length of water pipe and water main relaid and new water pipe and water main laid will be the overall length measured, along the top of the pipe in linear feet {meters}, complete in place, which shall include all valves, connections (Y's, T's, etc.) and fittings.

641.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. The accepted quantity of water pipe and water main laid will be paid for at the contract unit price per linear foot {meter}, complete in place, which shall be payment in full for furnishing and installing pipe; including all valves, connections, fittings, and joint material, making necessary pipe connections, excavating, backfilling, and for all materials, tools, labor, equipment and incidentals necessary to complete the work.

2. The accepted quantity of water pipe and water main relaid will be paid for at the contract unit price per linear foot {meter}, complete in place which shall be payment in full for removing, cleaning, excavating, relaying, making necessary pipe connections, furnishing new joint material, backfilling and for all materials, tools, labor, equipment and incidentals necessary to complete the work.

3. Final acceptance of this work will be subject to approval by the Utility Company involved, therefore, the Engineer may withhold payment for this work until the Contractor has obtained the owner's written approval that the work performed complies with the local codes and requirements of the Utility Company.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

641-A ___ inch {mm} Kind Water Pipe/Main Laid - per linear foot {meter}
641-B ___ inch {mm} Kind Water Pipe/Main Relaid - per linear foot {meter}

SECTION 642
FIRE HYDRANTS RESET

642.01 Description.

This Section shall cover the work of resetting existing fire hydrants together with any connections, valves and pipe or main necessary to be moved in resetting the hydrant.

642.02 Materials.

All materials shall conform to the appropriate requirements of Division 800, Materials, or shall be approved equivalent in kind and quality to that replaced.

642.03 Construction Requirements.

All work shall be done in a workmanlike manner, by competent workmen in accordance with the requirements of local codes and ordinances. Any materials lost or rendered unfit for re-use on account of negligence or improper handling by the Contractor shall be replaced by him without additional compensation.

Hydrants may be reset under pressure without removing joints where the situation permits; otherwise, hydrant and necessary pipe shall be taken up and then reset at the designated elevation and location.

Attention is directed to the requirements of Article 641.03 for relaying water pipe and mains.

642.04 Method of Measurement.

The number of fire hydrants reset will be the number actually reset as directed and accepted.

642.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of fire hydrants reset, measured as above provided, will be paid for at the contract unit price each which shall be payment in full for all excavation, backfilling, resetting fire hydrants and all necessary connections, valves, and pipe, and for all equipment, tools, materials, and labor necessary to complete the work.

Final acceptance of this work will be subject to approval by the Utility Company involved, therefore, the Engineer may withhold payment for this work until the Contractor has obtained the owner's written approval that the work performed complies with the local codes and requirements of the Utility Company.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

642-A Fire Hydrant Reset - per each

SECTION 643
WATER METERS AND VALVE BOXES RESET

643.01 Description.

This Section shall cover the work of removing existing water meters and valve boxes as shown on the plans or designated, and resetting them at the locations and at the elevations designated.

The term "water meter" shall include the water meter, the meter box, and cover, the adjacent water cutoff, all connections, and pipe necessary to be moved in resetting the meter. The term "valve box" shall include all sections of the box or casing over the valve, extending from the water or gas main to the surface, and the cover for same.

643.02 Materials.

All new materials furnished for use shall conform to the appropriate requirements of Division 800, Materials, or shall be approved equivalent in kind and quality to the materials used in the original construction.

643.03 Construction Requirements.

All work shall be completed in a workmanlike manner, by competent workmen. The upper section of the valve box shall be adjusted carefully to the designated elevations. The valve box shall not be removed during grading operations without permission of the Engineer and shall be carefully protected

from damage. The Contractor shall accurately reference the location of each box which he is permitted to remove, in order to make correct replacement. Backfill shall be tamped around each box located in the pavement area to the required density of the adjacent material.

Any meter, valve box, or accessories lost or rendered unfit for re-use due to negligence or improper handling by the Contractor shall be replaced by him without additional compensation.

643.04 Method of Measurement.

The number of water meters and valve boxes reset will be the number of each, reset complete in place as directed and accepted.

643.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of water meters and valve boxes reset, measured as provided above will be paid for at the contract unit price each, which shall be payment in full for all excavation, backfilling, resetting the meter or valve box and all necessary connections, and for all equipment, tools, materials and labor necessary to complete the work.

Final acceptance of this work will be subject to approval by the Utility Company involved, therefore, the Engineer may withhold payment for this work until the Contractor has obtained the owner's written approval that the work performed complies with the local codes and requirements of the Utility Company.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

643-A Water Meters Reset - per each
643-B Valve Boxes Reset - per each

SECTION 645
SANITARY SEWERS

645.01 Description.

This Section shall cover the work of furnishing and installing new sanitary sewers and the removal and relaying of existing sanitary sewers at the locations and to the established lines and grades shown on the plans or designated.

This work shall also include the furnishing and construction of joints, cutting and connection to other pipes as may be required by the plans or directed to provide an acceptable facility.

645.02 Materials.

Materials furnished for use shall conform to the requirements of Section 854 and other appropriate sections of Division 800, Materials. The type and size of pipe will be shown on the plans or in the proposal. The pipe strength shall be in accordance with the requirements of Section 854 unless otherwise provided by plan details or the existing system to which the lines are a part require a stronger grade or actual laying conditions require the use of stronger wall pipe.

645.03 Construction Requirements.

(a) GENERAL.

Pipe shall not be laid or relaid except in the presence of the Engineer or Inspector and shall not be covered until approved. Pipe designated to be relaid that is damaged or rendered unfit for use through negligence or improper handling shall be replaced by the Contractor without additional compensation.

The construction methods employed in the adjustment or relocation of the sewer lines shall be in accordance with the current codes and practices of the Utility Company involved. All work performed shall be under a qualified experienced supervisor for this type work.

Work required for the adjustments shall be performed by the Contractor in such a manner that will limit interruption of the service a minimum period of time.

When installing non-metallic sewer pipe, the Contractor shall install a metallic tape on the pipe or provide other suitable means whereby the installation can be relocated by electronic detection devices.

(b) EXCAVATION AND FOUNDATION.

The trench shall be excavated true to established lines and grades. Tunneling will not be permitted unless authorized in writing. Trenches shall be excavated at least 9 inches {250 mm} on each side of the pipe. Trenches shall be properly sheeted or braced wherever needed. Sides of the trenches shall be kept as near vertical as possible. Bell holes shall be excavated to insure that the pipe rests upon the bottom of the trench for length. If the bottom of the trench is in rock or is of soft or otherwise unsatisfactory material, the trench shall be excavated 12 inches {300 mm} below grade and as directed by the Engineer. Such excavation shall be considered a part of necessary sewer excavation. The trench shall then be backfilled up to the proper grade elevation and compacted as directed using selected material from the excavation or other approved sources suitable for the purpose intended, this foundation preparation is considered incidental to the work and no additional compensation will be given.

(c) LAYING.

The laying of pipe in finished trenches shall be started at the outlet end and brought up grade with the spigot end pointing in the direction of flow. Pipe shall be laid with ends abutting and with not more than 3/4 of an inch {19 mm} variation from established alignment at the vertical centerline or from grade at the flowline.

Pipe shall be fitted and matched so that they will form a sewer with a smooth, uniform invert. Pipes shall be so lowered as to avoid damage and unnecessary handling in the trench and hubs or bells shall be clean when laid.

(d) JOINTS.

All joints shall be sealed for the entire circumference of the pipe providing an acceptable watertight joint.

Joints in vitrified clay and concrete pipe and iron pipe using lead or metallic joint compound shall first be packed with jute, oakum or hemp of an amount and quality necessary for the purpose intended. The remaining space in the joint shall then be filled with joint compound with sufficient additional material added to form a bead around the joint. Care shall be taken to prevent protrusion of joint material inside the pipe. The inside of the joint shall be wiped and finished smooth. For rubber or other type gaskets, installation shall be in accordance with manufacturer's recommendations consistent with the type pipe joint being used. No joint shall be finished until the two next joints in advance hare been placed.

Walking or working on or over the completed sewer line, except such as is necessary for tamping or backfilling, will not be permitted until at least 1 foot {300 mm} of backfill is in place over the top of the pipe.

(e) BACKFILLING.

All trenches and excavations shall be backfilled with approved natural soil or, when directed or provided on the plans, with foundation backfill material.

The backfilling shall follow closely the laying of the pipe. The material shall be carefully deposited equally on both sides of the pipe in uniform layers not to exceed 6 inches {150 mm} in compacted thickness and tamped with proper tools so as not to disturb the pipe. Backfilling under roadbeds shall be compacted to the density specified for embankments in Section 306. Backfill not under roadbeds shall be compacted as directed consistent with surrounding materials. Where roadways or other crossings are disturbed by placing the sewer, the Contractor shall restore them to their original condition and shall replace all surface material and all paving, sidewalks, sod, or other disturbed surfaces, furnishing all necessary new materials without extra compensation except as provided in this section. Topsoil disturbed by excavation across private property shall be replaced as nearly as possible to its original position.

After completing the backfill, the Contractor shall promptly remove all surplus material, rubbish, and all equipment, leaving the site and adjacent areas in a neat and presentable condition.

(f) SANITARY SEWERS WITHIN ROADWAY LIMITS.

The excavation, bedding, and backfilling of sanitary sewer within the roadway limits shall be performed as provided in Section 530.

645.04 Method of Measurement.

The actual accepted length of sanitary sewer laid or relaid as directed will be measured in linear feet {meters} along the center of the line, complete in place. Tees, wyes, crosses, bends and like specials will only be measured for payment along the center of the line being laid. Excavation,

foundation preparation and backfilling for sanitary sewers will not be measured separately for payment but shall be included in the contract unit price for the sanitary sewer pipe.

645.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. The accepted length of sanitary sewer laid or relaid complete in place measured as noted above will be paid for at the respective contract unit prices for the kinds, and sizes specified in the proposal including the excavation and backfilling for a depth of 6 feet {2 m} or less below the existing ground line, which shall be payment in full for furnishing (or removal and salvaging), hauling, excavating, foundation preparation, laying or relaying, backfilling, compacting, clean-up and for all materials, equipment, tools, labor, and incidentals necessary to complete the work except manholes, junction boxes, or like connecting masonry.

2. The accepted length of sanitary sewer pipe laid or relaid, measured as provided above, at depths greater than 6 feet {2 m} below the existing ground line shall have an adjusted unit price, arrived at by increasing the contract unit price by the percentage indicated in the table below. The unit price coverage provided in Item 1 above shall govern for such adjusted unit price.

Depth Sewer Installed Below Existing Ground Line	Percentage Contract Unit Price Bid to be Increased
More than 6 feet {2 m}, but less than 9 feet {3 m}	25
9 feet {3 m} and more, but less then 12 feet {4 m}	50
12 feet {4 m} and more, but less than 15 feet {5 m}	75
15 feet {5 m} and more	100

3. Final acceptance of this work will be subject to approval by the Utility Company involved, therefore, the Engineer may withhold payment for this work until the Contractor has obtained the owner's written approval that the work performed complies with the local codes and requirements of the Utility Company.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

645-A ___ inch {mm} Type Sanitary Sewer Pipe - per linear foot {meter}
645-B ___ inch {mm} Cast/Ductile Iron Sanitary Sewer Pipe Relaid - per linear foot {meter}

Types: Vitrified Clay (V.C.)
Plain Concrete (P.C.)
Reinforced Concrete (R.C.)
Cast Iron (C.I.)
Ductile Iron (D.I.)
Cast Iron Soil (C.I.S,)
ABS or PVC Composite (A.B.S.)
PVC (P.V.C.)
Concrete Lined Corrugated Metal (C.L.C.M.)

SECTION 649
ENCASEMENT PIPE FOR UTILITIES

649.01 Description.

This Section shall cover the work of furnishing and installing an encasement pipe for water or sewer type utility. The installation shall include placement of the pipe at the location shown on the plans or directed and in conformity with the lines and grades established by the Engineer.

The location of the encasement pipe within the construction limits of a project will determine the method of installation. The installation requirements are designed as follows:

Type 1, installation - installed by open trench method complying with requirements for installation with Class C bedding , Section 530.

Type 1A, installation - installed by open trench method complying with requirements for installation and backfilling Section 535.

Type 2, installation - installed by an approved jacking, boring, or tunneling procedure.

649.02 Materials.

Materials furnished for use shall comply with the appropriate provisions of Division 800, Materials, with specific reference to Section 862.

649.03 Construction Requirements.

(a) GENERAL.

The three types of installations are for use as follows:

Type 1 Designated for use under roadways where construction permits open cut method.

Type 1A Designated for use outside of roadways where encasement is desired and where construction permits open cut method.

Type 2 Designated for use where open cut method is not permissible. The Contractor may, at his option, substitute this installation method for either Type 1 or 1A installation provided no additional cost to the Department is involved. This type installation is basically for use under existing facilities and where traffic is not to be disturbed.

The type of pipe joints used will be at the Contractor's option provided the joint produces a smooth surface on the inside of the pipe suitable for installation of the carrier or line pipe. In order to prevent earth, debris, rodents, etc. from entering the encasement, the ends of the pipe shall be sealed by grouting or other suitable means as directed by the Engineer.

(b) OPEN CUT METHOD.

The procedure for excavating and backfilling of pipe by the open cut method shall be as prescribed in Section 530 for a Type 1 installation and as prescribed in Section 535 for a Type 1A installation.

(c) BORING, JACKING OR TUNNELING METHOD.

When a Type 2 installation is required, the method selected by the Contractor must be approved by the Engineer.

The Contractor shall submit to the Engineer details of the procedure he proposes to use along with a description of the equipment available for use. The results of said procedure shall produce a neatly installed encasement pipe without damage to the existing facility and without excessive voids in the earth surrounding the encasement pipe. If there are indications that voids exist around the encasement, the Engineer shall have cause to order the Contractor to pump under pressure a concrete grout to seal the voids. Any damage to the facility (roadbed, slopes, etc.) caused by the installation operation shall be restored by the Contractor to the satisfaction of the Engineer without cost to the Department.

(d) SEATING OF CARRIER PIPE.

Tracks, guides or other types of supports acceptable to the utility company involved shall be provided for conveying the carrier pipe through the encasement.

(e) END TREATMENT OF ENCASEMENT PIPES.

Provisions shall be made at the ends of all encasement pipes to prevent water and other foreign matter from entering the casing. Sealing of the ends of the encasement pipe may be accomplished by products manufactured specifically for this purpose or may be constructed of rubble masonry or concrete mortar.

649.04 Method of Measurement.

The accepted amount of encasement pipe of the type installation required shall be measured by the linear foot {meter}, to the nearest foot {0.1 m}.

649.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted encasement pipe measured as noted above will be paid for at the contract unit price bid for the type installation involved. Said unit price bid shall be full compensation for the furnishing and installation of the pipe, for all excavation and backfill, except as provided in Section 530 for Type 1 installation, sealing ends of encasement, disposal of excess material and for all labor, tools, equipment and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

649-A ___ inch {mm} Encasement Pipe, <u>Type 1, 1A or 2 Installation</u> - per linear foot {meter}

SECTION 650
TOPSOIL

650.01 Description.

This Section shall cover the work of furnishing topsoil material, or the use of State furnished material from stockpiles, and the incorporation of the topsoil material into the work as plating material on shoulders, medians and slopes, or for other uses as may be designated.

The use of the Item of "Topsoil" requires that the Contractor provide the material from sources he has obtained. The use of the item "Topsoil from Stockpiles" denotes the State will provide the material in stockpiles established under the provisions of Section 210.

Basic work consists of loading, hauling, spreading, manipulating, and compacting the topsoil material, all in accordance with these Specifications, to the lines, grades and cross section indicated on the plans or directed by the Engineer.

650.02 Materials.

(a) DEFINITION.

Topsoil is defined as a natural, workable, friable, loamy soil without admixture of subsoil, refuse, or foreign materials, reasonably free from hard lumps, stiff clay, hardpan, gravel, noxious weeds, brush, or other undesirable material, and suitable for growing grasses, legumes, or other vegetative ground cover.

(b) REQUIREMENTS.

Acceptable topsoil shall have demonstrated by the occurrence upon it of healthy vegetative growth that it is well drained, and that it does not contain toxic amounts of either acid, alkaline, or other phytotoxic elements. The areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage and other characteristics as to offer assurance that, when removed in quantity, the product will be homogeneous in nature and of acceptable quality.

(c) SOURCES OF MATERIAL.

1. TOPSOIL FURNISHED BY CONTRACTOR.

Where the plans specify the Item of Topsoil, the Contractor shall furnish the topsoil material and shall obtain it from areas, arranged for and furnished by him from outside of the right of way. However, both material and areas must be approved and attention is directed to Subarticle 106.0l(b) for treatment of area after removal of material.

2. TOPSOIL FURNISHED BY STATE FROM STOCKPILES.

Where the plans specify the Item of Topsoil From Stockpiles, the Contractor shall use topsoil from stockpiles established under Subarticle 210.03(b).

650.03 Construction Requirements.

(a) SOURCE AREA OPERATIONS.

All areas from which topsoil is to be stripped shall be cleaned of all refuse which will hinder or prevent seedbed preparation or growth. In securing topsoil from approved areas, should unforeseen strata or seams of material occur which do not meet the requirements for topsoil, such material shall be removed from the topsoil and disposed of as directed, or if directed, the area shall be abandoned.

(b) HAULING TOPSOIL.

Topsoil shall be hauled in vehicles suitable for the purpose. Scrapers of a reasonable capacity will be considered as acceptable; however, excessive spillage will not be tolerated and loads shall be controlled to prevent such. Topsoil spilled on subgrade or other base or pavement structure layers shall be removed immediately.

(c) CONDITIONING OF AREA TO RECEIVE TOPSOIL.

Unless otherwise directed, before depositing topsoil upon any area, all shaping and dressing of such area shall have been completed and approved.

(d) APPLICATION OF TOPSOIL.

After the application of the topsoil to such a depth as indicated or directed, the area shall be harrowed and disked entirely through the layer of topsoil and into the subsoil to a depth of at least 2 inches {50 mm} in order to secure proper bond of the topsoil with the subsoil. At this stage all large lumps, large rocks, roots, or other objectionable matter shall be gathered up and disposed of. On such

areas where the application of topsoil involves primarily the backfilling of rills or small washes, ground preparation, if directed, may be delayed until just before the application of fertilizer and grassing operations.

(e) COMPACTION.

It is intended that the grassing operation shall follow immediately after the placing of topsoil in which case such grassing operation would require satisfactory compaction in order to prevent erosion. In the event that grassing operations are delayed, the layer of topsoil shall be mixed, tilled, or compacted until satisfactory.

(f) MAINTENANCE.

The Contractor shall maintain the topsoil that has been placed, without extra compensation, in connection with any seeding, sodding, planting, or other work, until final completion of the project. Maintenance shall consist of preserving, protecting, and such other work as may be necessary to keep the work in a satisfactory condition.

650.04 Method of Measurement.

(a) TOPSOIL, ITEM 650-A.

This item covers topsoil material furnished by the Contractor complete in place on the roadbed and will be measured in cubic yards {cubic meters}, loose measure in the delivery vehicle at the point of delivery on the roadbed.

(b) TOPSOIL FROM STOCKPILES, ITEM 650-B.

This item covers topsoil material taken from State furnished stockpiles on the Right of Way and will be measured in cubic yards {cubic meters} by the cross-section and average end areas method at the stockpile.

650.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The volume for the Item of Topsoil measured as provided above will be paid for at the contract unit price per cubic yard {cubic meter}, which price shall be full payment for cleaning and removing refuse from the topsoil; for ground preparation; for furnishing the material including royalty and related costs, handling, hauling, spreading, shaping, bonding to subsoil, and compacting in its final position; for satisfactory disposal of surplus material; and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

The volume for the Item of Topsoil from Stockpiles, measured as provided above, will be paid for at the contract unit price per cubic yard {cubic meter}, which price shall be full payment for ground preparation; for cleaning and removing debris from the topsoil, for all handling, hauling, spreading, shaping, bonding to subsoil, and compacting in its final position; and for furnishing all equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

650-A Topsoil - per cubic yard {cubic meter}
650-B Topsoil from Stockpiles - per cubic yard {cubic meter}

SECTION 651
GROUND PREPARATION AND FERTILIZERS FOR EROSION CONTROL

651.01 Description.

This Section shall cover the work consisting of the preparation of the areas designated on the plans or directed for the ground covers specified in Sections 652, 653, 654, 657, 658 and other applicable Sections of these Specifications. It is the intent that erosion control features be constructed concurrently with other work at the earliest time deemed practical by the Engineer. Whenever any section of the road is deemed substantially complete and there is a high potential for erosion and subsequent water pollution to occur, the Engineer may direct, even to the exclusion of other operations, that the Contractor promptly accomplish the ground preparation described herein and place the erosion control items provided in the contract.

Ground preparation shall, in general, consist of plowing, disking and harrowing of the areas to receive a ground cover in accordance with other Sections of these Specifications.

Fertilizers, whether provided as a separate item of work or included as a part of a specified ground cover, shall include furnishing, uniform application, and incorporation into the soil, to the depth of preparation specified, fertilizers of the types provided on the plans or in applicable sections of these specifications.

The cost of water necessary for ground preparation, planting and rapid establishment of a stand of all erosion control items, and the maintenance of these items for the duration of the contract shall be included in the unit price bid for the respective item of work involved.

651.02 Materials.

(a) GENERAL.

All materials shall conform to the provisions of Division 800, Materials. Specific reference is made to Article 860.12, Fertilizer.

(b) SUBSTITUTION.

Additional grades of manufactured fertilizers will be accepted on the basis of nominal content of each of the three provided fertilizing ingredients. Standard commercial grades other than those provided as shown in Subarticle 860.12(c), or a combination of such grades, may be used without extra compensation, provided the rate of their use is adjusted to supply at least as much of each fertilizing element as supplied by the required grade when used at the rate provided for the items of work involved. When provided on the plans, basic slag may be substituted for agricultural limestone on the basis of approximately the same neutralizing power together with appropriate adjustment being made for phosphate content in the basic slag. Example: If Basic Slag contains 3% P_2O_5, then one ton {one metric ton (1000 kg)} of Basic Slag will provide 60 pounds {30 kg} of P_2O_5. For the purpose of these specifications, agricultural limestone and basic slag shall be considered as manufactured fertilizer except that they shall contain no insecticide.

651.03 Construction Requirements.

(a) EQUIPMENT.

All equipment necessary for properly handling, storing, placing and incorporating the fertilizer into the prepared ground and for ground preparation shall be at hand, proved to be in good condition and available when required, and shall have been approved before work will be permitted to begin.

(b) GROUND PREPARATION.

Ground preparation shall consist of cultivation to loose depth of approximately 4 inches {100 mm} (minimum) except on slopes steeper than 1 to 2.5, where the depth shall be at least 2 inches {50 mm}. The plowing, harrowing, cultivating, and all other operations shall be performed with proper equipment and in such a manner as to break up all clods, lumps, or earth balls, and remove all boulders, stumps, large roots, or other objects which will interfere with the work. The ground shall be plowed to the required depth then cultivated with a rotary tiller and/or disk harrow, in both directions if feasible, until the result is a smooth, uniform, loose, well broken, and fine grained soil; thus providing a suitable bed for seed, grass, or other vegetative material. In small or inaccessible areas use of hand tools will be permitted. The Contractor shall add sufficient water to provide sufficient soil moisture to prepare the ground.

On certain slopes the Engineer may, upon written permission of the Central Office allow the procedure outlined under Subitem 652.03(a)3c in lieu of ground preparation.

(c) APPLYING FERTILIZER.

When deemed appropriate by the Engineer, the Department may perform a soil analysis to determine pH/lime requirements. Lime shall be applied in the quantities called for in the soil test report.

Fertilizers shall be applied uniformly into the areas to be planted or improved in such amount and to such depth and according to the methods indicated in the Specifications for the various ground covers. The fertilizer shall be well pulverized and free of lumps when applied. In no case shall fertilizer not mixed with soil be permitted in direct contact with roots. When fertilizers are applied hydraulically they must be diluted sufficiently so that no damage is done to either seed or established vegetation.

Agricultural limestone and/or basic slag shall be applied separately but may be incorporated into the soil with fertilizers in one operation.

Fertilizer and agricultural limestone and/or basic slag shall be uniformly mixed into the required depth of preparation by suitable harrows, rotary tillers, or other suitable equipment before any more work is done in the area.

On rocky slopes, any required limestone or basic slag shall be applied as outlined in Subitem 652.03(a)3c.

651.04 Method of Measurement.

(a) GROUND PREPARATION.

No measurement or direct payment will be made for ground preparation unless a specific pay item is set up in the contract. In such case it shall be measured in acres {hectares} parallel to the surface.

(b) FERTILIZERS.

Fertilizers incorporated in or on the soil as directed and accepted will be measured in tons {metric tons} when there is a specific pay item in the contract for fertilizer; and then only for the extra quantity specified and applied as directed over and above the rate of application specified in the respective ground cover sections.

651.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. When separate payment is provided for ground preparation measured as provided above, it will be paid for at the contract unit price per acre {hectare} for ground preparation, which shall be payment in full for all equipment, tools, labor and incidentals necessary to complete the work.

2. The quantity of fertilizer measured as provided above, will be paid for at the contract unit price per ton {metric ton} complete in place which shall be payment in full for furnishing and incorporating fertilizer, and for all equipment, tools, labor, and incidentals necessary to complete the work.

Payment for the amount of fertilizer applied at the specific rate provided in the various ground cover sections of these specifications shall be included in the contract unit price of the appropriate ground cover pay items.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

651-A Ground Preparation - per acre {hectare}
651-B Agricultural Limestone - per ton {metric ton}
651-C _____ Commercial Fertilizer - per ton {metric ton}
651-D Basic Slag - per ton {metric ton}
651-E Super Phosphate - per ton {metric ton}
651-F Ammonium Nitrate - per ton {metric ton}
651-G Ammonium Sulphate - per ton {metric ton}
651-H Sodium Nitrate - per ton {metric ton}
651-I Potassium Chloride - per ton {metric ton}

SECTION 652
SEEDING

652.01 Description.

(a) GENERAL.

This Section shall cover the work of furnishing, planting and establishing an acceptable stand of grass or other vegetative cover from seeds of the specified species designated for use, for protection of the project.

Basic work shall consist of ground preparation in accordance with the provisions of Section 651; temporary (first stage) seeding if required due to seasonal planting limitations on permanent species; the furnishing and incorporation of fertilizer in the amounts specified in Subarticle 652.03(a) and (d); the furnishing, inoculation, and planting of seeds during the designated planting season, and the covering, compacting and maintaining of the seeded areas.

Work necessary to prepare the soil, rapidly establish a stand of vegetation, and maintain required seedlings in a satisfactory manner shall be classified as a part of the seeding items. Work required to facilitate and maximize soil preparation, plant establishment and on-going vegetative maintenance shall be the Contractor's responsibility. Water shall be applied to seeded areas in quantities and at intervals as necessary to maintain adequate growing conditions for the establishment of a healthy, uniform stand and cover of the required vegetation. Water may be applied by the use of hose and attached sprinklers, soaker hose, water truck with irrigation attachments, or other watering equipment that will apply water at such rate and manner as to avoid damage to finished surfaces. The amount of water and when it shall be applied shall be the Contractor's responsibility until acceptance of the project.

Mowing, if required, will be paid for as a separate pay item. Mulch, if required, will be applied and paid for separately under Section 656. Topsoil, if required, will be applied and paid for separately under Section 650.

(b) PLANTING ZONES.

For the purpose of specifying seeding and sowing dates considered appropriate to locations in Alabama, the State has been divided into three planting zones: Zone 1 is the northern section, Zone 2 is the central section, and Zone 3 is the southern section of the State. Acceptable mixes are provided in the mixed seeding tables of Article 860.01.

The planting zones consist of the following counties:

ZONE 1		ZONE 2		ZONE 3	
Blount	Lauderdale	Autauga	Marengo	Baldwin	Monroe
Calhoun	Lawrence	Bibb	Montgomery	Barbour	Pike
Cherokee	Limestone	Bullock	Perry	Butler	Washington
Clay	Madison	Chambers	Pickens	Clarke	
Cleburne	Marion	Chilton	Russell	Coffee	
Colbert	Marshall	Choctaw	Sumter	Conecuh	
Cullman	Morgan	Coosa	Tallapoosa	Covington	
Dekalb	Randolph	Dallas	Tuscaloosa	Crenshaw	
Etowah	Shelby	Elmore	Wilcox	Dale	
Fayette	St. Clair	Greene		Escambia	
Franklin	Talladega	Hale		Geneva	
Jackson	Walker	Lee		Henry	
Jefferson	Winston	Lowndes		Houston	
Lamar		Macon		Mobile	

652.02 Materials.

All materials furnished for use shall comply with the requirements of Division 800, Materials, with specific reference made to Section 860.

652.03 Construction Requirements.

(a) GENERAL.

Seeding operations shall be performed as provided in these Specifications or as shown on the plans so that seeds of the various plant species included in the seed mixture designated for use are sown during the proper planting dates specified for the species involved. In order to establish an acceptable stand of the designated species, it may be necessary to accomplish temporary (first stage) seeding as noted in Subarticle 652.03(d).

When during any part of the specified sowing season, weather or ground conditions are such that satisfactory results are not likely to be obtained, the Engineer will not permit the work to proceed.

1. INSPECTION.

a. The Contractor shall notify the Engineer at least twenty-four hours in advance of the time he intends to start inoculating and mixing seed or begin sowing seed and shall not proceed with such work until so approved by the Engineer.

b. All ground preparation, incorporation of required fertilizer and lime, inoculation of seed, seed mixing, and other work preparatory to planting as well as the operation of sowing, covering, and rolling shall be done in accordance with plans and specifications and as approved by the Engineer and in the presence of the Inspector.

2. CONDITIONING OF THE AREA TO BE SEEDED.

Before sowing any seed upon any area, all shaping, fine grading, raking, and dressing shall have been completed unless otherwise approved by the Engineer.

3. GROUND PREPARATION AND FERTILIZER.

a. Ground Preparation.

Except where the seeds are to be sown in a previously developed stubble, all areas to be seeded shall receive standard ground preparation as provided in Subarticle 651.03(b).

b. Fertilizer Requirements.

Fertilizer shall be applied as specified in Subarticle 651.03(c) and evenly mixed to the depth of preparation immediately after application. Fertilizer shall be applied mechanically in dry form or, if so authorized in writing by the Engineer, applied in solution by approved hydraulic equipment. Fertilizer shall be uniformly mixed to the required depth of preparation by suitable harrows, rotary tillers, or other equipment satisfactory to the Engineer before any planting or other work is done on the area. The seed bed for all seedings shall be fertilized initially with 1500 pounds {1680 kg} of grade 8-8-8 fertilizer per acre {hectare} or a sufficient quantity of any other grade or grades of commercial fertilizer that will provide at least 120 pounds {135 kg} of nitrogen, 120 pounds {135 kg} of P_2O_5 and 120 pounds {135 kg} of K_2O per acre {hectare}, as computed from the nominal contents of fertilizer elements. When quantities required vary as a result of soil tests from those shown herein, any increase will be paid for at the unit prices of Items 651-B through 651-I. For any decrease below quantities shown herein, deduction will be made at the unit prices of Items 651-B through 651-I. After the required plant species have emerged and shown normal growth (usually approximately 40 days) and while the soil surface is moist, a second application of fertilizer shall be made as a top dressing of sodium nitrate, ammonium sulfate, ammonium nitrate, or other approved nitrogen fertilizer uniformly applied at a rate to provide at least 67 pounds {75 kg} of nitrogen per acre {hectare}; for example, approximately 200 pounds {224 kg} of 33.5% ammonium nitrate per acre {hectare}.

c. Fertilizing Rocky Slopes.

(1) If slopes to be seeded are determined by the Engineer to be too rocky for performing standard ground preparation but sufficiently soft or shaly to permit some form of treatment, the following method shall be used:

Apply one-half the required limestone or basic slag (determined by soil test) and fertilizer to the raw slope, and scarify as approved by the Engineer.

Cover the slope with approximately 4 inches {100 mm} of topsoil. Apply the remaining one-half of the required limestone or basic slag and fertilizer.

Mix the fertilizer with the layer of topsoil.

Proceed with seeding.

(2) If approved in writing by the Engineer, the following procedure may be used on slopes steeper than 1:2:

One-half the required limestone and one-half the required fertilizer shall be applied hydraulically and in separate operations.

The specified seed mixes shall then be applied as per specification requirements for hydroseeding.

Mulching materials shall be applied in accordance with the provisions of Section 656.

After approximately forty (40) days, the remaining specified limestone and fertilizer shall be hydraulically applied in separate operations on the slope area.

Four (4) weeks from the application date of the second fertilization, an approved high nitrogen fertilizer that provides 67 pounds {75 kg} of nitrogen per acre {hectare} shall be applied, but not by hydraulic methods.

Subsequent applications of fertilizers shall be applied at intervals of approximately six (6) months each, as directed by the Engineer. These applications shall consist of 500 pounds {560 kg} of 8-8-8 per acre {hectare} or equivalent which may be applied by approved mechanical or hydraulic methods.

(b) INOCULATION OF LEGUME SEEDS.

Preparatory to sowing, the legume seed approved for use shall be inoculated as provided herein. Each species of seed shall be inoculated separately with the appropriate amount and kind of commercial culture according to instructions of the manufacturer of the material approved for use, then allowed to surface dry to a free flowing state before mixing or sowing. In general, no greater

quantity of seed shall be inoculated at one time than can be sown by the end of the following work day. All inoculated seed shall be protected from the sun and direct contact with commercial fertilizers.

(c) MIXING SEED.

Following inoculation, seed of approximately the same size may be mixed together. Just prior to planting, all seed to be sown together shall be mixed by approved means until uniform in proportion and consistency.

(d) SOWING.

1. GENERAL.

Sowing of seed uniformly over the area at the rates specified for each species shall, in general, follow promptly after incorporation of fertilizer.

Sowing shall be accomplished by one of the methods noted herein as approved by the Engineer.

2. STANDARD METHOD.

This method is designed for use on cleared areas where no existing growth is retained and consists of sowing and covering of the seeds.

Sowing shall be done by approved mechanical seeders. Hand operated cyclone sowers, in sufficient number, will be considered mechanical seeders. No sowing shall be done during windy weather, when the prepared surface is crusted, or when the ground is frozen, wet or otherwise in a non-tillable condition.

Care shall be exercised during covering operations to preserve the line, grade and cross-section of the seeded areas so that areas adjacent to pavement, walks, etc., are not left higher than the paved surface. Unless otherwise approved, after the seed has been sown the seed bed shall be compacted immediately by means of a cultipacker, light roller or approved drag. The weight {mass} of the roller or drag needed will be determined by the Engineer according to the type and physical condition of the soil involved. Rolling or covering of seed may be omitted when seeding is done hydraulically and mulched.

When called for in Tables 1 and 2 of Subarticle 860.01(b) or directed by the Engineer for certain grassing seasons, a stand of temporary grass/vegetation shall be required. Ground preparation for Temporary (First Stage) grassing shall be the same as for permanent grassing (seeding) Item 652.03(a)3. All Temporary (First Stage) grassing shall be mulched in accordance with Section 656.

In the appropriate season for permanent grassing, when weather, soil conditions, and soil temperatures are within limits of accepted agronomic practice for the intended species, the area to be re-planted in permanent grassing shall be prepared in accordance with the seeding in stubble method of Item 652.03(d)3. The area shall be vegetated with the permanent species as provided in the appropriate table of Subarticle 860.01(b).

Separate payment will be made for Temporary (First Stage) grassing planted under this specification as Pay Item 652-B.

3. SEEDING IN STUBBLE METHOD.

This method is designed for use in rejuvenating existing ground cover areas whereby the stubble of the existing turf is to be retained. This method requires that the existing vegetation be mowed to a height of approximately 3 inches {75 mm} or sprayed with an approved herbicide, or both, to retard further growth of the existing vegetation. The area shall then be lightly scarified by disking or other approved method to prepare a suitable seedbed for this method of seeding.

This procedure requires that any required fertilizer shall be spread as previously provided and if spread mechanically, worked into the soil by rotary hoe, spiking or other methods that will not uproot the existing plant cover. After sowing the seed in the same manner noted in Item 2 above, they shall be covered by a second spiking followed by rolling or an approved sod seeder may be used as a one-step planter. Hoeing, spiking, and rolling may be omitted where seed is spread by hydraulic equipment, provided existing growth is approximately 3 inches {75 mm} to 6 inches {150 mm} in height.

(e) MULCHING.

Where mulching, Pay Item 656-A, is provided in the contract, the areas which are designated to be mulched shall be covered within 48 hours after the area has been seeded. Such mulching will be measured and paid for separately under Section 656.

(f) CARE DURING CONSTRUCTION/ESTABLISHMENT.

All work shall be pursued in accordance with contract erosion control requirements.

The Contractor shall provide plant establishment of the required species of permanent vegetation prior to final acceptance of the project. Plant establishment shall consist of preserving, protecting, watering, reseeding, or replanting and other such work and at such time as may be necessary to keep the grassed areas in a satisfactory condition. The Contractor shall mow all seeded areas of medians, shoulders and front slopes as directed by the Engineer. In addition, the Contractor shall mow as necessary to prevent tall grass from obstructing signs, delineation, traffic movements, sight distance, or otherwise becoming a hazard to motorists. Such mowing shall be performed in a manner that will not cause unnecessary damage to desirable vegetation. No mowing of lespedezas or tall fescue shall be made until after these plants have produced mature seed.

It shall be the Contractor's responsibility to provide satisfactory growth and coverage of the specified species. Growth and coverage on areas seeded as specified shall be considered to be in reasonably close conformity with the intent of the contract when the vegetation, exclusive of that from seed not expected to have germinated and shown growth at that time, has reached a point of maturity such that each area shows satisfactory visible growth with no bare spots larger than 5 square inches {3225 mm^2}. Bare spots shall be scattered and the total bare areas shall not comprise more than 1/100 of any given area.

When the time element is such that final acceptance could be made for all other items of the work except for newly planted repaired areas, or other areas with insufficient grass, the Contractor, if he so elects, may complete final filling of the eroded areas, or treat bare areas with an application of grassy mulch of the species designated, obtained, placed and handled in accordance with Section 657. With this treatment, care shall be taken on shoulders, front slopes, medians and other critical areas to maintain the line and grade established for the areas. Grassy mulch used for the purpose described above will not be paid for as such, but after acceptance will be considered as an acceptable substitute for the satisfactory growth and coverage required under this specification.

The Contractor shall water, fill washes, and otherwise protect and maintain the seeded areas including any mulch or cover used until the contract is accepted or grassing bond is released.

All of the above work shall be performed without additional compensation, unless otherwise specified.

(g) BASIS OF ACCEPTANCE.

The acceptance of designated seeded areas will be based upon verification of a satisfactory stand of vegetative cover in the season for each species required for establishment. If a satisfactory stand of desired vegetation is not established, the area shall be re-seeded after appropriate soil preparation and re-established without additional cost to the Department.

A satisfactory stand is defined as a cover of living plants, after true leaves are formed, of the required seed species designated for use in which gaps larger than 5 square inches {3225 mm^2} do not occur.

652.04 Method of Measurement.

(a) SEEDING.

1. The completed and accepted seeding will be measured in acres {hectares} parallel to the seeded surface.
2. Extra seed, ordered in writing, in addition to the types and rates provided by the specifications, shall be measured in pounds {kilograms} of the ordered seed actually placed.

(b) MOWING.

Mowing, where provided separately in the contract and required, will be measured in acres {hectares} parallel to the mowed surface. Each separate mowing of the same location will be measured separately.

(c) SUPPLEMENTARY ITEMS.

1. No measurement for payment will be made for fertilizers used as provided by Item 652.03(a)3.
2. Topsoil, where required, will be measured and paid for as provided in Section 650.
3. Water used in mixing, applying, and maintaining seed and/or mulch will not be measured or paid for as a separate pay item.
4. Mulching, where provided separately in the contract and required, will be measured as provided in Section 656.

(e) SEEDING IN STUBBLE.

The completed and accepted seeding in stubble will be measured in acres {hectares} parallel to the seeded surface.

652.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Completed and accepted seeding will be paid for at the contract unit price per acre {hectare} for Seeding (of the kind or mix provided) which price shall be full compensation for all ground preparation, furnishing, preparing, and applying all fertilizers, seeds and inoculants, including water needed in mixing, planting, establishing, and maintaining of the seeded areas until final acceptance, and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

Completed and accepted temporary (first stage) seeding will be paid for at the contract unit price per acre {hectare} for Temporary Seeding of the mix required which price shall be full compensation for all ground preparation, furnishing, preparing, and applying all fertilizers, seeds and inoculants, including water needed in mixing, planting, establishing, and maintaining of the seeded areas until re-planted with the designated permanent species, and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

Mowing directed by the Engineer, completed and accepted, will be paid for at the contract unit price bid per acre {hectare} which shall be payment in full for the mowing including equipment, labor, and incidentals necessary to complete this item of work.

(b) EXTRA SEED.

Extra seed, ordered in writing, sown on any designated area of seeding measured as provided in Subarticle 652.04(a), will be paid for at the verified invoice cost of the seed plus 15 percent. Verified cost shall be the lowest price submitted from at least two (2) wholesale dealers or distributors of seed, satisfactory to the Engineer.

(c) SUPPLEMENTARY ITEMS.

Topsoil, mulching and fertilizer used in addition to the amount provided herein will be paid for under their respective Sections.

(d) SEEDING IN STUBBLE.

Completed and accepted seeding in stubble will be paid for at the contract unit price per acre {hectare} for Seeding In Stubble of the mix required which price shall be full compensation for all mowing, providing and applying herbicide, ground preparation, furnishing and preparing all fertilizers and seeds, including water needed in mixing, planting, establishing, and maintaining of the seeded in stubble areas, and for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

(e) ADJUSTMENT IN FERTILIZER RATES.

Payment or deduction for additional or reduced amounts of fertilizer shall be made as provided in Subitem 652.03(a)3b.

(f) PAYMENT WILL BE MADE UNDER ITEM NO.:

652-A Seeding (Mix ___*___) - per acre {hectare}
652-B Temporary Seeding (Mix ___**___) - per acre {hectare}
652-C Mowing - per acre {hectare}
652-D Seeding In Stubble (Mix ___*___) - per acre {hectare}

* Specify mix number.
** Specify temporary mix number if applicable.

SECTION 653
SPRIGGING

653.01 Description.

This Section shall cover the work of furnishing and planting approved live grass sprigs or plugs and the establishment of an acceptable growth from such planting on slopes and areas of the project as may be designated by the plans or directed.

Basic work consists of ground preparation in accordance with provisions of Section 651; the furnishing and incorporation of fertilizers in the amount noted in this Section; the furnishing, planting,

covering, compaction, and watering as necessary to establish and maintain the sprigs in a live and growing condition throughout the life of the contract. The amount of water and when it is to be applied shall be the responsibility of the Contractor until acceptance of the project.

653.02 Materials.

All materials shall conform to requirements of Division 800, Materials, with particular attention directed to Section 860.

Sprigs shall comply with requirements of Article 860.02. They may be from local harvest or imported. Sprigs hauled such distance that they cannot be planted the same day harvested will be classified as imported. Except as provided in this Section, imported sprigs shall be iced or watered during transit and planted not later than two (2) days after digging.

653.03 Construction Requirements.

(a) GENERAL.

1. PREPARATION OF SPRIGGING SITE.

Whenever any section of the road is deemed to be substantially complete, the Contractor, even to the exclusion of all other operations, shall, on that section, promptly fill major washes, dress all earthwork in accordance with plans, place loamy topsoil as required, accomplish ground preparation as provided by Article 651.03 and plant the sprigs along embankment slopes, on front slopes, shoulders, and other areas as directed, together with solid sodding and other ditch and slope protection provided in the contract. In connection with ground preparation, agricultural limestone or basic slag at a rate of 4000 pounds per acre {4480 kg per hectare} and commercial fertilizer 8-8-8 at a rate of 1500 pounds per acre {1680 kg per hectare}, shall be broadcast separately and mixed into the ground to the depths specified in Article 651.03. In lieu of 8-8-8 fertilizer, any other acceptable grades of commercial fertilizer will be accepted that will provide at least 120 pounds {135 kg} of nitrogen, 120 pounds {135 kg} of available phosphoric acid and 120 pounds {135 kg} of total potash per acre {hectare} as computed from the nominal content of fertilizer ingredients.

2. FURROWS.

Following completion of ground preparation and fertilizing, furrows shall be plowed on lines parallel to the roadway and spaced 12 inches {300 mm} apart unless otherwise indicated on the plans. The furrow may be made with a small straight shovel, opener plow, turning plow, or other appropriate tool, but must be not less than 2 inches {50 mm} deep and reasonably true to line.

3. PLANTING OF SPRIGS.

a. General.

Unless otherwise provided by the plans and/or proposal, sprigs shall be placed in continuous lines in the furrows (equivalent of a minimum of 200 square feet per acre {415 m^2 per hectare}). Care shall be exercised to place the roots downward. The sprigs shall be set promptly after being taken from the bags. If the soil is not moist when the sprigs are being set, additional watering in the open furrows may be required. Immediately after being placed in the furrows, the sprigs shall be covered with 1 to 2 inches {25 to 50 mm} of pulverized soil. Clods or hard particles shall not be placed over the sprigs.

Grass plugs may be used in lieu of sprigs, size of plug shall not be less than 2 inches x 2 inches {50 mm x 50 mm} planted 10 to 12 inches {250 to 300 mm} on center (the equivalent of a minimum of 200 square yards per acre {415 m^2 per hectare}) otherwise the same requirements for planting sprigs shall apply.

Sprigs and grass plugs may also be planted and covered by planting machines of an approved type. On steep slopes of embankments and inaccessible areas, they may be planted by means of hand tools.

In all cases, the earthwork and shoulders shall be restored to the required shape and surface condition after planting has been completed.

b. Broadcast Planting.

When permission is granted in writing by the Construction Bureau, broadcasting of sprigs or stolons may be performed if immediately covered by disc harrowing or coulters (straight disc planter) followed by rolling or cultipacking. Machinery and method for this operation must be approved. This method requires a minimum of the equivalent of 200 square yards {415 m^2} of sod per acre {hectare}. The sprigs must be covered to a minimum depth of 1/2 of an inch {13 mm} for

centipede, hybrid bermuda and zoysia species with 2 inches {25 mm} required for common bermudagrass.

4. COMPACTION.

After planting of the sprigs has been completed, the entire areas shall then be compacted to the satisfaction of the Engineer. Rollers, cultipackers, or other approved equipment may be used for this purpose. The rolling shall be continued until all clods are broken and until the dirt is recompacted so as to prevent washing the grass out during normal rains.

5. WATERING.

After compaction of the sprigged areas has been accomplished, the areas shall be watered by the use of spray or sprinkler which will apply the water without erosive force and in sufficient quantity to saturate the area.

(b) SEASON FOR SPRIGGING.

No seasonal limitation shall be applicable to the planting of sprigs. It shall be the Contractor's responsibility to control his operations so that the planting will be accomplished during the most favorable time of the year. In any event, the Contractor shall be solely responsible for obtaining a satisfactory stand of grass.

(c) CARE DURING CONSTRUCTION.

1. GENERAL.

The Contractor shall water, fill washes, and otherwise care for all sprigged areas in a satisfactory condition until final acceptance of the entire contract. The Contractor shall be responsible for establishment and maintenance of a satisfactory stand of grass from the normal growing cycle after planting until final acceptance. This care shall be performed without additional compensation.

Mowing, if ordered by the Engineer, will be measured and paid for as provided in Section 652.

2. WATERING.

Watering of the sprigged areas, shall be applied in the form of a spray or sprinkle, without erosive force in sufficient amounts that will keep the sprigs in a living and growing condition.

3. DAMAGED AREAS.

Any sprigged areas that are damaged shall be resprigged by the Contractor without additional compensation.

4. ADDITIONAL FERTILIZER.

After the sprigs have developed a green growth above the ground surface, the Contractor, without additional compensation, shall broadcast a surface application of nitrate of soda, ammonium nitrate, or other approved high nitrogen fertilizer at a rate sufficient to provide at least 67 pounds {75 kg} of nitrogen per acre {hectare} (for example – 200 pounds {225 kg} of 33.5 percent ammonium nitrate applied per acre {hectare} will provide the 67 pounds {75 kg} of nitrogen per acre {hectare}.)

(d) SUBSTITUTION OF SEEDING.

After the Contractor has exerted all reasonable effort to obtain satisfactory sprig growth, or during extreme weather periods, the Department may consider the substitution of seeding as specified in Section 652 or 658 for certain portions of the project as may be deemed necessary; however, such must be requested and approved in writing, but in no event will consideration be given to the substitution of other than seed of a mix compatible with the type of grass required by the plans or proposal. Unless the contract provides a quantity of Item No. 652-A, the price-limited Item No. 652-B shall govern. If there are no contract unit prices for either Item No. 652-A or 652-B, the Engineer may, without supplemental agreement, effect the required substitution by use of a suitable mix of Item 652-B at a fixed unit price of $375.00 per acre {$927.00 per hectare}. It will be expected that the Contractor submit a balanced bid contingent upon the substitution of such seeding for all or part of the item of sprigging. No price adjustments for such substitution as ordered will be considered.

In areas where it is considered desirable to protect completed sprigging or seeding against early erosion or other damage, such sprigging or seeding may be supplemented by sowing seeds as ordered, over the previous planting. Such seeding or overseeding, when ordered in writing, will be paid for as provided in Subarticle 653.05(b).

(e) BASIS OF ACCEPTANCE.

The acceptance of areas designated to be sprigged will be based on the Engineer's determination that the proper ground preparation, planting, etc. has been accomplished and the establishment of a satisfactory stand of grass has been established. If a satisfactory stand of grass is not established, the area shall be resprigged without additional cost.

A satisfactory stand of grass is defined as a living and growing grass of not less than nine live and health plants per square yard {square meter}, uniformly spaced above the ground surface. This may be deemed to include grass that is dormant during a cold or dry season but has roots which have taken hold in the soil and show sprouts that are capable of growing after the unfavorable period has passed.

653.04 Method of Measurement.

(a) SPRIGGING.

The completed and accepted sprigging will be computed in square yards {square meters} from measurements made parallel to the planted surface.

(b) SUPPLEMENTARY ITEMS.

No measurement or payment will be made for fertilizer used as provided by Subarticle 653.03(a) and Subarticle 653.03(c). Payment or deduction for additional or reduced amounts of fertilizer shall be made as provided in Subitem 652.03(a)3b.

653.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Completed and accepted sprigging measured as provided above will be paid for at the contract unit price bid per square yard {square meter} for sprigging, which price shall be full compensation for all ground preparation, fertilizing as provided in Item 653.03(a)1, furnishing and preparing all fertilizers, sprigs, planting, replanting, and maintaining of the sprigged areas until final acceptance and for all materials, equipment, tools, and labor necessary to complete the work. Payment or deduction for additional or reduced amount of fertilizer shall be made as provided in Subitem 652.03(a)3b.

(b) SUPPLEMENTARY ITEMS.

Topsoil, mulching, seeding, and fertilizer or seeds used in addition to the amount provided herein will be paid for under their respective sections.

Overseeding as specified in Subarticle 653.03(d) when ordered in writing will be paid for as specified in Subarticle 652.05(b), which shall be full compensation for furnishing seed and overseeding as directed.

(c) PAYMENT WILL BE MADE UNDER ITEM NO.:

653-A Sprigging - per square yard {square meter}

SECTION 654
SOLID SODDING

654.01 Description.

This Section shall cover the work of furnishing, planting or otherwise re-establishing solid grass sodding in various locations throughout the construction limits of the work. This Section shall also cover the work of salvaging and replanting of solid sodding.

Basic work consists of furnishing sod, or in the case of salvaging sod, the salvaging thereof, ground preparation under the provisions of Section 651, the furnishing and application of fertilizer at the rates noted in this Section, the furnishing and applying of all water necessary to establish and maintain the sod and the maintenance of the established sod throughout the life of the contract. The amount of water required and when it is to be applied shall be the Contractor's responsibility.

654.02 Materials.

All materials shall conform to the appropriate requirements of Division 800, Materials. Specific reference is made to Section 860.

654.03 Construction Requirements.

(a) PREPARATION OF PLANTING SITE.

Areas which are to be planted with sod shall have all shaping and dressing performed prior to commencing planting operations.

The surface of the area designated for sodding shall receive ground preparation, as described in Section 651. The Engineer may authorize elimination of ground preparation on shoulders and fill slopes, or other areas where the soil is sufficiently loose or pulverized. Fertilizer must be incorporated into planting areas by approved means to a depth of at least 2 inches {50 mm}. If the soil is not moist, it shall be watered until it is in a workable condition.

Areas to be sodded shall be fertilized initially with 2 tons {4480 kg} of agricultural limestone or basic slag and 1500 pounds {1680 kg} of grade 8-8-8 fertilizer per acre {hectare}; or in lieu of grade 8-8-8 or a sufficient quantity of any other approved grade or grades of commercial fertilizer that will provide at least 120 pounds {135 kg} of nitrogen, 120 pounds {135 kg} of available phosphoric acid and 120 pounds {135 kg} of total potash per acre {hectare} as computed from the nominal content of fertilizing ingredients. Variations in quantity of fertilizer from those shown above or on the plans shall be adjusted as specified in Item 652.03(a)3b. Following this, the sod shall be placed immediately.

(b) PLANTING SOD.

1. PLACING.

The sod shall be placed on the prepared surface with the edges in close contact, cracks between blocks of sod shall be closed with small pieces of sod, and acceptable loamy top soil shall be used to fill joints. The entire sodded area shall then be tamped in place in a satisfactory manner and watered as necessary.

2. CLASS "A" EROSION CONTROL NETTING.

On slopes of approximately 1:2 or steeper when directed, Class "A" Erosion Control Netting may be used to anchor the sod. The Class "A" Erosion Control Netting used as directed shall be paid for as specified in Section 659.

(c) SALVAGE AND REPLANTING SOLID SOD.

At the locations shown on the plans or designated, the existing solid sod shall be salvaged, stored, and replaced after the area has been regraded.

Salvaging and handling of the sod shall be performed as specified in Article 860.05, except that the time limit for replanting will not apply. However, preparation of the area for replanting shall be excavated to avoid delay. Any sod rendered unsuitable for reuse due to the Contractor's negligence in storing, watering, or promptly preparing sites for replanting shall be replaced in kind by the Contractor without additional compensation.

The Contractor may at his option elect to furnish sod of the identical species from another site, in lieu of salvaging, etc. of existing sod.

Preparation of replanting sites, fertilizing, and replanting shall be the same as specified in Subarticles 654.03(a) and (b),

(d) CARE DURING CONSTRUCTION.

1. GENERAL.

The Contractor shall preserve, protect, water, apply additional fertilizer, and such other work as may be necessary to keep the work in a satisfactory condition. The Contractor shall be responsible for satisfactory growth of the grass until the time of final acceptance.

2. WATERING.

Watering of the sodded areas, shall be applied in the form of a spray or sprinkle, without erosive force in sufficient amounts that will keep the sod in a living and growing condition.

3. DAMAGED AREAS.

Any sodded areas that are damaged shall be resodded by the Contractor without additional compensation.

4. ADDITIONAL FERTILIZER.

After the sod has shown growth (usually approximately 40 days) and while the soil surface is moist, a second application of fertilizer shall be made as a top dressing of nitrate of soda, sulfate of ammonia, ammonium nitrate, or other approved high nitrogen analysis fertilizer used at a rate to provide at least 67 pounds {75 kg} of nitrogen per acre {hectare} (for example, 200 pounds {225

kg} of 33.5 percent ammonium nitrate applied per acre {hectare} will provide 67 pounds {75 kg} of nitrogen per acre {hectare}).

(e) BASIS OF ACCEPTANCE.

Acceptance of sodded areas will be based on verification of the establishment of a well knitted, living, growing sod covering the areas designated to be sodded. If an acceptable stand of living and growing sod is not obtained, the area shall be resodded without additional cost.

A "living and growing sod" shall be interpreted to include sod that is seasonally dormant during the cold or dry season with roots that have taken hold on the sod and capable of growing off after the dormant period.

654.04 Method of Measurement.

The completed and accepted sodding placed or salvaged and replaced, as shown on the plans or as directed, will be computed in square yards {square meters} from measurements made parallel to the surface of the actual area sodded.

654.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted amount of Solid Sodding for slopes, ditch checks, outlets and flumes, and other areas will be paid for at the contract unit price for Solid Sodding which price shall be full compensation for furnishing all materials, ground preparation, planting, fertilizing, rolling, watering, top dressing, and maintaining the sod until acceptance of the contract, and for all materials, equipment, tools, and labor necessary to complete the work.

The accepted amount of salvaged and replaced solid sod will be paid for at the contract unit price for the Item of Salvaging and Replacing Solid Sod which shall be payment in full for all work listed above in this Article except for the furnishing of the solid sod.

Payment or deduction for additional or reduced amounts of fertilizer shall be made as provided in Subitem 652.03(a)3b.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

654-A Solid Sodding - per square yard {square meter}
654-B Salvaging & Replacing Solid Sod - per square yard {square meter}

SECTION 656
MULCHING

656.01 Description.

This Section shall cover the work of furnishing and placement of mulching materials (covering with hay or other suitable material) on areas indicated on the plans or directed, in accordance with these Specifications.

Mulch placed under this Section shall consist of two types: Class A, Type 1 shall be mulch not requiring an adhesive, consisting of hay or straw placed on 1:3 or flatter slopes by using a krimper, wood fiber or excelsior; Class A, Type 2 shall be hay or straw mulch that does require an adhesive.

Water necessary to satisfactorily prepare, establish and maintain mulching placed under this Section shall be classified as a part of the mulching item involved. The amount of water and when it shall be applied shall be the Contractor's responsibility until acceptance of the project.

656.02 Materials.

Materials used in this work shall conform to the requirements of Division 800, Materials. Specific reference is made to Section 860.

656.03 Construction Requirements.

(a) GENERAL.

Mulching material shall be applied in accordance with the rate specified in Article 860.03 for the particular type mulch being used.

(b) EQUIPMENT.

Straw and hay mulch shall be applied with a mechanical mulch spreader designed to break up balls or clusters of mulch and apply it evenly over the surface so as to provide adequate shading from

direct sunlight. If an adhesive is used on the mulch, the mulch spreader shall be equipped and so designed to apply effectively the adhesive to the mulch and form a uniform, porous and stable mulch blanket held in place by the adhesive over the designated area.

On slopes 1:3 or flatter, a mulch krimper shall be used instead of the adhesive. The krimper shall be a roller-type device equipped with flat, uncupped, dull edged disks. The disks shall have a minimum width of 1/4 of an inch {6 mm} and shall be placed a maximum of 2 inches {200 mm} apart along the axle or shaft. The krimper shall be specially designed so that by adding weight {mass} or using hydraulic force from the tractor the mulch will be imbedded a minimum of 2 inches {50 mm} into the ground, prepared as specified in Article 651.03. The diameter of the disks shall be large enough to prevent the axle or shaft from dragging or in any way disturbing the mulch or soil.

Under no circumstances shall a disc harrow be used to perform this krimping operation.

Wood fiber mulch will not require an adhesive but shall be applied only by satisfactory hydraulic equipment.

Excelsior (wood) will not require an adhesive, however, it must be applied evenly with mechanical mulch spreaders or other approved equipment.

(c) MULCHING OPERATIONS.

Immediately after the area to be mulched has received ground preparation and the specified plantings, the mulch shall be applied at the rates specified for the type mulch used. Hay or straw mulch material which contains an excessive quantity of matured seeds or noxious weeds or a species which would constitute a menace to the planted species and to surrounding farm land, will not be acceptable. Mulch which is too fresh, or excessively brittle, or so decomposed as to retard growth of grass will not be acceptable.

Mulch shall not be applied during periods of high winds or other unfavorable conditions. Care shall be exercised to protect the public, adjacent property, bridges, curbs, sidewalks, and the like from discoloration especially by an asphalt adhesive. The Contractor shall be responsible for any such damage to public or private property. Any damage or discoloration to bridges or other parts of the roadway shall be repaired without delay at the Contractor' expense.

During krimping operations, care shall be taken to follow as closely as possible to the contours of the mulched ground's surface.

(d) CARE DURING CONSTRUCTION.

This shall consist of caring for the mulch in a satisfactory condition without additional compensation until acceptance of the project and shall include replacement of any portions damaged by erosion, fire, wind or other causes.

656.04 Method of Measurement.

The completed and accepted area of mulch, applied as directed will be measured in acres {hectares}, computed from surface measurements of the area ordered treated.

656.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted mulched area measured as provided above will be paid for at the contract unit price for mulching which shall be payment in full for furnishing of all the materials, handling, placing, and for all equipment, labor, tools, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

656-A Mulching, Class A, Type ____ - per acre {hectare}

SECTION 657
GRASSY MULCH

657.01 Description.

This Section shall cover the work of furnishing grassy mulch material and the planting and establishment of an acceptable stand of grass from the grassy mulch planting.

Basic work consists of site clearing and moistening, mangling, excavating, loading, hauling, depositing, spreading, discing in, machining, fertilizing and compacting the grassy mulch material on shoulders, slopes, berms and other designated areas along the roadway, in accordance with the

provisions and requirements of these Specifications and conformity with the lines, grades, and cross-sections indicated on the plans or established.

Water necessary to satisfactorily prepare, establish and maintain the grassy mulch shall be classified as a part of the grassy mulch item involved. The amount of water and when it shall be applied shall be the Contractor's responsibility until acceptance of the project.

657.02 Materials.

All materials shall conform to the appropriate provisions of Division 800, Materials. Specific reference is made to Section 860.

657.03 Construction Requirements.

(a) PREPARATION OF AREA.

Before planting or depositing grassy mulch upon any area, ground preparation as provided by Section 651 shall have been completed on such areas, unless otherwise directed.

Agricultural limestone or basic slag at the rate of 2 tons per acre {4480 kg per hectare} and 8-8-8 commercial fertilizer or the kind of fertilizer provided by the plans and/or proposal at the rate of 1500 pounds per acre {1680 kg per hectare} shall be applied uniformly over the area to the depth of preparation in advance of the placing of the grassy mulch, but shall not be applied more than one day ahead of planting operations. Variations in quantities of fertilizer from those shown herein or on the plans shall be adjusted as specified in Subitem 652.03(a)3b. Fertilizer lost, for any reason, before it is covered with the grassy mulch, shall be replaced by the Contractor without extra compensation.

(b) APPLICATION OR PLANTING.

1. GENERAL.

The areas designated for receiving grassy mulch and the rate of application shall be such that 1 cubic yard {1 m^3} of grassy mulch shall not be spread over more than 12 square yards {10 m^2} of area, unless otherwise shown on the plans or directed. The loads shall be dumped upon the prepared area and spread uniformly to the required thickness. After the application of the grassy mulch to the depth indicated or directed, the material shall be disc-harrowed and cultivated into the subsoil to a depth of at least 3 inches {75 mm} in order to make a proper moisture bond of the grassy mulch and the subsoil. Following this operation, final shaping and smoothing shall be done with a blade grader or a combination of board drags.

In general, grassy mulch will not be placed on excavated slopes steeper than 1:3.

2. COMPACTION.

After the spreading, cultivating, and final shaping has been completed, the entire area shall then be compacted in a satisfactory manner. Rollers, cultipackers, or other approved equipment may be used for this purpose.

3. WATERING.

Grassy mulch areas shall be watered immediately after being placed and as subsequently as necessary to obtain and maintain the desired results.

(c) CARE DURING CONSTRUCTION.

1. GENERAL.

The Contractor shall preserve, protect, water and perform such other work as may be necessary to maintain and keep the work in a satisfactory condition.

Mowing, if ordered by the Engineer, will be measured and paid for as provided in Section 652.

2. WATERING.

Watering of the grassy mulched areas shall be applied in the form of a spray or sprinkle, without erosive force, in sufficient amounts that will keep the grassy mulch in a living and growing condition.

3. DAMAGED AREAS.

Any grassy mulched areas that are damaged shall be reprocessed by the Contractor without additional compensation.

4. ADDITIONAL FERTILIZER.

After the grassy mulch has developed a green growth above the ground surface, the Contractor, without additional compensation, shall broadcast a surface application of nitrate of soda, ammonium nitrate, or other approved high nitrogen fertilizer at a rate sufficient to provide at least 67

pounds {75 kg} of nitrogen per acre {hectare} (for example – 200 pounds {225 kg} of 33.5 percent ammonium nitrate applied per acre {hectare} will provide the 67 pounds {75 kg} of nitrogen per acre {hectare}.)

(d) BASIS OF ACCEPTANCE.

The acceptance of areas treated with grassy mulch will be based on the Engineer's determination that the proper ground preparation, planting, etc. has been accomplished, and a satisfactory stand of grass has been established. If a satisfactory stand of grass is not established, the area shall be replanted without additional compensation.

A satisfactory stand of grass is defined as a living, growing grass of not less than nine live and healthy plants per square yard {square meter}, uniformly spaced above the ground surface. This may be deemed to include grass that is dormant during a cold or dry season, but has roots which have taken hold in the soil and show sprouts that are capable of growing after the unfavorable period has passed.

657.04 Method of Measurement.

Grassy mulch will be measured by the cubic yard {cubic meter} at the point of delivery, loose vehicle measurement.

657.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The volume of grassy mulch, as above measured, will be paid for at the contract unit price per cubic yard {cubic meter} of grassy mulch, which price shall be full payment for furnishing all materials, cleaning, and removing refuse from the source of the grassy mulch, mowing and raking, discing, windrowing, loading, hauling, transporting, ground preparation, fertilizing, placing, spreading, cultivating, shaping and compacting in final position; for maintaining and for furnishing all equipment, tools, labor, and incidentals necessary to complete the work.

Payment or deduction for additional or reduced amount of fertilizer shall be made as provided in Subitem 652.03(a)3b.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

657-A Grassy Mulch - per cubic yard {cubic meter}

SECTION 658
HYDRO-SEEDING AND MULCHING

658.01 Description.

This Section shall cover the work of furnishing, sowing and establishing an acceptable growth of grass from specified seeds on designated project areas by hydraulically sowing of the seeds and mulching of the seeded areas.

Basic work consists of ground preparation in accordance with the provisions of Section 651; furnishing and incorporation of fertilizer in the amount specified in this Section; the furnishing, inoculation, sowing of the seeds during the designated sowing season; the furnishing and application of mulching material; the furnishing and application of water as necessary to establish and maintain the grass during the period of the contract.

The amount of water and when it shall be applied shall be the Contractor's responsibility until acceptance of the project.

658.02 Materials.

Materials furnished for use shall comply with the appropriate requirements of Division 800, Materials. Specific reference is made to Section 860.

658.03 Construction Requirements.

(a) GENERAL.

General requirements of Subarticles 652.03(a), (b) and (c) are applicable to hydro-seeding. Special attention is directed to the requirements for ground preparation and fertilizing both before and after sowing of the seed.

Lime, if required, shall be applied before the hydro-seeding operation.

Fertilizer may be applied either before the hydro-seeding or incorporated in and applied with the water-seed-inoculant mixture.

Wood cellulose or natural wood fiber mulch shall be applied either as a part of the hydro-seeding mixture or as a separate operation following the hydro-seeding.

Straw or hay mulch shall be applied after the hydro-seeding operation.

(b) EQUIPMENT.

Equipment for applying seed by the hydro-seeding method shall be designed for this purpose and be capable of pumping a water-seed-inoculant mixture uniformly over the area to be seeded. Power driven agitators shall be provided to keep the mixture uniform during the application.

When wood cellulose or natural wood fiber mulch is used, the equipment shall be so designed as to satisfactorily handle the material.

For hay or straw mulch, equipment shall be as specified in Subarticle 656.03(b).

(c) PREPARATION OF SEED.

The seed mixture meeting the appropriate requirements of Article 860.01 shall be the seed inoculated, using four (4) times the manufacturer's recommended rate of inoculant culture. The seed shall be placed in culture solution and the mixture shall be mixed by mechanical agitator in the hydraulic seeder.

(d) APPLICATION OF THE SEED.

After completion of ground preparation, including fertilizing, and the seed preparation, the seed mixture shall be applied by approved equipment in such a manner that the seed will be dispersed at the rates specified for each particular specie in the seed mixture used.

(e) APPLICATION OF MULCHING.

Immediately after application of the seed as provided above, the seeded area shall be mulched using one of the approved Class A mulches provided in Article 860.03. The rate of application of the mulch shall be as specified in Article 860.03 for the kind of mulch being used.

(f) CARE DURING CONSTRUCTION.

The Contractor shall water, fill washes, and otherwise protect and maintain the seeded areas until the contract is accepted or the grassing bond is released.

Damage by either pedestrian, vehicular traffic, or other causes shall be repaired by the Contractor. It shall be the responsibility of the Contractor to establish and maintain a satisfactory stand of grass until final acceptance of the project.

Mowing, if ordered by the Engineer, will be measured and paid for as provided in Section 652.

All of the above work shall be done by the Contractor without additional compensation.

(g) BASIS OF ACCEPTANCE.

The acceptance of designated areas to be seeded will be based on verification of a satisfactory stand of grass and legumes in the season for each seed specie required by the mix designated for use, If a satisfactory stand of grass is not established, the area shall be re-seeded without additional compensation.

A satisfactory stand of grass shall be defined as a cover of living grass after true leaves are formed (limited to the species of seed that are expected to germinate in the current season) in which gaps larger than 5 square inches {3225 mm^2} do not occur.

658.04 Method of Measurement.

(a) HYDRO-SEEDING TREATMENT.

1. The completed and accepted hydro-seeded areas will be measured in acres {hectares} parallel to the treated surface.

2. Extra seed, ordered in writing in addition to the types and rates provided by the Specifications, plans, or proposal, shall be measured in pounds {kilograms} of the ordered seed actually placed.

(b) SUPPLEMENTARY ITEMS.

1. No measurement for payment will be made for fertilizers used as provided by Item 652.03(a)3.

2. Topsoil, where provided in the contract and required over barren areas will be measured and paid for as provided in Section 650.

3. Water used in mixing, applying, and maintaining seed and/or mulch will not be measured or paid for as a separate pay item.

658.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Completed and accepted seeding will be paid for at the contract unit price per acre {hectare} for hydro-seeding (of the kind of mix provided) which price shall be full compensation for all fertilizing and ground preparation, furnishing and preparing all fertilizers, seeds and inoculants, including water needed in mixing and sowing, furnishing and preparation of mulching materials, application of mulch (including adhesive) and the maintaining of the seeded areas until final acceptance, and for all materials, equipment, tools and labor necessary to complete the work, and for any of the foregoing material, operation, etc., necessary and incidental to seeding.

(b) EXTRA SEED.

Extra seed, ordered in writing sowed on any designated area of seeding measured as provided in Item 658.04(a)2, will be paid for at the verified cost of the seed plus 20 cents per pound {44 cents per kilogram}. Verified cost shall be the lowest price submitted from at least two (2) wholesale dealers or distributors of seed.

(c) SUPPLEMENTARY ITEMS.

Topsoil and fertilizer used in addition to the amount provided herein will be paid for under their respective Sections.

(d) ADJUSTMENT IN FERTILIZER RATES.

Payment or deduction for additional or reduced amounts of fertilizer shall be made as provided in Subitem 652.03(a)3b.

(e) PAYMENT WILL BE MADE UNDER ITEM NO.:

658-A Hydro-Seeding & Mulching (Seed Mix) - per acre {hectare}

SECTION 659
EROSION CONTROL NETTING

659.01 Description.

This Section shall cover the work of furnishing, laying, and maintaining an approved protective netting material over seeded, sprigged or sodded areas in accordance with these Specifications and in conformity with details shown on the plans or directed. Areas to be covered by erosion control netting will be shown on the plans or designated by the Engineer. The Contractor may select one of the types of materials permitted for class of netting specified unless a specific type is designated by the plans or proposal.

Erosion Control Netting will be divided into three basic classes of use as follows:

Class A

A type of anchor system designated for use with solid sod and mulch (normally an open weave netting).

Class B

A type of anchor system designated for use over a prepared ground which has been seeded or sprigged and mulch is not used (normally an open weave netting with a filler material).

Class C

A type of anchor system designated for use over a prepared ground which is to be seeded and no mulch used (a flexible three-dimensional soil reinforcement netting). The use of either Class C1 or Class C2 will be as designated by the plans or the Engineer.

659.02 Materials.

Materials furnished for use shall comply with the appropriate requirements of Division 800, Materials, with specific reference made to Article 860.11.

659.03 Construction Requirements.

(a) GENERAL.

If the manufacturer's recommendations for installation are different than those described, the Contractor will be required to follow the more stringent of the two.

(b) PRELIMINARY PREPARATION.

Prior to placement of the erosion control netting, the area shall have been prepared in accordance with the ground preparation, fertilizing, and seeding, sprigging or solid sod (may or may not include mulch covering) as provided on the plans or directed, all in accordance with the applicable portion of these Specifications.

(c) PLACING NETTING.

Netting shall be placed immediately after completion of the required operation for placing the item of work which the netting is to control.

Erosion control netting strips shall be rolled out flat, parallel to the direction of flow, in flumes and ditches, perpendicular to the direction of flow on backslopes. When two or more strips are required to cover an area, they shall overlap 3 inches {75 mm} inches (minimum); however, excelsior blankets will not require lapping but are to be butted together and staples placed with half of each staple located in each of the adjoining blankets. Ends of strips shall overlap a minimum of 6 inches {150 mm} with the upgrade section on top. The upslope end (anchor slot) of each strip shall be buried in 6 inch {150 mm} vertical slots, and soil tamped firmly against it. When, in the opinion of the Engineer, conditions warrant, any other edge exposed to excessive flow shall be buried similarly.

(e) CHECK SLOTS.

These shall consist of 24 inch {600 mm} minimum width separate strips of netting placed at right angles to the direction of water flow immediately prior to placing the general covering of netting, and shall be made by burying a tight fold of netting vertically in the soil a minimum of 6 inches {150 mm} deep, and tamping and stapling in place. Check slots shall be placed so that one check slot, junction slot, or anchor slot of the netting occurs every 50 feet {15 m} of slope.

The netting shall be spread evenly and smoothly, and in contact with the soil at all points. It shall be pressed into the soil by use of a light lawn roller, or other approved method, and portions of the netting not so pressed into soil shall be hand tamped or stapled to assure close contact with the earth.

Each strip shall be stapled in three rows; each edge and the center spaced at not more than 3 feet {900 mm} longitudinally. Check slots and ends of strips shall be stapled at 9 inch {225 mm} intervals across their width.

659.04 Care During Construction.

This shall consist of protection and of repairs made necessary by erosion, wind, fire, and/or other causes. Repairs shall be such as to re-establish the condition and grade of soil as existed prior to application of netting, including stability, restoring damaged ground preparation, refertilization and replanting of damaged areas, without additional compensation. The period of care shall continue until acceptance of the contract or release of the grassing bond. Care shall be performed without additional compensation.

659.05 Method of Measurement.

Accepted erosion control netting placed as directed will be measured by the square yard {square meter}, based on the finished surface dimensions of the area covered. Separate measurement will not be made for folds, laps, check slots, anchor slots, junction slots, etc.

659.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Erosion Control Netting measured as provided above will be paid for at the contract unit price which shall be full compensation for the construction of the item, including all materials, equipment, tools, labor and incidentals required to complete the item.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

659-A Erosion Control Netting, Class ____ - per square yard {square meter}

SECTION 660
VINES, SHRUBS AND TREE PLANTING

660.01 Description.

This Section shall cover the work of furnishing, planting, and establishing healthy, live, growing trees, shrubs, seedlings, vines or other designated plants at designated locations on the project. The specie, size, etc. of vines, shrubs, seedlings and trees will be as indicated on the plans or proposal.

Basic work consists of furnishing or harvesting of plants and transporting thereof; preparation of plant site or beds including furnishing and preparation of soil, fertilizer, mulch and other miscellaneous items incidental to the planting procedure; the planting of the plants in a workmanlike manner in accordance with accepted horticultural practices along with the water necessary to establish and maintain the plants in a live, growing condition throughout the life of the project. The amount of water to be used and when it shall be applied shall be the Contractor's responsibility until acceptance of the project.

660.02 Materials.

All materials shall conform to the requirements of Division 800, Materials. Specific reference is made to Roadside Improvement Materials, Section 860.

660.03 Construction Requirements.

(a) GENERAL.

The normal growing period for vines, shrubs, and trees is defined as that time period between April 1 and September 30. All vines, shrubs and trees shall be planted so as to provide the maximum growing time allowable under the contract time. All plantings shall be scheduled to provide a minimum of one growing season except as noted in Subarticle 860.06(b).

Pine seedlings shall be planted in North Alabama only between December 1 and March 15; in South Alabama only between December 1 and February 15. Planting will not be permitted during periods of drought or when the ground is frozen. These seasonal limits may be changed only on written orders from the Engineer.

Any rock or underground obstructions shall be removed to the depth necessary to permit planting according to the plans and Specifications unless other locations for the planting are approved. Explosives may be used only where and as expressly approved.

(b) PLANTING OPERATIONS FOR VINES, SHRUBS AND TREES.

1. ROW PLANTING.

a. Furrows or trenches shall be opened in the locations designated to a depth at least 6 inches {150 mm} greater than the depth of the roots or ball when extended in their normal position, and in no case less than 12 inches {300 mm} for vines and shrubs. The width of furrows or trenches shall be at least 12 inches {300 mm} greater than the spread of the roots when extended in their normal position, and in no case less than 12 inches {300 mm} for vines and 18 inches {450 mm} for shrubs.

b. The furrows or trenches shall then be partially filled with prepared plant topsoil and the vines or shrubs placed so that the crown, bud or base of the tops, as the case may be, is at or slightly below the previous growing level and the roots are in a natural spread. After the roots have been completely covered with plant topsoil, the commercial fertilizer 8-8-8 shall be evenly scattered over the surface of the plant topsoil at the rate of approximately 0.1 pound per foot {0.15 kg per meter} of furrow or trench, followed by a satisfactory watering. After the water has soaked in and the plant topsoil is no longer muddy, additional plant topsoil shall be added and firmly compacted. Compaction shall stop when the compacted plant topsoil is 2 inches {50 mm} below the finished grade. The balance of the furrow or trench shall then be filled with loose plant topsoil until it is slightly lower than the finished grade.

2. SPOT PLANTING.

Planting operations shall be in accordance with the specifications for row planting as far as applicable. Commercial fertilizer, 8-8-8, shall be applied at a rate of 0.1 pound per square yard {0.05 kg per square meter}. Pits for trees and shrubs shall not be less than 18 inches {450 mm} deep

and 3 feet {900 mm} in diameter unless otherwise shown on the plans. If the trees to be planted are larger than 2 inches {50 mm} in caliper or 10 feet {3 m} in height, the size of the pits shall be increased in proportion to the increase in size of the trees. For shrubs the pit shall be 12 inches {300 mm} greater than the ball diameter or root spread. The bottom of all planting pits for trees shall have the soil loosened at least 6 inches {150 mm} deeper than excavated. The side walls of all planting pits shall be vertical and the bottoms flat. Sloping walls of pits or crowding of root systems will be cause for rejection of the planting.

3. DRAINAGE.

Tile or pipe underdrain subsoil drainage shall be installed as provided by the plans or directed. Such tile pipe shall meet the requirements of Section 853. Trenches shall be not less than 18 inches {450 mm} below finished grades. Drain tile shall be connected with a suitable outlet.

4. DISPOSAL OF EXCESS SOIL.

Excess soil shall be disposed of as directed.

5. PLANT TOPSOIL.

Unless otherwise provided by the plans, plant topsoil shall be used in preparation and in the backfill of plant pits in connection with row planting and spot planting.

6. SETTING PLANTS.

a. All plants shall be set plumb at such a level that after settlement they bear the same relation to the level of the surrounding ground as they bore to the ground from which they were dug. All plants shall be planted in plant topsoil which shall be settled by watering when required and by tamping. For spring planting, a shallow saucer capable of holding water shall be formed about each plant by placing a mound of soil around the edge of each pit, unless otherwise directed. Care shall be taken in setting plants to protect adjacent planting from damage.

b. Balled and burlapped plants or balled platform plants (BB, BP) are to be planted with plant topsoil carefully tamped around and under the base of each ball to fill voids. Platforms shall be removed. All cloth, ropes, et cetera, shall be removed from the tops of balls, but no cloth shall be pulled out from under the balls.

c. Roots or bare-root (BR) plants shall be properly spread out in a natural position and plant topsoil shall be carefully worked in among them. All broken and frayed roots shall be cleanly cut off.

(c) PLANTING OPERATIONS FOR SEEDLINGS.

1. GENERAL.

The pine seedlings shall be transported to the planting area in a manner that will protect the roots from the wind and sun and guard against skinning or otherwise damaging the plant or root system. The roots shall be kept moist at all times. The recommended method of hand planting is shown in detail on the plans. Seedlings shall be placed in the hole to an approximate depth of 1/4 of an inch {6 mm} deeper than the depth the plant grew in the nursery. Care shall be taken not to bend or fold the roots due to a small shallow hole. Planting by use of a soil auger will be acceptable, if care is taken to remove the air pockets by packing to ground level.

2. FERTILIZER.

No extra fertilizer will be required on areas that have been previously fertilized, fertilizer will be applied as directed by the Engineer, and payments made for extra fertilizer quantities provided on the plans.

3. SPACING.

The seedlings shall be spaced approximately 6 feet {1800 mm} on centers, or as shown on the plans, planting in an irregular pattern as outlined by the Engineer.

(d) PRUNING.

All pruning shall be done on the site before planting in accordance with the schematic drawings provided in the plans and as directed. Pruning shall follow modern horticultural practices (American Standard for Nursery Stock) and shall be done with approved tools designed for the purpose intended. Lopping, topping or shearing of trees or shrubs will be grounds for rejecting the plants as unsuitable and not meeting the requirements. Damaged, scarred, frayed, split, or skinned branches, limbs or roots shall be pruned back to live wood nearest to the next sound outside lateral bud, branch, limb or root. The terminal leader or bud in all trees or shrubs shall be left intact and not removed

unless damaged. The top growth of all vines shall be cut back approximately one-third unless otherwise directed.

(e) GUYING, STAKING AND WRAPPING OF TREES.

1. GUYING AND STAKING.

All trees shall be staked or guyed unless otherwise directed. Unless otherwise directed, all trees up to 2 inches {50 mm} in caliper, or up to 10 feet {3 m} in height, shall be supported by a single 8 foot {2.5 m} (above ground line) stake; all trees from 2 inch {50 mm} caliper up to 3.5 inch {100 mm} caliper, or from 10 to 14 feet {3 to 4.2 m} in height, shall be supported by two 10 foot {3 m} (above ground line) stakes. All trees from 4 to 6 inch {100 to 150 mm} caliper shall be supported by 4 stakes at least 12 feet {3.6 m} (above ground line) long. All stakes shall be at least 2 feet {600 mm} in the ground. All trees larger than 5 inch {125 mm} caliper, or other trees with heavy crowns shall be supported by anchored wires and guyed 3 ways with double No. 10 wire. Stakes shall not injure plant balls. No. 12 wire and rubber hose, or approved substitutes, shall be used to secure the tree to stakes without chafing or injury. Wires used for guying shall be secured to the tree by passing through a rubber hose, by using wood stakes protected from the bark by heavy cloth padding, or by similar means to prevent chafing and injury at a point approximately 2/5 of the height of the tree. Guy wires shall be anchored in the ground to stakes or deadmen at a distance from the trunk of about 3/4 of the height of fastening. Guy wires shall be tightened by driving the stakes, leaving subsequent tightening to be done by maintenance forces by twisting the wires.

2. WRAPPING.

Trees shall have their bark protected from transpiration using Method A, B, or C.

a. Method A.

All trunks and branches shall be sprayed with "Dowax" or similar approved wax compound immediately before or after digging, The material shall be applied as directed by the manufacturer.

b. Method B.

The trunks of all trees, from the ground line to the height of the second branches, or to the height directed, shall be wrapped not later than four (4) days after planting. Trees over 4 inches {100 mm} in caliper shall also have their larger branches wrapped. A single layer of burlap bandage shall be wound spirally starting from the base and overlapping 1.5 inches {38 mm}. The burlap shall be securely tied in place with binder twine at about 6 inches {150 mm} intervals.

c. Method C.

The trunks of all trees from the ground line to the height of the first branches shall be wrapped not later than four (4) days after planting with an approved wrapper, overlapping as noted in Method B.

(f) MULCHING.

All plants shall be mulched, within two (2) days after planting. Mulching shall be Class B in accordance with the provisions of Subarticle 860.03(c), unless otherwise shown by plan details. Thickness shall be as shown on the plans. When the vines or shrubs are set closer than 2.5 feet {750 mm} of each other, the mulch shall be spread over the entire area thus planted. When the planting distance is 2.5 feet {750 mm} or more, the layer of mulch shall cover the backfilled plant hole only, unless otherwise shown on the plans. Mulching will not be required for pine seedlings unless so specified on the plans.

(g) WATERING.

The vine, shrub and tree plantings shall be given one watering during the course of the planting operations and additional waterings as needed. Sufficient water shall be applied to wet thoroughly the adjacent area down through the root system. Water shall be applied in such a manner that will prevent erosion of the finished surface.

(h) CARE DURING CONSTRUCTION.

The Contractor shall properly care for all vine, shrub and tree planted areas in a satisfactory condition until the work has been completed, and until final acceptance as defined in Article 105.16 and other requirements contained in provisions included in the proposal. Care shall consist of providing protection of the planting beds and seedling areas by the use of clearly visible stakes or markers to prevent damage by State maintenance vehicles and/or others. Weeding and repairing of all planted areas or pits, including an area 3 feet {1 m} outside of the normal perimeter of the beds, pits or bedding areas, shall be required with particular attention directed to the following specific times:

1. At the inspection of all planted areas to be made prior to placement of the plants.
2. At the time of Final Inspection.

In addition to the above, any damage to the adjacent areas mentioned above caused by the work involved in the preparing of or by the existence of the beds shall be repaired by the Contractor without cost to the State.

(i) BASIS OF ACCEPTANCE AND REPLACEMENTS.

The Engineer shall make periodic inspections of the work to determine the condition of the plantings. On these inspections, especially those noted in this Section, all plants which the Engineer determines are not in a healthy growing condition shall be rejected. All plants rejected shall be immediately replaced by the Contractor with the same kind and sizes and in the same manner as originally provided except that plantings out of season shall comply with the requirements for out of season plantings noted in Article 860.06.

Not less than 60 or more than 75 calendar days prior to the completion date of the project, an inspection of the plantings shall be made by the Engineer, at which time all defective, dead or missing plants shall be replaced as prescribed for out of season plantings.

Based on the findings of the above noted inspection, the Engineer shall direct the Contractor to replace dead, defective or missing plants; such replacements shall be replaced in the same manner as noted for rejected plants in the paragraph next above.

All replacements, etc., for plants prior to final acceptance shall be considered incidental to the work and no additional compensation other than the unit prices bid will be allowed.

At the final inspection of the project, all dead, defective or missing plants shall be rejected and deleted from the contract and no compensation for rejected plants will be allowed.

660.04 Method of Measurement.

(a) PLANT TOPSOIL.

The accepted quantity of this material used as ordered will be measured in cubic yards {cubic meters} (loose measurement) in the vehicle at point of dumping. No measurement will be made for overhaul of this material.

(b) VINES, SHRUBS, AND TREES.

The quantity of vines, seedlings, shrubs and/or trees to be paid for under this item will be the actual number ordered, planted and accepted. Only vines, seedlings, shrubs and trees in a living, healthy condition will be accepted.

660.05 Basis of Payment.

(a) PLANT TOPSOIL.

This material will be paid for at the contract unit price bid per cubic yard {cubic meter} which price and payment will be full compensation for furnishing, excavating, loading, hauling (including overhaul), unloading, furnishing, and mixing all component materials and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) VINES, SEEDLINGS, SHRUBS, AND TREES.

Vines, Seedlings, Shrubs, and Trees ordered, planted and accepted will be paid for at the contract unit price for each. Such price and payment shall be full compensation for furnishing plants, plant test or certification service, planting, pruning, guying and staking, wrapping, mulching, furnishing and applying fertilizer (including all fertilizers covered by Article 860.12 and/or provided by the plans), and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

(c) WATERING.

No direct payment will be made for water used in the placement and care of planting during the construction. All water necessary shall be considered as a part of the unit price bid for items provided by this Section.

(d) PAYMENT WILL BE MADE UNDER ITEM NO.:

660-A Plant Topsoil - per cubic yard {cubic meter}
660-B Vines, Type - per each
660-C Shrubs, Type - per each
660-D Trees, Type - per each
660-E Seedlings, Type - per each

SECTION 661
TRANSPLANTING TREES, SHRUBS AND VINES

661.01 Description.

This Section shall cover the work of transplanting of specified trees, shrubs and vines and the reestablishing of them in positions shown on the plans or designated.

Basic work consists of digging plants, preparing them for transplanting and transporting thereof; preparation of plant sites or beds, furnishing and preparation of soil fertilizer, mulch and other miscellaneous incidentals necessary to planting procedure; the planting of plants in a workmanlike manner in accordance with accepted horticultural practices along with the water necessary to establish and maintain the plants in a live, growing condition throughout the life of the project. The amount of water to be used and when it is to be applied shall be the Contractor's responsibility until acceptance of the project.

661.02 Materials.

All materials shall conform with the requirements set forth in Division 800, Materials, with specific reference made to Section 860.

661.03 Construction Requirements.

(a) GENERAL.

The requirements provided for Vines, Shrubs and Tree Planting, Section 660, and Roadside Improvement Materials, Section 860, shall apply in all respects to transplanting trees and shrubs, except where otherwise indicated by specific requirements given below.

Trees, shrubs and vines to be transplanted will be identified clearly on the plans as to existing and proposed location, species, and size. Planting holes of the size shown on the plans for the particular specie of plant material shall be dug and approved prior to moving existing plants. Material to be transplanted shall be dug with the size ball for collected plants recommended in the American Standard For Nursery Stock, current edition, unless otherwise shown by plan details or directed by the Engineer.

(b) WATERING.

The vine, shrub and tree plantings shall be given one watering during the course of the planting operations and additional watering as needed. Sufficient water shall be applied to wet thoroughly the adjacent area down through the root system. Water shall be applied in such a manner that will prevent erosion of the finished surface.

(c) CARE DURING CONSTRUCTION.

Care during construction shall be the same as specified in Subarticle 660.03(h).

(d) BASIS OF ACCEPTANCE AND REPLACEMENT.

The basis of acceptance and replacement shall be the same as specified in Subarticle 660.03(i).

661.04 Method of Measurement.

(a) PLANT TOPSOIL.

The accepted quantity of this material used as ordered will be measured in cubic yards {cubic meters} (loose measurement) in the vehicle at the point of dumping.

(b) VINES, SHRUBS AND TREES.

The quantity of transplanted vines, seedlings, shrubs and/or trees to be paid for under this item will be the actual number ordered, planted and accepted. Only vines, seedlings, shrubs and trees in a living, healthy condition will be accepted.

661.05 Basis of Payment.

(a) PLANT TOPSOIL.

This material will be paid for at the contract unit price bid per cubic yard {cubic meter} which price and payment will be full compensation for furnishing, excavating, loading, hauling (including overhaul), unloading, furnishing, and mixing all component materials and for all labor, equipment, tools, and incidentals necessary to complete the work.

(b) VINES, SEEDLINGS, SHRUBS, AND TREES.

Transplanted vines, seedlings, shrubs, and trees ordered, planted and accepted will be paid for at the contract unit price for each. Such price and payment shall be full compensation for furnishing plants, plant test or certification service, planting, pruning, guying and staking, wrapping, mulching, furnishing and applying fertilizer, and for all materials, labor, equipment, tools, and incidentals necessary to complete the work.

(c) WATERING.

No direct payment will be made for water used in the placement and care of planting during the construction. All water necessary shall be considered as a part of the unit price bid for items provided by this Section.

(d) PAYMENT WILL BE MADE UNDER ITEM NO.:

661-A Transplanting Vines, Kind - per each
661-B Transplanting Shrubs, Kind - per each
661-C Transplanting Trees, Kind - per each

SECTION 663
TREE WELLS AND TREE ROOT PROTECTION

663.01 Description.

This Section shall cover the work of (1) protecting selected trees, shrubs or other woody plants by the use of tree wells constructed so as to protect the root system and/or (2) placing a porous tree root protection material, mulch or other approved material to such depth around the roots as may be provided by plan details or directed.

Tree wells shall be constructed of concrete, rubble masonry, or brick masonry as may be provided on the plans. Such construction shall be performed in accordance with the design and details indicated on the plans.

663.02 Materials.

All materials furnished for use shall comply with the appropriate requirements of Division 800, Materials, with specific reference to the following:

Tree Well Masonry Concrete, Section 501
Rubble Masonry, Section 612
Brick or Concrete Block Masonry, Section 613
Tree Root Protection Material, Section 860

663.03 Construction Requirements.

(a) EXCAVATION & DRAINAGE.

All excavation incidental to and necessary for constructing the work in the area of the trees to be protected shall be conducted so as to avoid injuring the root system. No backfill of any nature shall be placed by the Contractor above the root spread of a tree or plant designated to be preserved until a porous material not less than 3 inches {75 mm} in depth or the depth directed has first been placed above the roots.

Adequate drainage of tree wells, etc. shall be provided by means of weep holes, drain tile, etc., as may be indicated on the plans or directed.

(b) TREE WELLS.

Tree wells shall be constructed in accordance with the dimension and arrangement shown on the plans or as directed. They shall be made of masonry as shown on the plans or directed, provided; however, that mortar will be omitted in any portion of the tree well extending below the level of the top of the contiguous broken stone root protection.

(c) TREE ROOT PROTECTION.

1. Where tree root protection is ordered, the porous material shall be placed to a depth ranging from 3 to 12 inches {75 to 300 mm} (or to such other depths indicated on the plans) over the root spread of the tree or trees selected, about each of which a tree well is to be constructed, or other trees within or without the fill area, not to be welled but designated for tree root protection.

2. The area for tree root protection shall be first cleaned of all vegetation and porous material shall be then spread loosely over the required area.

3. Following the spreading of the porous material for tree root protection, a minimum of from 4 to 5 inches {100 to 125 mm} of topsoil shall be spread above the porous fill to bring the area to the finished-grade lines designated. Such topsoil shall be transported, handled and paid for under the item of Topsoil, Section 650, all as directed in writing.

4. Sufficient care shall be taken so that trees or shrubs which are to be preserved in place are not scarred or damaged by the operations under this item. The root area to be protected shall be the area of ground surface lying within the periphery of the limb spread of the tree.

663.04 Method of Measurement.

(a) TREE WELLS.

The volume of masonry to be paid for shall be the number of cubic yards {cubic meters} of masonry measured complete in place and accepted.

(b) TREE ROOT PROTECTION.

The volume of tree root protection to be paid for shall be the number of cubic yards {cubic meters} of stone, gravel, slag, or other approved material placed in tree root protection, measured loose in vehicle at point of delivery, and accepted.

663.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The volume of masonry, determined as provided above, shall be paid for at the contract unit price per cubic yard {cubic meter} bid for Tree Well Masonry. The volume of porous material tree root protection, measured as provided above, shall be paid for at the contract unit price per cubic yard {cubic meter} for Tree Root Protection Material, which price and payment shall be full compensation for excavating and cleaning the ground surface, for placing the porous fill, for procuring and delivering all materials and for all labor, equipment, tools and incidentals necessary to complete the item. No direct payment will be made for excavation, including its backfill and disposal, incidental and necessary to tree wells and tree root protection work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

663-A Tree Well Masonry - per cubic yard {cubic meter}
663-B Tree Root Protection Material - per cubic yard {cubic meter}

SECTION 665
TEMPORARY EROSION CONTROL

665.01 Description.

(a) GENERAL.

This Section shall cover the work of providing, establishing, and maintaining temporary erosion control work items which consist of measures shown on the plans, determined by the Department provided Erosion Control Plan (ECP) or determined by the Contractor and approved by the Engineer, or ordered by the Engineer during the life of the contract to control erosion within the project limits. Temporary water erosion control provisions as defined herein will not be incorporated into the project without prior approval of the Engineer after he determines that it is impractical to utilize permanent erosion control methods.

The provisions of this Section are in no way intended to relieve the Contractor of responsibilities covered under other sections of the Specifications. The pollution control provisions contained herein shall be coordinated with the permanent erosion control features to assure effective continuous erosion control throughout the life of the project.

(b) REQUIREMENTS.

1. When a Department provided ECP is not included in the plans, the Contractor shall submit to the Engineer, in writing, a detailed plan for the accomplishment of acceptable erosion control on the project prior to the preconstruction conference. This Contractor provided plan shall include both temporary and permanent measures for the work within the project right of way, construction easements (if any), and plan-designated material sources or waste areas (if any). This work shall comply with the requirements of Department obtained stormwater permits, where required. The time sequence proposed for placing all erosion control features will be in the plan; however, if

jobsite conditions should make it necessary to modify the time sequence, the Contractor shall submit a revised plan. These plans must be approved by the Engineer before the work will be permitted to commence.

When a Department provided ECP is included in the plans, the Contractor, in lieu of the above, shall comply with the requirements of Article 107.21.

The Contractor shall be responsible for obtaining and complying with all stormwater permits, where required, on all Contractor-selected material pits, waste areas, plant sites, haul roads and other off-site areas selected by the Contractor to construct the project according to Subarticle 106.01(b).

2. The Contractor shall not expose more than 17.5 acres {7 hectares} of erodible material for any separate major operation within the project limits or beyond the right of way without prior approval of the Engineer. Consideration for increasing the specified limits noted above will be given upon written request and presentation of an acceptable justification for such (justification should include operation plan, men and equipment to be utilized and any necessary modifications to previously accepted erosion control plan). Additional temporary erosion control items required as a result of this increased area which would not normally be required in the course of the 17.5 acre {7 hectare} limited area, will be provided at no cost to the State.

Temporary erosion control work may involve the construction of temporary berms, dikes, sediment basins, drains, fences, dams, floating basin booms, etc. with the use of temporary seeding, mulching, erosion control netting, hay bales, sand bags, check dams, rip-rap, floating curtain booms, etc. as deemed necessary by the Engineer.

3. The Contractor will be required to incorporate all permanent erosion control features into each 17.5 acre {7 hectare} increment of the project immediately upon completion of the grading of that section. Once work has begun on a section it shall be pursued continuously until completion. Temporary erosion control measures shall be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent erosion control features; or that are needed temporarily to control erosion that develops during normal construction and prior to substantially completing cuts and fills as may be approved by the Engineer.

In the event the Contractor fails to comply with the requirements of the Department provided ECP, his plan or as directed by the Engineer, the Engineer will order the Contractor to discontinue all operations except the work involved in erosion control until such time as these requirements are met. In case of failure on the part of the Contractor to comply fully, provisions of Subarticle 108.04(b) and Article 108.12 will be applied to the fullest extent.

Except as modified in this Section, all requirements of the following Sections shall apply:

Riprap	Section 610
Ground Preparation and Fertilizers for Erosion Control	Section 651
Seeding	Section 652
Sprigging	Section 653
Solid Sodding	Section 654
Mulching	Section 656
Grassy Mulch	Section 657
Hydro-Seeding and Mulching	Section 658
Erosion Control Netting	Section 659

665.02 Materials.

The geotextile used in sediment control shall meet the requirements of AASHTO M 288 for Temporary Silt Fence and Section 810 of these specifications.

TEMPORARY PIPE.

Temporary pipe may be constructed of any type material which will adequately carry the water.

TEMPORARY WIRE FENCE (INCLUDING POSTS).

Temporary fence and post material may be of any type fencing and post material that will adequately serve the intended purpose.

POLYETHYLENE.

Polyethylene sheets may be of any size or color capable of serving the purpose intended provided it is of at least 4 mil {0.1 mm} in thickness.

HAY BALES.

Bales may be either hay or straw containing 5 cubic feet {0.14 m^3} of material and having a weight {mass} of not less than 35 pounds {16 kg}.

SAND BAGS.

Bags may be cotton, burlap, or other approved material which will adequately confine the sand. Bags shall have a volume of approximately 1 cubic foot {0.03 m^3}.

TEMPORARY RIPRAP.

Riprap shall be suitable for the purpose intended and shall be one of the classes noted in Article 814.01. The riprap shall be Class 2 unless otherwise designated on the plans or approved by the Engineer.

SILT FENCE.

Silt fences consist of a woven wire fabric, mounted on posts with a geotextile filter attached to the fence fabric, or a geotextile filter attached to posts by means of adjustable belts or loops or other means that will securely hold the geotextile filter in an upright position.

The Department has established an Approved Materials, Sources, and Devices With Special Acceptance Requirements List for this material (List II-3, Geotextiles For Use As Silt Fence). Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

The geotextile fabric must pass a six month weathering test before it will be placed on the list. Even though a material is listed on the Approved Materials list, failure of the material under field conditions may be cause for the disqualification of the material at any time.

FLOATING BASIN BOOM.

Floating basin booms shall consist of a heavy duty reinforced fabric attached on the upper side to floatation members and ballasted on the lower side with chains or weights to form a bottom-tensioned floating curtain boom.

All materials used in the floating basin boom shall comply with the requirements shown by plan details or noted hereinafter in this Item.

The floatation members shall be made of foam with a minimum diameter of 6 inches {150 mm} or as shown on the plans. The skirt depth below the foam floatation shall be a minimum of 6 feet {2 meters} or as shown on the plans. The ballast shall be galvanized proof coil chains or other acceptable weights capable of retaining the skirt in a vertical position. The boom shall be Yellow or International Orange in color unless shown otherwise on the plans.

Anchors capable of holding the floating basin boom in place shall be provided at the locations shown on the plans.

665.03 Construction Requirements.

(a) GENERAL.

Construction details shall be in accordance with the appropriate section of the Specifications for the type work performed unless otherwise noted in this Article.

(b) TEMPORARY SEEDING.

Ground preparation as required in Section 651 is hereby waived. Areas to be temporary seeded shall be left in a rough graded condition and all water pockets eliminated. Slopes that are smooth or hard shall be lightly scarified with scarifying teeth or some other acceptable method, running perpendicular to the direction of water flow. The intent of this scarifying is to obtain a rough area to hold the seed and prevent them from washing away before germination.

Application of 1000 pounds {1120 kg} of 8-8-8 fertilizer per acre {hectare} shall be applied by either hydraulic or conventional methods. Seeding shall then be applied hydraulically or by approved mechanical seeders using the appropriate seed mix shown below:

North and South Alabama	
September through December	
Abruzzi Rye:	70 pounds per acre {79 kg per hectare}
Kentucky 31 Fescue:	30 pounds per acre {34 kg per hectare}
Weeping Lovegrass:	5 pounds per acre {6 kg per hectare}
January through April 15	
Kentucky 31 Fescue:	30 pounds per acre {34 kg per hectare}
Reseeding Crimson Clover:	30 pounds per acre {34 kg per hectare}
Weeping Lovegrass	5 pounds per acre {6 kg per hectare}
April through August	
Brown Top Millet ** :	30 pounds per acre {34 kg per hectare}
Weeping Lovegrass:	5 pounds per acre {6 kg per hectare}
Kentucky 31 Fescue * :	30 pounds per acre {34 kg per hectare}

* Overseeded in September or October

** Brown Top Millet (Panicum Ramosum) - 97% Min. Purity-80% Min. Germinable.

All seeded areas shall be immediately and periodically watered until a minimum growth of 3 inches {75 mm} above the ground surface is evident. Necessary measures to provide and maintain a quick and satisfactory growth will be required. No payment shall be made for temporary seed until a satisfactory growth has been established to a minimum of 2 inches {50 mm} above ground. Payment may be withdrawn for any temporary seeding growth not adequately maintained.

All temporary seeded areas shall be top dressed when true leaves are formed with 60 pounds {68 kg} of elemental nitrogen per acre {hectare}, at no additional cost. After six months all temporary seeded areas shall be top dressed with 400 pounds per acre {450 kg per hectare} of 15-0-15 if grass stand is still required for protection.

(c) TEMPORARY MULCHING.

When mulching is required for temporary seeded areas, the mulch shall be limited to cereal grain straw (oats, wheat, or rye). If cereal grain straw is not available, other type mulches provided in Article 860.03 may be used provided the Contractor at no extra cost will increase the required quantity of annual grasses or legumes (Abruzzi Rye, Crimson Clover and Brown Top Millet) by 50%.

(d) TEMPORARY PIPE.

Temporary Pipe shall be of the size designated on the plans or approved by the Engineer. The length shall be as determined by the Engineer. Bedding requirements are waived.

(e) TEMPORARY WIRE FENCE.

Construction methods shall produce an acceptable fence with the fabric securely attached to posts. Within each installation site the fence fabric and posts shall be of the same type.

(f) POLYETHYLENE.

Polyethylene sheets shall be placed only in areas where water flow and silt must be contained. Installation shall be as described for erosion control netting.

(g) SAND BAGS.

Bags shall contain approximately 1 cubic foot {0.03 m^3} of sand and be securely fastened. When placed, the bags should have a thickness of approximately 6 inches {150 mm}.

(h) HAY BALES.

Bales shall be securely anchored by the use of stakes and wire or other approved methods.

(i) EROSION CONTROL CHECK DAMS.

Check dams shall be of the type shown on the plans or approved by the Engineer. The check dams shall be constructed at the locations shown on the plans or approved by the Engineer.

(j) TEMPORARY RIP RAP.

Temporary rip rap shall be placed in accordance with Section 610 except that foundation preparation will not be required. The location of the rip rap shall be as shown on the plans or approved by the Engineer.

(k) SILT FENCE.

The Contractor shall install a temporary silt fence as shown on the plans, and at other locations as directed by the Engineer. Fence construction shall be adequate to handle stress from sediment loading. At the bottom of the fence, the geotextile shall be buried a minimum of 6 inches in

a trench so that no flow can pass under the barrier. The trench shall be backfilled and the soil compacted over the geotextile. Fence height shall be as shown on the plans or specified by the Engineer. The geotextile shall be spliced together only at a support post with a minimum 6 inch {150 mm} overlap.

When wire support fence is used, the wire mesh shall be fastened securely to the upslope side of the post. The wire shall extend into the trench a minimum of 2 inches {50 mm} and extend above the original ground surface as shown on the plans.

Silt fences shall be continuous and transverse to the flow, and limited to handle an area equivalent to 1000 square feet per 10 feet {31 m^2 per meter} of fence.

It is the Contractor's responsibility to maintain the integrity of silt fences as long as they are necessary to control sediment runoff. The Contractor shall inspect all temporary silt fences immediately after each rainfall and at least daily during prolonged rainfall. Any deficiencies shall be immediately corrected by the Contractor. In addition, the Contractor shall make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, additional silt fences shall be installed as directed by the Engineer. Should the silt fence become damaged or otherwise ineffective while the barrier is still necessary, it shall be repaired promptly with a new section of filter overlapping 12 inches {300 mm} on each side of a break.

Sediment deposits shall either be removed when the deposits reach approximately one-half the height of the silt fence or a second silt fence shall be installed as directed by the Engineer.

The silt fence shall remain in place until the Engineer directs that it be removed. Upon removal, the Contractor shall remove and dispose of any excess silt accumulations, dress the area to give a pleasing appearance, and vegetate all bare areas in accordance with contract requirements. The fence materials will remain the property of the Contractor and may be used at other locations provided the materials meet the requirements of Table 1 of AASHTO M 288 for Sediment Control.

(l) DRAINAGE SUMPS.

Temporary drainage sumps or sediment basins shall be constructed near the ends of drainage structures or ditches where needed to control silting. The size, shape and location of these sumps shall be as shown by the plan details or directed by the Engineer.

Construction of the sumps shall be accomplished by methods and equipment suitable for the purpose and acceptable to the Engineer. The sump may be supplemented by the use of pipe, polyethylene, hay bales or other temporary items in this Section as indicated by the plans and/or approved by the Engineer.

The sumps shall be cleaned periodically by the removal and disposal of the silt collected in the sumps as deemed necessary to keep the unit functional.

When the sump is deemed of no further use, the sump shall be closed, backfilled with suitable material and compacted as directed, and the area dressed and shaped to blend with the adjacent natural ground.

The above work will be covered under Item 665-K, Drainage Sump Excavation; however, if the proposal does not contain such an item, payment for the work noted above will be made under the Item of Unclassified Excavation.

(m) FLOATING BASIN BOOM.

Floating basin booms shall be constructed at the locations shown on the plans or approved by the Engineer. Installation shall be as recommended by the manufacturer.

665.04 Method of Measurement.

Items 665-A and 665-B will be measured in acres {hectares} computed from surface measurements taken parallel to the treated surface. Computations will be to the nearest 0.1 of an acre {0.1 ha}.

Item 665-C will be measured in linear feet {meters} to the nearest foot {0.1 m} with measurements taken along the center line of the pipe.

Item 665-D will be measured in linear feet {meters} to the nearest foot {0.1 m} with measurements taken along the top line of the fence.

Item 665-E will be measured in square yards {square meters} computed from surface measurements of the area treated. Computations will be to the nearest square foot {0.1 m^2}.

Items 665-F, 665-G and 665-H will be measured in individual units of the type item actually used in the treatment.

Item 665-I will be measured on acceptable scales in one ton units of 2000 pounds {one metric ton units of 1000 kg} each of the material actually used.

Item 665-J will be measured in linear feet {meters} to the nearest foot {0.1 m} with measurements taken along the top line of the fence.

Item 665-K will be measured in cubic yards {cubic meters} computed from dimensions of the sump size and depth approved by the Engineer. No measurements will be made of material removed during sump cleaning operations or backfilling when the sump is closed.

Item 665-L will be measured in linear feet {meters} to the nearest 0.1 foot {0.1 meter} with measurements taken along the top line of the boom.

665.05 Basis of Payment.

(a) GENERAL.

The basis of payment for all temporary erosion control items provided under this Section shall include the maintenance of the items throughout the duration of their need.

If work is deemed necessary that is not included in the contract, the Contractor may submit his plan along with any new items and costs thereof for approval by the Engineer. If approved, the work may be performed at an agreed unit price as per Article 104.03 or the work may be performed on a Force Account basis. The Engineer may at any time order work not included in the contract to be performed by Supplemental Agreement or Force Account basis.

In the event that temporary erosion control measures are necessary due to negligence or failure on the part of the Contractor in installing the permanent measures, such temporary work shall be performed at the Contractor's expense.

Payment for any temporary erosion control measures deemed necessary by the Engineer on areas outside the right of way or easements will be included in other items of work and no direct payment will be made. Such areas shall include material pits, haul roads, plant or storage sites, or any area used for the Contractor's convenience.

The unit price coverage for items listed herein measured as noted in Article 665.04, shall be full compensation for furnishing all materials, the construction and/or installation of the materials into complete erosion control measures, and shall include all equipment, tools, labor, and incidentals necessary to complete the work, to maintain all work in an acceptable condition as long as deemed necessary by the Engineer, and to remove all items as directed.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

665-A Temporary Seeding - per acre {hectare}
665-B Temporary Mulching - per acre {hectare}
665-C ___ inch {mm} Temporary Pipe - per linear foot {meter}
665-D Temporary Wire Fence (Including Posts) - per linear foot {meter}
665-E Polyethylene - per square yard {square meter}
665-F Hay Bales - per each
665-G Sand Bags - per each
665-H Erosion Control Check Dams, Type - per each
665-I Temporary Riprap, Class ____ - per ton {metric ton}
665-J Silt Fence, Type ____ - per linear foot {meter}
665-K Drainage Sump Excavation - per cubic yard {cubic meter}
665-L Floating Basin Boom - per linear foot {meter}

SECTION 666
PEST CONTROL

666.01 Description.

The work covered by this Section shall consist of furnishing and applying designated chemicals to control certain destructive pests, namely, Armyworm, Fall Armyworm, Cutworm, Spittlebug, White Grubs and Pine Bark Beetles.

Because of the destructive nature of the action of these pests to trees and ground cover with the possible result of erosion and ultimate siltation of areas, control of these pests is a necessity.

Both the Engineer and the Contractor have the responsibility of continually observing the planted areas for possible pest damage. The Contractor should, upon observing any of these pests, report such to the Engineer, both verbally and in writing.

The Engineer will verify any reports of this type of pest and direct appropriate treatment to be taken.

The following brief descriptions are provided for ease in recognizing these pests:

ARMYWORM: A medium size caterpillar of dark green color with white stripes on sides and down the middle of the back, Size, approximately 1 inch {25 mm} in length. This worm usually feeds only at night destroying foliage.

FALL ARMYWORM: A medium size caterpillar of dark green color with white stripes on sides and down the middle of the back with a distinctive yellow inverted "Y" on the head capsule. Size, approximately 1 inch {25 mm}. This worm will feed both day and night destroying foliage.

CUTWORM: A fat bodied caterpillar with a greasy appearance, color mostly greybrown or mottled on top and lighter color underneath. Size, approximately 1 to 2 inches {25 to 50 mm} in length when full grown. This worm hides during the day and feeds at night, destroying foliage.

SPITTLEBUG: Most easily identified by a frothy mass of plant juice at the forks of plant stems resembling spittle. This pest lives inside the spittle mass.

WHITE GRUBS: The immature (larval) stage of June or May beetles. Length, 0.5 to 1.5 inches {13 to 38 mm}, have three pairs of legs near the head, and characteristically rest in a C-shaped position. Their heads and rear ends are brown. Green June Beetle grubs crawl on their backs with their legs up.

PINE BARK BEETLES: These beetles are distinguished from other bark beetles in that the rearward end of the abdomen is scooped out and spined (4 to 6 spines on each side). The southern pine beetle and black turpentine beetle have a more rounded abdomen. The black turpentine beetle is the larger of the two, being about 1/4 inch {6 mm} long . The southern pine beetle is about 1/8 {3mm} inch long. All of the pine bark beetles are roughly cylindrical and are dark brown to black.

666.02 Material.

The treatments to be used under this Section shall be as per the current Alabama Pesticide Handbook or Guidelines as may be issued by the Alabama Cooperative Extension Service. As new pesticide materials are approved by the State Department of Agriculture and Industries, the Bureau of Construction may allow their use upon written request by the Contractor.

All chemicals shall be a product of a reputable manufacturer, processed in accordance with all State and Federal regulations for such manufacture.

RESTRICTED USE OF INSECTICIDES

Whenever the State Department of Agriculture and Industries or other Federal or State agency restricts the use of any insecticide on highway right-of-way, its initial or continued use shall require the approval of the ALDOT Construction Engineer. It is illegal to place herbicides in a manner that is not consistent with the requirements shown on the insecticide container labeling.

666.03 Construction Requirements.

(a) GENERAL.

The Engineer after verification of the pest occurrence and identification of the type pest shall direct the use of treatments as noted in Article 666.02 in accordance with the following:

Equipment used in the application shall be designed for the application method to be used and approved by the Engineer for use.

The application of pesticides shall be performed by or under the direct supervision of a licensed pesticide applicator, licensed in the area of right-of-way pest control. Uniform coverage is required. If uniform coverage is not obtained, the Contractor shall retreat the entire area in such a manner that uniform coverage is obtained. Retreatment because of uneven coverage shall be without additional cost to the State. Retreatment shall not be performed within seven days of the original treatment. All treatments shall be at the direction of the Engineer.

In all treatments, dilutions of liquids and technical material dosage applied shall follow label instructions, these Specifications and be verified by the Engineer.

Any change to the dilution rates of a specific chemical or the substitution of chemicals other than those meeting the requirements of Article 666.02 must have prior written approval of the

ALDOT Construction Engineer and any such approved change must be without additional cost to the State.

(b) SAFEGUARDS.

Safeguards in applying insecticides are the responsibility of the Contractor, and he shall be responsible for any damage to humans or wildlife incurred during application operations.

The following are minimum basic safeguards to be observed.

1. Avoid drift of any spray or dust material on adjacent property.
2. Confine Sprays or Dust to areas that will not contaminate streams or lakes adjacent to the Right-of-Way.
3. Carbaryl (Sevin) and Malathion are highly toxic to bees; therefore, if spraying or dusting is carried out near bee yards, give advance notice to beekeeper so that he can protect his bees.
4. In general, spraying with ground equipment is the least hazardous to wildlife; therefore, all treatment shall be applied by approved ground driven equipment unless approved otherwise by the Engineer.
5. Operators of spraying or dusting equipment must wear the recommended apparel for specific insecticides being applied in executing this work.
6. Only qualified personnel will be permitted to engage in this type operation. The Contractor or subcontractor shall submit, if required by the Alabama Department of Transportation, a list of the roads, railroads, or other areas that he has treated. This list must be certified by the official for whom the work was performed.
7. Normally, pesticide spraying will be restricted to roadside areas which are under construction, and subsequently, are not open to the public. However, should areas such as scenic overlooks, rest areas, etc., be ordered treated, precautions for the protection of the public must be taken; namely, by keeping pedestrians off the area until the insecticide dissipates from the turf area to a point that it is no longer an area of concern in accordance with the product labeling.

666.04 Method of Measurement.

Item 666-A will be measured in acres {hectares} computed from surface measurements taken parallel to the treated surface. Computations will be to the nearest 0.1 of an acre {0.1 ha}.

Item 666-B will be measured by the gallon {liter} of dispensed solution with measurements taken from the storage vessel before and following dispersal to determine the actual amount of solution used. Computations will be to the nearest gallon {L}.

Item 666-C will be measured by the square yard {square meter} of dispensed solution with surface measurements taken parallel to the treated surface. Computations will be to the nearest 0.1 square yard {0.1 square meter}.

666.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Completed and accepted pest control treatment measured as noted above shall be full compensation for the furnishing of the respective insecticide noted, for the uniform application of the insecticide and for all materials, equipment, tools, labor and incidentals necessary for the satisfactory completion of the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

666-A Pest Control Treatment- per acre {ha}

666-B Spot Pest Control Treatment - (*) (**) (***) (****) per gallon {L}

666-C Spot Pest Control Treatment - (*) (**) (***) (****)
per square yard {square meter}

* Specify Type

** Specify Rate

*** Specify Carrier Rate of Application

**** Specify Type of Carrier

SECTION 668
PRE-EMERGENT HERBICIDE TREATMENT

668.01 Description.

This section shall cover the work of applying soil active herbicide(s) on the highway right-of-way in accordance with the plans, specifications, material label instructions, or as directed by the Engineer to control the growth of noxious weeds, brush, vines and grasses.

668.02 Materials.

Materials furnished for use in this vegetation control work shall be produced by reputable, recognized manufacturers and registered by the U.S. Environmental Protection Agency. Materials shall be licensed for use in the State of Alabama and shall be pre-qualified for use by the Alabama Department of Transportation. An approved drift control agent shall be used in all liquid broadcast applications. Adjuvants, such as, but not limited to, surfactants shall be used when called for by product label instructions of the herbicide designated on the plans or directed by the Engineer. All herbicide and related adjuvants shall be labeled for right-of-way use. Unless specified otherwise by the plans and/or proposal, potable water shall be the carrier for dispersing the herbicide. The use of herbicides other than those dispensed with a water carrier, such as granules, pellets, powders, capsules, etc., shall be placed as indicated on the product label at locations indicated on the plans, or as directed by the Engineer. Herbicides and their application rates that are approved for use on ALDOT rights-of-way may be found in the latest edition of the Addendum to "A Manual for Roadside Vegetation Management – Chapter IV" which is revised, printed and distributed annually by the Alabama Department of Transportation's Maintenance Bureau. The type of herbicide required on the project and the required application rate will be shown on the Plans.

668.03 Construction Requirements.

(a) EQUIPMENT.

1. EQUIPMENT FOR BROADCAST SPRAYING.

The Contractor shall utilize equipment in this contract that is in good working condition and is suitable and safe for accurately dispensing herbicide within the right-of-way limits of the highway and for performing the work required under this contract. The contractor shall provide sufficient equipment and accessory items necessary for efficient operation and completion of the herbicide application in the designated time limitations.

Broadcast spraying equipment shall be capable of controlling the rate of application using a computerized, calibrated sprayer. The computer module and accessory equipment shall be capable of monitoring ground speed with the ability to compensate the output volume of the spray solution to provide accurate and uniform dispensing of the spray solution to the surface area of the highway right-of-way throughout the operable speed range. The computer shall have a non-volatile memory with the ability to store and report data. Reporting capability shall include quantity of material sprayed, area treated, and hours of operation on a daily basis.

Equipment shall be capable of dispensing herbicide by either (1) tank mixed solution, or (2) chemical injection and mixing immediately prior to the distribution nozzles. In the event tank mix equipment is used, means shall be provided for constant agitation (either jet or mechanical) of the mixture during the filling and spraying operation. Each piece of equipment shall be equipped with a hand gun and nozzles capable of spreading the mixed solution uniformly, at the specified rate, over surface areas missed or inaccessible to the broadcast spraying.

Herbicide application equipment operated from the roadway or paved shoulder surface shall be equipped with a portable sequential arrow unit and impact attenuator or be immediately followed at all times by a shadow vehicle equipped with these two items.

Smaller motorized ground operated equipment may be used with the approval of the Engineer. This equipment may be used on smaller areas, such as landscaped areas within the limits of the right-of-way. The smaller areas are defined as the areas that are inaccessable to truck mounted and agricultural type sprayers normally used for broadcast applications from the roadway or open areas within the right-of-way. This smaller motorized ground operated equipment shall be equipped with a hand gun and/or nozzles capable of spreading the mixed solution uniformly over the area to be

treated. Means shall be provided for constant agitation (either jet or mechanical) of the mixture during the filling and spraying operations.

2. EQUIPMENT FOR SPOT SPRAYING.

Spot spraying by means of hand guns, backpack sprayers, portable tanks, etc., shall be capable of applying the herbicide solution at the designated plan rate or as directed by the Engineer. Herbicides placed with this type equipment shall dispense solution which contains the correct herbicide to carrier ratio. The herbicide solution shall be directed and placed on the target area to provide uniform, adequate and proper coverage.

(b) METHODS OF OPERATION.

Prior to beginning work, a conference between representatives of the Department and the Contractor will be arranged by the Department. In this meeting plans, specifications, unusual conditions, methods for marking non-sprayable areas, and other pertinent items regarding the work will be discussed. Certain "No-Spray" areas may occur; these fall within the defined limits of the spraying area as indicated by the plans and specifications. These areas are where various businesses or agencies have ornamental plantings or improved turf within the highway right-of-way and perform their own maintenance, or as directed by the Engineer. The Department will determine all non-sprayable areas.

Spraying will not be permitted when, in the opinion of the Engineer, soil, vegetation, and/or weather conditions are such that the right-of-way or the vegetation would be damaged or spraying would be ineffective.

The Contractor shall spray as close as practicable to all fixed objects, exercising extreme care not to damage trees, plants, shrubs, signs, delineators or other appurtenances which are part of the facility. Any damage caused by the Contractor's spraying operations to any tree, plant, shrub, sign, delineator or other appurtenance which is part of the facility shall be pruned, trimmed, repaired or replaced immediately by the Contractor at no cost to the Department. The Engineer will determine whether the damage shall be corrected by pruning, trimming, repair or replacement.

The Contractor shall be responsible for any damage to public or private property which may occur as a result of the spraying operation.

(c) SPRAYING APPLICATION REQUIREMENTS.

The Contractor shall possess the appropriate license and permit required by the State of Alabama Department of Agriculture and Industries for conducting business in the State of Alabama.

All personnel directly involved in the application of the herbicide solution, to include operators and project supervisory personnel, shall be experienced in the ground application of pesticides on highway rights-of-way.

Operators and project supervisors involved with this project shall possess a commercial applicator permit issued by the State of Alabama Department of Agriculture and Industries covering the "Right-of-Way" category.

The Contractor will furnish two copies of product labels and material safety data sheets for the products used on the project. One copy of each will be furnished to the Engineer and one copy will be kept with the vehicles applying the herbicide at all times.

While spraying, care shall be exercised to prevent damage by spray drift or direct contact of herbicide to areas containing plantings of shrubs and bushes, designated wildflower areas, deciduous or evergreen trees, residential plantings, vegetable or flower gardens, any susceptible farm crops, or other desirable plants. In the event of damage to any desirable plants which includes damage or "brown-out" to low hanging limbs of trees along the right-of-way, the Contractor will correct by either replacement, pruning, trimming or compensation of any damages caused by the misapplication or drift of the herbicide solution immediately following visual recognition, verbal or written notification and/or instructions from the Engineer.

No herbicide solution shall be sprayed without a drift control agent. No spraying shall be undertaken when the wind velocity is 5 mph {8 km/h} or greater.

No spraying shall be undertaken during a rain, when heavy rain is imminent, or when soil is saturated.

The Contractor shall take extreme care to insure that herbicide does not enter any lakes, streams, ponds or wetlands.

The speed of any vehicle used to apply the herbicide solution to the highway right-of-way, shall not exceed 11 mph {18 km/h} when operated from the roadway/paved shoulder surface or 5 mph {8 km/h} when operated off the improved portion of the roadway.

The pattern of spray shall be such as to provide even, uniform coverage.

(d) LIABILITY OF CONTRACTOR.

The Contractor shall assume all liability for any damage resulting from the application of the herbicides for this project and shall hold the State of Alabama harmless from any claims arising from this damage. It is illegal to place herbicides in a manner that is not consistent with the requirements shown on the herbicide container labeling.

(e) RECORD OF WORK.

It shall be the Contractor's responsibility to "scout ahead" for each day's anticipated work. Department-furnished forms (BM-196) "Herbicide Scouting Report" shall be completed prior to the beginning of each day's work. A completed and signed copy shall be furnished to the Department's Engineer for each day's operation.

The Contractor shall account for each day's work and provide information on location, area covered, weather conditions, personnel, equipment, herbicide used, rates and productivity. This information shall be provided on the Department's "Herbicide Treatment Report", which will be provided by the Department. A completed and signed copy of this report shall also be furnished to the Department's Engineer for each day's work.

668.04 Method of Measurement.

Item 668-A will be measured in acres {hectares} computed from surface measurements taken parallel to the treated surface. Computations will be to the nearest 0.1 of an acre {0.1 ha}.

Item 668-B will be measured by the gallon {L} of dispensed solution with measurements taken from the storage vessel before and following dispersal to determine the actual amount of solution used. Computations will be to the nearest gallon {L}.

Item 668-C will be measured by the square yard {square meter} of dispensed solution with surface measurements taken parallel to the treated surface. Computations will be to the nearest 0.1 square yard {0.1 square meter}.

668.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Payment for all satisfactorily completed work of pre-emergent herbicide application as specified, measured as provided above, will be paid for at the contract bid price which shall be full compensation for furnishing all labor, equipment, herbicides, adjuvants, carrier, fuels, incidentals and liability insurance necessary to complete the work. Partial payments will be made on monthly estimates based on the percentage of the total work performed as estimated by the Engineer.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

668-A Broadcast Pre-Emergent Herbicide Treatment (*) (**) (***) (****) per acre (ha)
668-B Spot Pre-Emergent Herbicide Treatment (*) (**) (***) (****) per gallon {L}
668-C Spot Pre-Emergent Herbicide Treatment (*) (**) (***) (****)
per square yard {square meter}

* Specify Type of Herbicide
** Specify Rate of Herbicide Application
*** Specify Carrier Rate of Application
**** Specify Type of Carrier

SECTION 669
POST-EMERGENT HERBICIDE TREATMENT

669.01 DESCRIPTION

This section shall cover the work of applying contact (foliage active) herbicide(s) on the highway right-of-way in accordance with the plans, specifications, material label instructions or as directed by the Engineer to control the growth of noxious weeds, brush, vines and grasses.

669.02 MATERIALS

Materials furnished for use in this vegetation control work shall be produced by reputable, recognized manufacturers and registered by the U.S. Environmental Protection Agency. Materials shall be licensed for use in the State of Alabama and pre-qualified for use by the Alabama Department of

Transportation. An approved drift control agent shall be used in all liquid broadcast applications. Adjuvants, such as, but not limited to, surfactants shall be used when called for by product label instructions of the herbicide designated on the plans or directed by the Engineer. All herbicide and related adjuvants shall be labeled for right-of-way use. Unless specified otherwise by the plans and/or proposal, potable water shall be the carrier for dispersing the herbicide. The use of herbicides other than those dispensed with a water carrier, such as herbicides dispensed with oil shall be placed as indicated on the product label at locations indicated on the plans, or as directed by the Engineer. Herbicides and their application rates that are approved for use on ALDOT rights-of-way may be found in the latest edition of the Addendum to "A Manual for Roadside Vegetation Management – Chapter IV" which is revised, printed and distributed annually by the Alabama Department of Transportation's Maintenance Bureau. The type of herbicide and the required application rate will be shown on the plans.

669.03 CONSTRUCTION EQUIPMENT

(a) EQUIPMENT

1. EQUIPMENT FOR BROADCAST SPRAYING.

The Contractor shall utilize equipment in this contract that is in good working condition and is suitable and safe for accurately dispensing herbicide within the right-of-way limits of the highway and for performing the work required under this contract. The contractor shall provide sufficient equipment and accessory items necessary for efficient operation and completion of the herbicide application in the designated time limitations.

Broadcast spraying equipment shall be capable of controlling the rate of application using a computerized, calibrated sprayer. The computer module and accessory equipment shall be capable of monitoring ground speed with the ability to compensate the output volume of the spray solution to provide accurate and uniform dispensing of the spray solution to the surface area of the highway right-of-way throughout the operable speed range. The computer shall have a non-volatile memory with the ability to store and report data. Reporting capability shall include quantity of material sprayed, area treated, and hours of operation on a daily basis.

Equipment shall be capable of dispensing herbicide by either (1) tank mixed solution, or (2) chemical injection and mixing immediately prior to the distribution nozzles. In the event tank mix equipment is used, means shall be provided for constant agitation (either jet or mechanical) of the mixture during the filling and spraying operation. Each piece of equipment shall be equipped with a hand gun and nozzles capable of spreading the mixed solution uniformly, at the specified rate, over surface areas missed or inaccessible to the broadcast spraying.

Herbicide application equipment operated from the roadway or paved shoulder surface shall be equipped with a portable sequential arrow unit and impact attenuator or be immediately followed at all times by a shadow vehicle equipped with these two items.

Smaller motorized ground operated equipment may be used with the approval of the Engineer. This equipment may be used on smaller areas, such as landscaped areas within the limits of the right-of-way. The smaller areas are defined as the areas that are inaccessable to truck mounted and agricultural type sprayers normally used for broadcast applications from the roadway or open areas within the right-of-way. This smaller motorized ground operated equipment shall be equipped with a hand gun and/or nozzles capable of spreading the mixed solution uniformly over the area to be treated. Means shall be provided for constant agitation (either jet or mechanical) of the mixture during the filling and spraying operations.

2. EQUIPMENT FOR SPOT SPRAYING.

Spot spraying by means of hand guns, backpack sprayers, portable tanks, etc., shall be capable of applying the herbicide solution at the designated plan rate or as directed by the Engineer. Herbicides placed with this type equipment shall dispense solution which contains the correct herbicide to carrier ratio. The herbicide solution shall be directed and placed on the target area to provide uniform, adequate and proper coverage in accordance with label instructions and as directed by the Engineer.

(b) METHODS OF OPERATION

Prior to beginning work, a conference between representatives of the Department and the Contractor will be arranged by the Department. In this meeting plans, specifications, unusual conditions, methods for marking non-sprayable areas, and other pertinent items regarding the work will be discussed. Certain "No-Spray" areas may occur; these fall within the defined limits of the

spraying area as indicated by the plans and specifications. These areas are where various businesses or agencies have ornamental plantings or improved turf within the highway right-of-way and perform their own maintenance, or as directed by the Engineer. The Department will determine all non-sprayable areas.

Spraying will not be permitted when, in the opinion of the Engineer, soil, vegetation, and/or weather conditions are such that the right-of-way or the vegetation would be damaged or spraying would be ineffective.

The Contractor shall spray as close as practicable to all fixed objects, exercising extreme care not to damage trees, plants, shrubs, signs, delineators or other appurtenances which are part of the facility. Any damage caused by the Contractor's spraying operations to any tree, plant, shrub, sign, delineator or other appurtenance which is part of the facility shall be pruned, trimmed, repaired or replaced immediately by the Contractor at no cost to the Department. The Engineer will determine whether the damage shall be corrected by pruning, trimming, repair or replacement.

The Contractor shall be responsible for any damage to public or private property which may occur as a result of the spraying operation.

(c) SPRAYING APPLICATION REQUIREMETNTS.

The Contractor shall possess the appropriate license and permit required by the State of Alabama Department of Agriculture and Industries for conducting business in the State of Alabama.

All personnel directly involved in the application of the herbicide solution, to include operators and project supervisory personnel, shall be experienced in the ground application of pesticides on highway rights-of-way.

Operators and project supervisors involved with this project shall possess a commercial applicator permit issued by the State of Alabama Department of Agriculture and Industries covering the "Right-of-Way" category.

The Contractor will furnish two copies of product labels and material safety data sheets for the products used on the project. One copy of each will be furnished to the Engineer and one copy will be kept with the vehicles applying the herbicide at all times.

While spraying, care shall be exercised to prevent damage by spray drift or direct contact of herbicide to areas containing plantings of shrubs and bushes, designated wildflower areas, deciduous or evergreen trees, residential plantings, vegetable or flower gardens, any susceptible farm crops, or other desirable plants. In the event of damage to any desirable plants which includes damage or "brown-out" to low hanging limbs of trees along the right-of-way, the Contractor will correct by either replacement, pruning, trimming or compensation of any damages caused by the misapplication or drift of the herbicide solution immediately following visual recognition, verbal or written notification and/or instructions from the Engineer.

No herbicide solution shall be sprayed without a drift control agent. No spraying shall be undertaken when the wind velocity is 5 mph {8 km/h} or greater.

No spraying shall be undertaken during a rain, when rain is imminent, or when foliage is wet. In the event a rain occurs producing a rainfall of one-tenth of an inch {2.5 mm} within four hours or less after the treatment of an area, the area shall be retreated without additional compensations. No spraying shall be undertaken during extended periods of extremely high temperatures and drought conditions.

The Contractor shall take extreme care to insure that herbicide does not enter any lake, stream, pond or wetlands.

The speed of any vehicle used to apply the herbicide solution to the highway right-of-way, shall not exceed 11 mph {18 km/h} when operated from the roadway/paved shoulder surface or 5 mph {8 km/h} when operated off the improved portion of the roadway.

The pattern of spray shall be such as to provide even, uniform coverage.

(d) LIABILITY OF CONTRACTOR

The Contractor shall assume all liability for any damage resulting from the application of the herbicides for this project and shall hold the State of Alabama harmless from any claims arising from this damage. It is illegal to place herbicides in a manner that is not consistent with the requirements shown on the herbicide container labeling

(e) RECORD OF WORK

It shall be the Contractor's responsibility to "scout ahead" for each day's anticipated work. Department-furnished forms (BM-196) "Herbicide Scouting Report" shall be completed prior to the

beginning of each day's work. A completed and signed copy shall be furnished to the Department's Engineer for each day's operation.

The Contractor shall account for each day's work and provide information on location, area covered, weather conditions, personnel, equipment, herbicide used, rates and productivity. This information shall be provided on the Department's "Herbicide Treatment Report", which will be provided by the Department. A completed and signed copy of this report shall also be furnished to the Department's Engineer for each day's work.

669.04 METHOD OF MEASUREMENT

Item 669-A will be measured in acres {hectares} computed from surface measurements taken parallel to the treated surface. Computations will be to the nearest 0.1 of an acre {0.1 ha}.

Item 669-B will be measured by the gallon {liter} of dispensed solution with measurements taken from the storage vessel before and following dispersal to determine the actual amount of solution used. Computations will be to the nearest gallon {L}.

Item 669-C will be measured by the square yard {square meter} of dispensed solution with surface measurements taken parallel to the treated surface. Computations will be to the nearest 0.1 square yard {0.1 square meter}.

669.04 BASIS OF PAYMENT

(a) UNIT PRICE COVERAGE

Payment for all satisfactorily completed work of pre-emergent herbicide application as specified, measured as provided above, will be paid for at the contract bid price which shall be full compensation for furnishing all labor, equipment, herbicides, adjuvants, carrier, fuels, incidentals and liability insurance necessary to complete the work. Partial payments will be made on monthly estimates based on the percentage of the total work performed as estimated by the Engineer.

(b) Payment will be made under Item No.:

669-A Broadcast Post-Emergent Herbicide Treatment (*) (**) (***) (****) per acre {ha}
669-B Spot Post-Emergent Herbicide Treatment (*) (**) (***) (****) per gallon {L}
669-C Spot Post-Emergent Herbicide Treatment (*) (**) (***) (****) per square yard {square meter}

* Specify Type
** Specify Rate
*** Specify Carrier Rate of Application
**** Specify Type of Carrier

SECTION 680
ENGINEERING CONTROLS

680.01 Description.

When this item is included in the proposal, it shall consist of the Contractor furnishing, placing, and maintaining construction stakes, lines, and grades necessary for the proper prosecution of the work under the contract, all in accordance with these specifications.

680.02 Materials.

All materials needed in the performance of the work under this Section shall be furnished by the Contractor.

680.03 Construction Requirements.

(a) DETERMINATION OF LINES AND GRADES.

The Engineer will furnish centerline control points (P.C.s, P.O.C.s, P.T.s, P.O.T.s, etc.) at intervals determined necessary by the Engineer in order for the Contractor to establish alignment on all roadways. Where ramps, cross roads, service roads, etc. are geometrically tied by plan details to the mainline roadway, the Engineer will only be responsible for establishing these control points along the mainline. The Engineer will stake the right-of-way and mark the clearing limits.

Bench marks will be furnished at intervals along the project for vertical control. Sufficient design roadway section information (elevations, slope ratios, etc.) will be provided to enable the Contractor to establish grade stakes and slope stakes. Alignment data and flowline data for drainage

structures (including box culverts) will be furnished the Contractor. For each bridge site, except box culverts, the Engineer will furnish a minimum of two horizontal control points and one bench mark for vertical control.

(b) CONTRACTOR'S RESPONSIBILITY.

The Contractor shall be responsible for all layout and engineering control work necessary for construction of all items of work covered by the contract utilizing the construction plans and the controls and design section data furnished by the Engineer as required by Subarticle (a) above. The Contractor shall be responsible for the referencing and the preservation of all furnished controls. If, in the opinion of the Engineer, any required state-furnished control stakes or marks are disturbed by the Contractor, the cost of replacing them shall be deducted from the payment for the work.

The Contractor shall check all furnished controls as a first order of work to assure himself that they are accurate. The Contractor's use of all furnished points and marks for construction of the project shall be prima facie evidence that he has satisfied himself that they are accurate and correct, and shall waive all claims for extra compensation for corrective work should they later be found to be incorrect. All discrepancies shall be reported immediately to the Engineer in writing.

From data furnished, the Contractor will be required to prepare and set grade stakes, set slope tie stakes (the Engineer may direct minor adjustments to fit the terrain), and other stakes necessary for grading operations; establish a centerline on each graded roadbed; and set blue-tops (centerline and transverse break points) at intervals not to exceed 100 feet {30 m} on tangents and 50 feet {15 m} on curves.

For control of alignment and elevation of base and pavement layers, the Contractor shall establish a line of horizontal and vertical control stakes along and near each side of each roadbed. These control stakes shall be set on intervals not to exceed 50 feet {15 m}. Each layer of soil and/or aggregate base shall be blue-topped (centerline and transverse break points) at intervals not to exceed 50 feet {15 m}.

For all bridge work the Contractor shall establish and maintain all horizontal and vertical control points, and furnish all lines and grades necessary for the bridge construction from the initial layout to the final acceptance of the bridges. The Contractor shall stake and reference all abutments, bents, and piers of each bridge structure prior to beginning work on any portion of the bridge. The staking shall be in accordance with methods shown in Volume 1, Part 2, Section E of the Department's Construction Manual or other method approved by the Engineer. Inaccessible piers shall be referenced by triangulation or other approved method. After construction of the substructure, the Engineer will check all cap elevations prior to construction of the superstructure. All discrepancies shall be resolved prior to proceeding with the superstructure construction. After the beams or girders are set, the Contractor shall profile them and check them against the plan grades. From this profile data, the deck forms shall be set to provide the deck thickness shown on the plans between the beams or girders. The Contractor shall accurately set all forms, headers, rails, and screeds to provide the dimensions, elevations, and grades shown on the plans. Upon completion of each structure, the Engineer will run a three-line profile of the bridge deck and check the finished surface against the plan grades.

The Contractor shall be liable for the accuracy of the alignment and elevation during construction operations. The Contractor, at his expense, shall restore, repair, or otherwise make good any portion of the work found to be incorrectly positioned (either horizontally or vertically) at any time prior to final acceptance of the work.

All inspection and measurements for payment required by the plans and specifications will be performed by the Department and is not classified as a part of the engineering controls.

(c) FURNISHING STAKES, TEMPLATES, ETC.

The Contractor shall furnish free of charge, all stakes, hubs, templates, straight-edges, and other materials necessary for constructing the work. He shall also furnish the Engineer with these items and materials as well as incidental labor as he may require to check the work prior to acceptance.

(d) ENGINEER/CONTRACTOR COOPERATION.

It will be necessary for the Engineer to take and plot cross-sections of the original ground, take and plot drainage sections, plot roadway templates, and prepare grade books in order to furnish the roadway design data required by Subarticle (a) above. The Engineer will make every effort to furnish the engineering controls and design data covered in Subarticle (a) as soon as possible after the contract has been executed and approved. Immediately after contract approval, the Contractor shall notify the Engineer as to areas where he plans to begin clearing and grading operations. The Project

Engineer will then concentrate his efforts in these areas (if not ready) where the Contractor will not be delayed after issuance of the Notice to Proceed.

The Contractor shall continue to coordinate his proposed work plans with the Project Engineer in an effort to avoid unnecessary delays. Should it become necessary for the Engineer to make grade changes during construction, the Contractor shall give the Engineer reasonable time to furnish new design data.

If, in the opinion of the Engineer, the Contractor has worked cooperatively and the overall project is delayed because of the Department's failure to furnish the required controls and/or design data in an expeditious manner, consideration will be given to a time extension.

680.04 Method of Measurement.

Measurement of the item of Engineering Controls will be made on a lump sum basis. When more than one project is included in a contract, each project will be designated a fractional part of the lump sum as shown on the plans.

680.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The item of Engineering Controls, measured as noted above, will be paid for at the contract lump sum price bid. Said lump sum shall be full compensation for furnishing all materials, equipment, tools, labor, and incidentals necessary to complete this item of work.

Partial payments for the item of Engineering Controls will be made on monthly estimates with the amount to be paid each month a percentage of the lump sum amount bid. This percentage shall be the same as the percentage of project completion during the estimate period.

When more than one project is included in a contract, payments will be made similar as outlined above with each project figured separately using the percentage of lump sum shown on the plans.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

680-A Engineering Controls - per lump sum

DIVISION 700
TRAFFIC CONTROL DEVICES AND HIGHWAY LIGHTING

SECTION 701
TRAFFIC STRIPE

701.01 Description.

This Section shall cover the work of furnishing all materials and the application of the materials to form either a permanent or temporary traffic stripe in substantial conformity with plan details and these specifications at the location shown on the plans or directed.

Dimensions, color, type of material and reflectivity of the stripe will be designated on the plans or in the proposal. The type of material will be designated by "Class" and the reflectivity of the material will be designated by "Type" according to the following:

CLASS	MATERIAL
1	Paint
2	Standard Thermoplastic Material
2T	Thin Film Spray Applied Thermoplastic Material
3	Tape
3W	Warranted Profiled Tape
TYPE	**REFLECTIVITY**
A	Reflective
B	Non-reflective

For the purpose of these specifications two (2) kinds of traffic stripe are designated: (1) standard or permanent traffic stripe and (2) temporary traffic stripe. Standard or permanent stripe shall be used at all times unless otherwise provided by the plans or proposal or ordered by the Engineer. Temporary stripe is a safety item designated to be used by the Engineer as deemed necessary for protection of the traveling public, on a short term basis. Unless specifically ordered in writing, no section of road shall be opened to traffic without either a temporary or permanent (as appropriate) traffic stripe having been placed.

In addition this Section shall cover the removal of existing or temporary traffic stripe when such is provided by the plans or proposal or directed by the Engineer.

701.02 Materials.

Materials furnished for use shall comply with the appropriate provisions of Division 800, Materials, with special reference to Sections 856 and 857. Section 856 covers three classes of permanent traffic marking materials and unless otherwise noted the Contractor may select any of the classes for use as a permanent marking material.

Temporary traffic striping material may be either of the following:

a. Reflectorized permanent traffic paint or removable traffic paint complying with the provisions of Section 856.

b. An approved reflectorized pressure sensitive traffic marking tape complying with the provisions of Section 857.

The Department has established List V-3, Temporary Traffic Marking Materials, and List V-4, Permanent Traffic Marking Materials. These lists are in the Department's Manual, "Materials, Sources, and Devices with Special Acceptance Requirements". Only the materials shown on these lists shall be furnished for use. Information concerning these lists is given in Subarticle 106.01(f) and ALDOT-355.

701.03 Construction Requirements.

(a) EQUIPMENT.

1. GENERAL.

Selection of the proper equipment to produce satisfactory results within the basic requirements noted in this Section shall be the responsibility of the Contractor.

Basic requirements are as follows:

a. A type that will permit traffic to pass safely within the limits of the roadway surface and shoulder while the unit is operating.

b. Designed for placement of both solid, broken, and dotted line stripes of the spacing shown on the plans with square neat stripe ends.

c. Provide for application of "drop-on" glass beads when reflectorized stripe is required.

d. Provide for application of striping material in accordance with the following:

(1) Application of Paint Stripe.

The spray machine shall have an attachment that will permit accurate regulation of the rate of application and a tachometer or other approved device to insure uniform paint application at the designated rate.

It shall be adjustable for applying one or two adjacent lines simultaneously along the centerline as may be required. The operation of the unit shall be such that paint will not be spattered or blown on another stripe. The unit shall be so designed that the paint will be properly agitated while in operation.

(2) Application of Thermoplastic Stripe.

The application equipment shall be especially designed for placing the plastic material in a hot molten state on the pavement, utilizing either an extrusion or spray method. Equipment shall have the capability of providing continuous mixing and agitation of the material while maintaining the material at the proper placement temperature in a continuous stripe of uniform thickness and width. The use of direct flame heat will not be allowed in any heating operation.

(3) Application of Tape Stripe.

Application of the tape material shall be in accordance with recommended procedures of the manufacturer of the material.

Applying the material when the pavement temperature is below 60 °F {16 °C} will not be allowed unless such is within the manufacturer's recommendations for placing and is authorized by the Engineer.

Characteristics of this type material are such that, under certain conditions, it can be placed during the rolling operations of a new bituminous plant mix layer.

2. TEMPORARY STRIPING EQUIPMENT.

Equipment for applying temporary striping shall be suitable for placing of the stripe in accordance with requirements noted elsewhere in this Section.

(b) CLEANING PAVEMENT.

All pavement areas to be striped shall be thoroughly cleaned using whatever equipment is necessary to clean the pavement thoroughly without damaging the surface taking particular care to remove all vegetation, loose soil, oils, and other debris from areas where edge striping is to be applied. Where necessary, the surface shall be wet with a water jet and scrubbed to dislodge all foreign material. After washing, the surface shall be allowed to dry thoroughly and any film of dried mud apparent after surface drying shall be removed before application of paint. Striping shall follow as closely as practicable after the surface has been cleaned and dried, but no striping shall be done until the surface has been inspected and permission given to proceed. Compensation for cleaning the surface shall be included in the contract unit prices of the striping pay items.

(c) REMOVING STRIPE.

Where so shown on the plans or directed, the traffic stripe, existing or temporary, shall be removed by sand blast, approved grinding equipment, approved chemical process, or similar approved methods that will not damage the surface. Burning or painting over the old stripe will not be permitted. Removal of traffic stripe, existing or temporary, will be paid for as a separate item of work. Where traffic stripe removal consists of removing pavement markers used as traffic stripes, the markers shall be removed by a method approved by the Engineer which shall completely remove the marker and adhesive without scarring or disfiguring the pavement. Where so shown on the plans or directed, existing traffic stripe, either paint, plastic or tape, located between markers shall be removed by one of the above mentioned methods and will be considered incidental to the work.

Where unsatisfactory striping performed by the Contractor must be removed and replaced in compliance with these specifications, the Contractor shall use one of the removal methods described above. No payment will be made for removal or replacement of the Contractor's unsatisfactory striping.

(d) WEATHER CONDITIONS.

No permanent striping will be permitted when (1) there is any moisture on the pavement surface or the air is misty, (2) the surface temperature of the pavement to be striped is below 40 °F {5 °C} for paint or 50 °F {10 °C} for thermoplastic, unless special disposition is authorized in writing, (3) wind or other conditions cause a film of dust to be deposited on the surface after cleaning and before striping can be placed, or (4) other conditions that in the opinion of the Engineer, would displace, damage or affect the bonding of the striping material to the pavement surface. Any striping placed in violation of the above conditions or damaged due to water or rain within 15 minutes after application, shall be removed and replaced without additional compensation.

For temporary striping the weather conditions noted above may be waived at the Engineer's discretion to obtain a traffic stripe before allowing traffic to traverse the roadway.

Unless authorized otherwise in writing by the Engineer, striping shall be accomplished during daylight hours. Approved lighting arrangements will be required for night time operations.

(e) APPLICATION.

1. GENERAL.

All striping and pavement markings shall be placed in accordance with the requirements of these Specifications, the detailed plans, and Part III of the current MUTCD.

The Engineer will indicate, on some identifiable point off the pavement surface, the limits of no-passing zones. The Contractor shall provide all other engineering services necessary for pre-marking of all proposed stripe within the limits of the designated work.

The Contractor may be required to paint over some existing stripe, as determined by the Engineer. This may require adjusting the operation of the sprayers to match the previous lengths of stripes and skips.

No striping material shall be applied over a guide cord; only longitudinal joints, existing stripes, or other approved type guides will be permitted.

In the absence of a longitudinal joint or existing stripe, the Contractor shall mark the points necessary for the placing of the proposed stripe. Edge striping shall be adjusted as necessary so that the edge stripe will be parallel to the centerline and not run off the edge of the pavement.

If a reflectorized stripe is required and a material with "premixed" glass beads is used, it shall be treated with a top dressing of glass beads as noted to provide instant reflectivity. Application of this top dressing shall be timed so that the beads will be firmly attached to the material before final set has occurred and accomplished in such a manner as to provide uniform coverage of the full width of stripe being placed. The minimum rate of application of this treatment shall be:

Minimum Rate of Application For Stripe With "Premixed" Glass Beads		
Type of Stripe	4 inch {100 mm} wide	6 inch {150 mm} wide
Solid Paint Stripe	44 pounds per mile {12.5 kg/km}	66 pounds per mile {18.75 kg/km}
Solid Thermoplastic Stripe	88 pounds per mile {25.0 kg/km}	132 pounds per mile {37.5 kg/km}

Appropriate adjustments shall be made for broken stripe.

If a reflectorized stripe is required and material without "premixed" glass beads is used, glass beads shall be applied at the same time but in a separate operation. The minimum rate of application of this treatment shall be:

Minimum Rate of Application For Stripe Without "Premixed" Glass Beads		
Type of Stripe	4 inch {100 mm} wide	6 inch {150 mm} wide
Solid Paint Stripe	117 pounds per mile {33.0 kg/km}	175.5 pounds per mile {49.5 kg/km}

Appropriate adjustments shall be made for broken stripe. The glass beads shall be applied to the material before final set has occurred and accomplished in such a manner as to provide uniform coverage for the full width of the stripe.

The operation of applying the drop-on glass beads shall be such that will insure adequate embedment and uniform coverage of the glass beads in the amounts noted for the type striping material used. A periodic check (at least every kilometer) which does not indicate uniform coverage and/or adequate embedment of beads shall be cause for ordering the effected section to be reworked without additional cost to the Department.

Failure of the striping material to adhere to the pavement surface during the life of the contract shall be prima facie evidence that the materials, even though complying with these

specifications, or the application thereof, was inconsistent with the intent of the requirements for the work under this Section and shall be cause for ordering corrective action or replacement of the stripe, all without additional cost to the Department.

Placement of permanent traffic marking material on freshly placed pavements, especially bituminous pavements, can be detrimental to the life expectancy of the marking material; hence, every effort should be made to allow the pavement to cure for approximately 14 days before placing of the marking material.

2. PAINT STRIPES.

a. Preparation of Paint.

Immediately before application, paints shall be agitated and mixed thoroughly to a uniform consistency, free from lumps or agglomerates. Paints shall be kept covered to retain volatiles. Paints shall not be thinned unless approval is given to correct consistency.

b. Rate of Application.

1. General requirements:

The application rates for solid stripe are given in the following paragraphs. Appropriate adjustment shall be made for broken lines or other width traffic lines.

The application rate shall not be more than 5 % under the designated rate in any mile. At any point where a check indicates a variation in excess of 5 % under the designated rate, the work shall be stopped and the equipment adjusted or replaced. This tolerance is for providing leeway in equipment adjustment only; a consistent and uncorrected underrun, even within the 5 % tolerance will not be acceptable; the Contractor will be required to approach closely the designated rate.

The paint machine shall be so designed that its operation will be at a uniform speed on a grade as well as level ground. The operating speed of the equipment shall be approved by the Engineer consistent with the characteristics of the equipment's capabilities to produce an acceptable stripe at the rate noted in paragraph one of this Subitem.

2. Smooth textured pavement surface (concrete or bituminous plant mix):

For a 4 inch {100 mm} solid stripe, paint shall be applied at the rate of 18 gallons per mile {43 L/km}. For a 6 inch {150 mm} solid stripe, paint shall be applied at the rate of 27 gallons per mile {64.5 L/km}.

3. Rough textured pavement surface (bituminous surface treatment or an open graded plant mix):

For a 4 inch {100 mm} solid stripe, paint shall be applied at the rate of 22 gallons per mile {52 L/km}. For a 6 inch {150 mm} solid stripe, paint shall be applied at the rate of 33 gallons per mile {78 L/km}. The Engineer may direct that the paint be applied at a different rate to cover an unusually rough pavement surface.

3. THERMOPLASTIC STRIPES.

a. Preparation of Materials.

The thermoplastic material shall be prepared in accordance with the recommendations of the manufacturer of the thermoplastic material. Special care shall be exercised in obtaining the proper molten state temperature and retaining said temperature during the application operation.

b. Rate of Application.

Unless provided otherwise by the proposal, and shown on the plans or directed by the Engineer, the rate of application of the standard thermoplastic striping, Class 2, shall be such as to produce a minimum average film thickness of 0.090 inch {2.3 mm} on lane striping and 0.060 inch {1.5 mm} on edge striping.

The rate of application of the thin film spray applied thermoplastic striping, Class 2T, shall be such as to produce a minimum average film thickness of 0.030 inch {0.8 mm} on lane and edge striping.

The thickness of the material shall be verified periodically (at least every 1/2 mile {kilometer}) and thickness more than 5 % under the designated thickness shall be reworked. A consistent, uncorrected underrun, even within 5 %, will not be accepted and the Contractor will be required to approach closely the specified thickness.

The pavement surface shall be treated with an approved primer-sealer just prior to application of the thermoplastic to facilitate bonding of the striping material to the pavement surface if recommended by the producer of the material. The rate of application of the primer-sealer shall be as recommended by the producer of the material.

4. TAPE STRIPES.

Application of the tape material shall be in accordance with recommended procedures of the manufacturer of the material.

Applying the material when the pavement temperature is below 60 °F {16 °C} will not be allowed unless such is within the manufacturer's recommendations for placing and is authorized by the Engineer.

Characteristics of this type material are such that, under certain conditions, it can be placed during the rolling operations of a new bituminous plant mix layer.

5. TEMPORARY STRIPE.

a. General.

Temporary striping has been designed for use when it is necessary to provide temporary pavement markings for traffic control during construction of a project. Said striping patterns and colors shall be consistent with the requirements of the MUTCD, the plan details, and the following:

Centerline and lane lines shall be broken line stripes unless the Traffic Control Plan in the plans specifies the use of a solid line stripe to control vehicular passing. Edge lines will not be required unless provided for on the plans or directed by the Engineer.

A broken line stripe shall consist of 4 inch or 6 inch {100 mm or 150 mm} wide by 8 foot {2.4 m} long markings placed on 40 foot {12 m} centers. A solid line shall be a continuous 4 inch or 6 inch {100 mm or 150 mm} wide stripe. Other width stripes may be required as shown on the plans.

Special attention is directed to the requirement that no section of road shall be opened to traffic without a traffic stripe as specified in Article 701.01. When traffic is to be maintained through the work, appropriate lane lines shall be maintained at all times. Existing lane lines covered by paving operations shall be replaced with temporary stripe.

In general the removal of the temporary striping prior to placement of a subsequent paving layer or permanent stripe will not be required except as follows:

(1) A solid line stripe of marking tape used on an underlying pavement layer, or any type stripe of marking tape used on a wearing surface.

(2) A solid line stripe of paint used on a wearing surface which is not to be replaced with a Class 1 permanent stripe that will completely cover the temporary stripe.

The removal of any temporary stripe shall be by such methods that will not damage nor disfigure the pavement surface of a wearing layer.

b. Temporary Traffic Marking Tape.

In general, the application of traffic marking tape shall be in accordance with the recommendations of the manufacturer of the material; however, minor changes will be allowed if such is shown to produce an equal or better application.

Note is made to the fact that approval for the use of this type material is subject to satisfactory performance under traffic. Any failure, for whatever reason, during the time frame the material is scheduled to perform shall be repaired immediately. Continued failure of a material to perform shall be cause for disallowing further use of that particular manufacturer's material.

Temporary type stripes of marking tape that are required to be removed shall be a product listed as a "REMOVABLE TAPES" on List V-3, TEMPORARY TRAFFIC MARKING MATERIALS, ("Materials, Sources, and Devices with Special Acceptance Requirements" manual).

c. Temporary Traffic Marking Paint.

Temporary traffic marking paints shall utilize standard Departmental traffic paints and beads. The paint and beads shall be placed at the same rate as specified for permanent stripe in Items 701.03(e)1 and 701.03(e)2 except that, for those places requiring a Class 2 permanent stripe, the temporary stripe shall be placed at the rate of 10 gallons per mile for 4 inch wide solid stripe and 15 gallons per mile for 6 inch wide solid stripe {24.0 L/km for 100 mm wide solid stripe and 36.0 L/km for 150 mm wide solid stripe}. Appropriate adjustments shall be made for broken stripe.

When Removable Traffic Paint is used, the paint shall meet the requirements of Subarticle 856.02(a) and be placed at the rate recommended by the manufacturer.

Equipment for placing the stripe shall be suitable for the purpose intended, capable of placing at least one stripe complete with beads.

(f) TOLERANCES.

1. STANDARD STRIPING.

A tolerance of 1/2 of an inch {13 mm} over or 1/8 of an inch {3 mm} under the specified 4 inch {100 mm} or 6 inch {150 mm} width will be allowed, provided the variation is gradual and does not detract from the general appearance. Segments of broken line may vary up to 1 foot {0.3 m} from the specified length. Segments shall square off at each end without mist or drip. Variations from the control guide up to 1 inch {25 mm} will be allowed provided the variation does not increase or decrease at a rate of more than 1/2 of an inch {13 mm} in 20 feet {7.5 m}. Lines that do not meet these tolerances shall be removed and replaced, without additional compensation. Establishment of tolerances does not relieve the Contractor of responsibility to construct as closely as practicable to exact plan dimensions.

2. TEMPORARY STRIPE.

The width of the temporary stripe shall not exceed the specified 4 inches {100 mm} or 6 inch {150 mm}, but shall have a 1/2 inch {13 mm} under tolerance. Traffic marking tape shall have a nominal 4 inch {100 mm} or 6 inch {150 mm} width. The tolerance for the lengths of the temporary broken stripe sections shall be 1 foot {0.3 m} under and 1 foot {0.3 m} over the length specified in Subitem 701.03(e)5.a. Strict compliance to alignment on underlying surfaces will not be required provided a reasonable straight line of markings is obtained. The tolerances for placement on a wearing surface shall be such that will not distort the alignment, etc. of the permanent stripe.

(g) PROTECTION OF TRAFFIC STRIPE.

Immediately following the application of the striping in areas under public traffic, traffic cones (Min. 7 inches {175 mm} high), red flags supported by springs or heavy wire on pedestals, or other approved devices, shall be placed alongside or over the line at intervals not exceeding 50 feet {15 m} to remain in place until the stripe has dried to such an extent that it will not be picked up by the tires of vehicles. All flags and supports shall be furnished and placed by the Contractor. It is essential that traffic be prevented from crossing a wet traffic stripe and should at any time the above provisions not be sufficient to prevent such, the Contractor shall use a sufficient number of flagmen, proper boards, or other protection for the wet stripe, particularly at crossings, to prevent traffic from crossing the wet stripe, or he shall reduce the amount of wet line by slowing down the striping operation. Sections of traffic stripe which have been marred or picked up by traffic crossing them before they have dried shall be repaired by the Contractor and the pavement cleaned outside the stripe without extra compensation.

(h) PROTECTION OF TRAFFIC.

The Contractor shall furnish and place without extra compensation all warning and directional signs required to direct, control and protect the traveling public while marking and striping operations are in progress. Temporary barricades of the design shown in the plans or as otherwise designated, together with the signs shown for use therewith, shall be placed as shown with reference to the pavement edges at the beginning and end of the section which the Contractor proposes to stripe in one operation. As soon as the striping material has dried sufficiently in any one section to permit traffic to cross the traffic line, the temporary barricades shall be moved ahead to the next section. No protectors or barricades shall be left in place overnight. The striping equipment shall be so operated that it will be unnecessary for the traffic to cross the newly placed traffic stripe behind the equipment in order to safely pass the striping machine, and the operation shall cause the least disruption to the normal flow of traffic as possible.

All protective and traffic warning devices shall be in accordance with Part VI of the current MUTCD.

(i) MAINTENANCE.

All sections of traffic striping, including temporary striping, which has been placed in accordance with the plans, specifications, and to the satisfaction of the Engineer, will be considered satisfactory, and the Contractor relieved of responsibility for ordinary maintenance on such sections after they are opened to public traffic, pending completion and acceptance of the contract. The Engineer reserves the right to order the Contractor to replace any traffic striping so placed with payment made under the appropriate Pay Item.

701.04 Method of Measurement.

(a) ITEMS 701-A, 701-B, 701-C, 701-E, 701-F, AND 701-G.

Solid or broken traffic stripe (Items 701-A, and 701-C) will be measured in miles {kilometers} along the centerline of each stripe either by direct measurement and computation to the nearest 0.001 mile {meter} or by odometer to the nearest 0.001 mile {meter}.

Solid, broken, or dotted traffic stripe (Items 701-B, 701-E, 701-F and 701-G) will be measured in linear feet {meters} along the centerline of the stripe to the nearest linear foot {meter}.

The length of broken traffic stripe and dotted traffic stripe complete in place and accepted will include the gaps shown on the plans as a part of the traffic line design but will not include the length of any other gap or section omitted by the Engineer.

Each 4 inch {100 mm} or 6 inch {150 mm} wide traffic stripe will be measured separately for payment.

(b) ITEMS 701-D AND 701-H.

Any traffic stripe, existing or temporary, removed as directed (Items 701-D and 701-H) will be measured in the same manner noted for placement of the type stripe involved.

Removal of markings or legends will be measured and paid for under the appropriate item provided in Section 703.

701.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The length of Solid or Broken Traffic Stripe, Item 701-A, and the length of Solid or Broken Traffic Stripe, Item 701-G, measured as noted above, will be paid for at the respective contract unit prices bid and shall be full compensation for the stripe complete in place which includes the cleaning of the pavement, the furnishing and applying of the striping material and for all equipment, tools, labor and incidentals necessary to complete the item of work.

The length of Dotted Traffic Stripe, Item 701-B, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for furnishing all materials of the appropriate color consistent with the use of the stripe in accordance with the plan details, the preparation of the pavement, the application of the striping material and for all equipment, tools, labor and incidentals necessary to complete this item of work.

The length of Solid or Broken Temporary Traffic Stripe, Item 701-C, and the length of Solid or Broken Temporary Traffic Stripe, Item 701-E, and Dotted Temporary Traffic Stripe, Item 701-F, measured as noted above, will be paid for at the respective contract unit prices bid which shall be full compensation for the furnishing of all materials, of the appropriate color consistent with the use of the stripe in accordance with the requirements of the plan details and the MUTCD, the preparation of the surface, the placing of the material, the maintenance of the traffic stripe, and for all equipment, miscellaneous materials, tools, labor and incidentals necessary to complete the item of work.

The length of existing or temporary Solid or Broken Traffic Stripe Removed, Item 701-D, and the length of Solid, Broken, or Dotted Traffic Stripe Removed, Item 701-H, measured as provided above, will be paid for at the contract unit price which shall be payment in full for all materials, equipment, tools, and labor necessary to complete the work. When the traffic stripe to be removed consists of pavement markers used as traffic stripes the cost of removing markers, marker adhesive, and existing paint, plastic or tape located between the markers shall also be included in the price.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

701-A Solid/Broken Color, Class * Type ** Traffic Stripe (***) - per mile {kilometer}
701-B Dotted Class * Type ** Traffic Stripe (***) - per linear foot {meter}
701-C Solid/Broken Temporary Traffic Stripe (****) - per mile {kilometer}
701-D Solid/Broken Traffic Stripe Removed (****) - per mile {kilometer}
701-E Solid/Broken Temporary Traffic Stripe (****) - per linear foot {meter}
701-F Dotted Temporary Traffic Stripe (****) - per linear foot {meter}
701-G Solid/Broken Color, Class * Type ** Traffic Stripe (***) - per linear foot {meter}
701-H Solid/Broken/Dotted Traffic Stripe Removed (****) - per linear foot {meter}

* Specify "1", "2", "2T", or "3" or "3W".
** Specify "A" or "B".
*** If Class 2 Stripe, specify thickness in inches {millimeters}.
**** Specify "Paint", "Plastic", "Tape", etc., only if required.

SECTION 703
TRAFFIC CONTROL MARKINGS AND LEGENDS

703.01 Description.

This Section shall cover the application, including furnishing of all materials, of traffic control markings and/or legends in substantial conformity with the plan details and these specifications at the locations designated on the plans or directed.

This Section shall also include the application, including furnishing of all materials, of temporary traffic control markings and legends in accordance with the plan details and these specifications at the locations designated on the plans or directed.

Dimensions, color, material, etc. shall be designated in the same manner as noted in paragraph 2 of Article 701.01 for Traffic Stripe.

In addition, this Section shall cover the work of removal of existing traffic control markings and legends when such is provided by the plans and/or proposal.

703.02 Materials.

Materials shall conform to the requirements of Division 800, Materials, with special attention directed to Section 856 and, in the case of temporary marking tape, to the requirements specified in Section 857.

All materials must be approved by the Engineer before installation and only materials of a recognized, reputable manufacturer will be considered.

The Department has established List V-3, Temporary Traffic Marking Materials, and List V-4, Permanent Traffic Marking Materials. These lists are in the Department's Manual, "Materials, Sources, and Devices with Special Acceptance Requirements". Only the materials on these lists shall be furnished for use. Information concerning these lists is given in Subarticle 106.01(f) and ALDOT-355.

703.03 Construction Requirements.

(a) GENERAL.

The application of traffic control markings and legends will not normally lend itself to the use of large automatic type machinery; however, selection of a method of placing the markings to produce a uniform satisfactory finished product consistent with the plan details shall be the responsibility of the Contractor.

Cleaning of the pavement surface prior to the placement of any traffic marking material will be required. This may be accomplished by either an attachment to the applying unit or a separate operation.

Applying units used with reflectorized markings shall be equipped with an attachment that will apply a top dressing of "drop-on" glass spheres to the marking material when such is required.

(b) CLEANING PAVEMENT.

All pavement areas to be treated shall be thoroughly cleaned. Cleaning shall be accomplished in the same manner as specified in Subarticle 701.03(b).

(c) REMOVING MARKINGS OR LEGENDS.

Where so shown on the plans or directed, traffic control markings or legends shall be removed by the same methods set forth in Subarticle 701.03(c). Removal of markings and legends shall be paid for as a separate item.

Where unsatisfactory traffic control markings are placed by the Contractor and must be removed and replaced to comply with these specifications, the Contractor shall use the removal methods described above. No payment will be made for removal or replacement of the Contractor's unsatisfactory traffic markings.

(d) WEATHER CONDITIONS.

Weather conditions provided in Subarticle 701.03(d) shall apply.

(e) APPLICATION.

1. GENERAL.

The general location of the Traffic Control Markings and Legends will be indicated on the plans or directed by the Engineer. The Contractor shall supply all engineering services necessary to pre-mark and lay out the traffic control markings and legends in accordance with the provisions of Part III of the current MUTCD and details shown on the plans.

If reflectorized markings or legends are required, they shall be treated with a top dressing of glass spheres as noted in this Section to provide instant reflectivity. Application of this top dressing shall be timed so that the spheres will be firmly attached to the material before final set has occurred and accomplished in such a manner as to provide uniform coverage of the entire marking or legend being placed. The minimum rate of application of this treatment shall be 0.025 pounds per square foot {0.12 kg/m²} for paint with "premixed" glass spheres, 0.050 pounds per square foot {0.24 kg/m²} for hot thermoplastic, and 0.066 pounds per square foot {0.32 kg/m²} for paint without "premixed" glass spheres.

2. PAINT.

a. Preparation of Paint.

Immediately before application, paints shall be agitated and mixed thoroughly to a uniform consistency, free from lumps or agglomerates. Paints shall be kept covered to retain volatiles. Paints shall not be thinned unless approval is given to correct consistency.

b. Rate of Application.

The application rate shall not be less than 0.0245 gallons per square foot {1 L/m²} including the volume of glass spheres in the mixture. The rate shall not vary below that specified above by more than 5 percent; any work below this amount shall be repainted without cost to the State.

3. THERMOPLASTIC.

a. Preparation of Materials.

The thermoplastic material shall be prepared in the same manner prescribed in Subitem 701.03(e)3.a.

b. The rate of application shall be such as to produce a minimum average film thickness of 0.125 inches {3 mm} on all markings and legends.

The thickness shall be verified periodically and thickness more than 5% under the designated thickness shall be reworked. Consistent underruns, even within 5% will not be accepted and the Contractor will be required to approach closely the specified thickness.

The pavement surface shall be treated with an approved primer-sealer (a type recommended by the thermoplastic material producer) just prior to application of the markings and legends to facilitate bonding of the thermoplastic to the pavement surface if recommended by the producer.

4. TEMPORARY.

a. General.

Temporary markings and legends have been designed for use when it is necessary to provide additional temporary traffic control during construction of a project. The markings and legends shall be consistent with the requirements of the MUTCD, the plan details, and the following requirements.

All temporary markings and/or legends, which have been placed in accordance with the plans, specifications, and to the satisfaction of the Engineer, will be considered satisfactory, and the Contractor relieved of responsibility for ordinary maintenance on such items after they are opened to public traffic, pending completion and acceptance of the contract. The Engineer reserves the right to order the Contractor to replace any temporary markings and/or legends so placed with payment made under the appropriate Pay Item.

Temporary paint markings and legends will not be required to be removed unless they are on a wearing surface and will not be completely covered by permanent paint markings and legends.

Temporary tape markings and legends will always be required to be removed whether on a wearing surface or an underlying pavement layer.

b. Temporary Traffic Marking Tape.

In general, the application of traffic marking tape shall be in accordance with the recommendations of the manufacturer of the material; however, minor changes will be allowed if such is shown to produce an equal or better application.

Note is made of the fact that approval for the use of this type material is subject to satisfactory performance under traffic. Any failure for whatever reason during the time frame the material is scheduled to perform shall be repaired immediately. Continued failure of a material to perform shall be cause for disallowing further use of that particular manufacturer's material.

c. Temporary Traffic Marking Paint.

Paint for temporary markings and legends shall meet the requirements of either Item 856.02(a)1. or Item 856.02(a)2. The paint shall be prepared and applied as specified in Item 703.03(e)2.

When Removable Traffic Paint is used, the paint shall be placed at the rate recommended by the manufacturer.

5. COLD LAID POLYMERIC MARKINGS.

Application of the polymeric film material shall be in accordance with recommended procedures of the manufacturer of the material.

Applying the material when the pavement temperature is below 60 °F {16 °C} will not be allowed unless such is within the manufacturer's recommendations for placing and is authorized by the Engineer.

Characteristics of this type material are such that under certain conditions, it can be placed during the rolling operations of a new bituminous plant mix layer.

(f) TOLERANCES.

A tolerance of 1/2 of an inch {12 mm} over or 1/8 of an inch {3 mm} under the specified width will be allowed, provided the variation does not detract from the general appearance. Areas treated shall have neat squared-off edges, painted areas shall have edges without mist or drip. Markings that do not meet these tolerances shall be removed and replaced without additional compensation. Establishment of tolerances does not relieve the Contractor of responsibility to construct as closely as practicable to exact plan dimensions.

(g) PROTECTION OF MARKED AREAS.

Protection of the markings shall be accomplished in the same manner set forth for striping in Subarticle 701.03(g).

(h) PROTECTION OF TRAFFIC.

Traffic protection shall be accomplished in the same manner set forth in Subarticle 701.03(h).

All protective and traffic warning and control devices shall be in accordance with Part VI of the current MUTCD.

(i) MAINTENANCE.

All treated areas which have been placed in accordance with the plans, specifications and to the satisfaction of the Engineer, will be considered satisfactory, and the Contractor will be relieved of responsibility for ordinary maintenance on such areas after they have been opened to public traffic, pending completion and acceptance of the contract.

703.04 Method of Measurement.

The area of Traffic Control Markings or Legends (Items 703-A, 703-B, 703-F, and 703-G) complete in place and accepted will be surface measured to the nearest 0.1 square foot {0.1 m^2} of the area actually treated.

The Removal of Traffic Control Markings or Legends (Item 703-C) shall be measured in the same manner as prescribed above except that it shall cover only the area from which the markings were actually removed.

The area of Temporary Traffic Control Markings or Legends, (Items 703-D and 703-E) complete in place and accepted, will be surface measured to the nearest 0.1 square foot {0.1 m^2} of the area actually treated. No measurement for payment will be made for the removal of temporary markings or legends, the removal of such being classified as incidental to the Items of Temporary Traffic Control Markings and Temporary Traffic Control Legends.

703.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted square feet {square meters} of Traffic Control Markings or Legends, Items 703-A, 703-B, 703-F, and 703-G, measured as provided above, will be paid for at the contract unit price bid which shall be full compensation for the item complete in place and includes the cleaning of the pavement, furnishing and applying the markings or legends, and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

The accepted square feet {square meters} of Traffic Control Markings or Legends Removed, Item 703-C, measured as provided above, will be paid for at the contract unit price bid which shall be

full compensation for the item complete in place and includes all necessary materials, equipment, tools, labor and incidentals necessary to complete the work.

The accepted square feet {square meters} of Temporary Traffic Control Markings or Legends, Items 703-D and 703-E, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the item complete in place and includes the cleaning of the pavement, furnishing and applying the markings or legends, and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

703-A Traffic Control Markings, Class ____ , Type ____ - per square foot {square meter}
703-B Traffic Control Legends, Class ____ , Type ____ - per square foot {square meter}
703-C Removal of Traffic Control Markings or Legends - per square foot {square meter}
703-D Temporary Traffic Control Markings - per square foot {square meter}
703-E Temporary Traffic Control Legends - per square foot {square meter}
703-F Cold Laid Polymeric Traffic Control Markings - per square foot {square meter}
703-G Cold Laid Polymeric Traffic Control Legends - per square foot {square meter}

SECTION 705
PAVEMENT MARKERS

705.01 Description.

This Section shall cover the work of furnishing and installing pavement markers of the Class and Type specified by the plans or proposal, at the locations designated on the plans or directed by the Engineer, all in conformity with the plans and these Specifications.

Pavement markers shall be divided into Classes and Types as noted.

Class "A" - Reflective markers.

Type 1 - Mono-directional.

1-A. 1 White reflector face with the marker body other than the reflector face shall be white, silver white or a neutral color.

1-B. 1 Yellow reflector face with the marker body other than the reflector face shall be yellow in color.

Type 2 - Bi-directional.

2-A. 2 White reflector faces with marker body other than the reflector faces shall be of a white, silver white, or a neutral color.

2-B. 1 White reflector and 1 yellow face with marker body other than the reflector faces shall be of a white, silver white, or a neutral color, or may be 1/2 yellow on the side with the yellow reflector and 1/2 white, silver white, or a neutral color on the side with the white reflector.

2-C. 1 White reflector and 1 red reflector face with the marker body other than the reflector faces shall be of a white, silver white, or a neutral color or may be 1/2 red on the side with the red reflector and 1/2 white, silver white or a neutral color on the side with the white reflector.

2-D. 2 Yellow reflector faces with the marker body other than the reflective faces yellow in color.

2-E. 1 Yellow reflector and 1 red reflector face with the marker body other than the reflector faces shall be yellow in color or may be 1/2 red on the side with the red reflector and 1/2 yellow on the side with the yellow reflector.

Class "A-H" - Reflective markers with hard, abrasion-resistant lens surface.

Type designations shall be as shown above for Class "A" markers.

Class "B" - Non-Reflective markers.

Type 1 - Ceramic.

1-A. White
1-B. Yellow
1-C. Black

Class "C" - Temporary markers.
Type 1 - Mono-directional.
1-A. 1 White reflector face
1-B. 1 Yellow reflector face
Type 2 - Bi-directional.
2-A. 2 White reflector faces
2-B. 1 White and 1 Yellow reflector face
2-C. 1 White and 1 Red reflector face
2-D. 2 Yellow reflector faces
2-E. 1 Yellow and 1 Red reflector

705.02 Materials.

Materials furnished for use shall comply with the appropriate requirements of Division 800, Materials, with special attention directed to Section 882.

The Department has established List V-2, Permanent Pavement Markers, Marker Adhesive, Delineators and Hazard Markers, and List V-3, Temporary Traffic Marking Materials. These lists are in the Department's Manual, "Materials, Sources, and Devices with Special Acceptance Requirements". Only the materials on these lists shall be furnished for use. Information concerning these lists is given in Subarticle 106.01(f) and ALDOT-355.

705.03 Construction Requirements.

(a) GENERAL.

Equipment shall include an automatic mixing and metering machine capable of preparing a machine type adhesive meeting the requirements of Article 882.04 and metering the amount of adhesive required to affix each marker to the pavement.

The procedure for installing the markers shall be that of the Contractor provided such is within the scope of the installation procedure recommended by the manufacturer of the marker and such is demonstrated to be operable and that the markers are firmly affixed to the surface in such a manner that they will not be displaced under traffic; the entire bottom surface shall be coated with adhesive.

The installation of the markers shall be such that the color of the marker housing is compatible with the color of the traffic stripes they are to supplement or replace.

Reflective pavement markers shall be placed at the designated location in such a way that the color of the reflected light is in accordance with the plan details or as directed by the Engineer.

The portions of the highway surface to which the marker is to be attached shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound pavement or any other material which might affect the attachment of the marker to the pavement, with the area to which the marker is to be affixed prepared by sand blasting immediately prior to placement of the marker.

The general locations of the pavement markers will be indicated by the plan details or directed by the Engineer. The Contractor shall provide all engineering services necessary to premark and lay out the markers in accordance with the plan details. The Contractor shall submit to the Engineer for approval three copies of a report of survey which clearly indicates the locations for the various types of markers to be used along with spacing, pattern, etc. specified by the plan details. Said report shall be submitted at least two weeks prior to beginning placement operations. Upon acceptance and approval of the report data the Engineer may waive the two week time period noted above. Note is made of the fact that obtaining approval of the above noted report is considered incidental to the work and no time extension or time delay will be considered due to failure to obtain approval of the report.

After placement of any temporary markers, the Contractor shall maintain them, at his expense, in such a manner as to provide good, definite delineation during hours of both daylight and darkness until (1) they are overlaid by a subsequent pavement layer, or (2) they are removed as directed by the plans or the Engineer, or (3) in case of a detour road, until traffic is removed from the detour.

(b) PUBLIC CONVENIENCE AND CLEAN UP.

The road may be fully open to public travel during the progress of work under this Section. Hence, when work is to be performed under traffic, the Contractor shall operate his equipment and store his materials and supplies in such a manner as to cause a minimum of inconvenience to the traveling public.

Upon completion of the work under this Section any damage to the pavement or other facilities caused by the operation or the Contractor's equipment, shall be repaired by the Contractor as directed without additional cost to the State.

705.04 Method of Measurement.

Pavement Markers installed as directed and accepted will be measured by counting separately the number of various class and types of markers provided by the plans or proposal.

705.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of Pavement Markers measured as noted above will be paid for at the respective contract unit price bid for each class and type specified by the plans or proposal. Said contract unit prices bid shall be full compensation for furnishing and installing the pavement markers, removing temporary pavement markers (if required), and for all materials, equipment, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

705-A Pavement Markers, Class ____ , Type ____ - per each

SECTION 707
DELINEATORS AND HAZARD MARKERS

707.01 Description.

This Section shall cover the work of furnishing delineators and hazard markers and the installation of such at the locations designated on the plans or directed, in conformity with the plans and these specifications.

Delineators will be classified by the "type" installation in accordance with plan details, which set forth details of various types of delineator installation. All delineators will be mounted on posts except as shown on the plans or detailed hereinafter.

At those locations shown on the plans or directed by the Engineer, delineators meeting the requirements specified hereinafter or on the plans shall be mounted on guardrail. All old delineators shall be removed and disposed of in a manner acceptable to the Engineer.

Also at those locations shown on the plans or directed by the Engineer, delineators meeting the requirements specified hereinafter or on the plans shall be mounted on barrier rail.

Hazard Markers will be classified according to the type of installation, in accordance with plan details. Hazard markers may be composed of sign panel and/or reflectors with backing panel, mounted on posts or highway structures.

707.02 Materials.

Materials furnished for use shall be new, complying with the appropriate sections of Division 800, Materials. Special reference is made to Section 881.

If the hardware used to secure an old delineator is in a condition acceptable to the Engineer, the Contractor, at his option, may use the old hardware in lieu of new hardware when mounting guardrail mounted delineators, Item 707-C.

The Barrier Rail Mounted Delineators and mounting hardware shall be new and shall be furnished and maintained in accordance with the details shown on the plans. The delineators shall have a minimum rectangular reflective area of 3 inches wide by 4 inches tall {75 mm inches wide by 100 mm tall}.

707.03 Construction Requirements.

(a) DELINEATOR INSTALLATIONS.

1. ERECTING POSTS.

The posts for the delineators shall be set at the locations shown on the plans and as directed by the Engineer. Posts shall be erected to a true vertical position. Any post damaged or otherwise unsuitable for the work shall be removed and replaced by the Contractor at his expense. Posts shall be inserted into the ground to a depth of not less than 24 inches {600 mm}.

Posts may be driven where this can be done without damage to the posts or galvanization. Otherwise, at the Contractor's election, posts shall be set in a 6 inch {150 mm} diameter

drilled hole and backfilled with sand and thoroughly flooded with water to insure compaction. This backfill shall extend up to the existing ground elevation, or the Contractor may use poured concrete in lieu of sand. If solid rock is encountered, holes shall be drilled and backfilled with concrete to the top of the rock or as directed.

Concrete for setting posts shall be Class A, Type 2 complying with applicable portions of Section 501, with the following modifications:

The concrete may be dry batched at a central mixing plant and delivered to the project. Before the concrete is placed water shall be added. This may be done in small amounts as needed and mixed on a mixing board or in a mortar box. After water is added, the mix shall be used within sixty (60) minutes. Posts shall be held in proper position until the concrete hardens. The concrete shall have cured for 72 hours before any strain is placed on the post.

Test cylinders for the concrete will not be required.

Where posts are required to be set in concrete medians, holes approximately 6 inches {150 mm} in diameter may be drilled or square holes approximately 6 inches by 6 inches {150 mm by 150 mm} may be cut or formed during placing of the concrete median. The posts shall be set by driving or other approved means, to a depth of not less than 24 inches {600 mm} below top of the median and to such greater depth as may be required to erect the delineator at the required elevation, above the pavement. After the post has been set, the hole up to the bottom of the pavement shall be backfilled and compacted; the hole for the depth of the median pavement shall then be filled with one of the appropriate bituminous plant mixes provided in the Specifications.

2. ATTACHING DELINEATORS.

After erection of the delineator posts as noted, the delineators shall be affixed to the post in the manner shown on the plans.

3. GUARDRAIL MOUNTED DELINEATOR.

The delineators shall be acceptably affixed to the guardrail in the manner shown on the plans. Old or reconditioned hardware may be used only with the approval of the Engineer. All delineators shall be new.

4. BARRIER RAIL MOUNTED DELINEATOR.

The delineators shall be acceptably affixed to the barrier rail in the manner shown on the plans. The delineators shall be installed at a maximum spacing of 40 feet {12.2 meters} between each delineator or at a closer spacing if shown on the plans or directed by the Engineer.

(b) HAZARD MARKERS INSTALLATIONS.

1. ERECTING POSTS.

Posts, when required, shall be installed in the same manner prescribed in Subarticle (a) for delineator posts modified to cover embedment depth of posts shown by plan details.

2. ATTACHMENT OF MARKERS AND PANELS.

After erection of posts, when required, markers and panels shall be affixed to posts or structures as required in accordance with the details shown on the plans.

(c) PUBLIC CONVENIENCE AND FINAL CLEANUP.

The road may be fully open to the public travel during the progress of work under this section. Hence, when work is to be performed under traffic, the Contractor shall operate his equipment as well as store materials and supplies in such a manner as to cause a minimum of inconvenience to the traveling public. Special attention is directed to Article 107.07.

Upon completion of the work under this Section, the Contractor shall remove all surplus and waste material caused by this work and shall restore the area to at least the same condition as was existing prior to commencing of the work. Any damage to slopes, pavement, etc. caused by the operation of the Contractor's equipment shall be repaired as directed without additional cost to the Department.

Prior to completion of the project, the Contractor shall clean the installed delineators, when directed by the Engineer, without additional cost to the Department.

707.04 Method of Measurement.

Delineator Installations installed as directed and accepted will be measured by counting separately the number of a particular type or types of delineator installations provided by the plans or proposal.

Guardrail mounted delineator, installed as directed and accepted, will be measured per each for the number installed.

Barrier rail mounted delineator, installed as directed and accepted, will be measured per each for the number installed. There will be no measurement of delineators that the Contractor must install to replace damaged or missing delineators.

Hazard Marker Installations installed as directed and accepted will be measured by counting separately the number of a particular type or types of hazard marker installations provided by the plans or the proposal.

707.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of the particular type of Delineator Installations ordered and accepted, measured as noted above, will be paid for at the respective unit prices bid for each type installation, Said unit price bid shall be full compensation for furnishing and installation of the delineators complete in place, including posts, hardware, brackets, braces and all materials, equipment, tools, labor and incidentals necessary to complete the work.

The number of guardrail mounted delineator installations, ordered and accepted, measured as noted above, will be paid for at the respective unit price bid for each delineator and shall be full compensation for furnishing, installing, and cleaning the delineators complete in place, including all hardware, delineators, materials, equipment, tools, labor, including the removal of old delineators, reconditioning of hardware and all incidentals necessary to complete the work.

The number of barrier rail mounted delineator installations, ordered and accepted, measured as noted above, will be paid for at the respective unit price bid for each delineator and shall be full compensation for furnishing, installing, and cleaning the delineators complete in place, including all hardware, delineators, materials, equipment, tools, labor, and all incidentals necessary to complete the work.

The number of the particular type of Hazard Marker Installations ordered and accepted, measured as noted above, will be paid for at the respective unit prices bid for each type installation. Said unit price bid shall be full compensation for furnishing and installing the Hazard Marker Installation complete in place, including post or anchors as required by plan details, hardware, brackets, braces and all materials, equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

707-A Type ____ , Color Delineator Installation - per Each
707-B Type ____ Hazard Marker Installation - per Each
707-C Guardrail Mounted Delineator - per Each
707-G Barrier Rail Mounted Delineator (*) - per Each
* Specify "Mono-directional", "Bi-directional", etc.

SECTION 708
OBJECT SAFETY MARKINGS

708.01 Description.

This Section shall cover the work of providing reflective safety markings on roadway objects and bridges in accordance with the details shown on the plans or directed.

Safety marking will be classified according to Type, in accordance with the following:

Type 1: A Type 1 marking shall consist of marking an area with alternate diagonal stripes of reflective yellow and a stripe of a non-reflective material. The size of the area and the width and slope of the stripes along with the reflective color will be shown in the detailed plans or directed by the Engineer.

Type 2: A Type 2 marking shall consist of marking an area with reflective white or silver-white material. The size and shape of the area of coverage will be shown in the detailed plans or directed by the Engineer,

708.02 Materials.

(a) REFLECTIVE MATERIAL.

The reflective material furnished for use shall be capable of readily adhering to various types of material especially concrete, steel, and wood, and capable of being applied by brush, spray, silk screen or other acceptable methods. The reflective material shall be capable of being applied in one application, that is, the addition of another material such as beads to produce the required reflectivity will not be acceptable.

Reflective requirements when tested by the procedure outlined in paragraph 4.4.7 of Federal Specifications LS-300A shall be as follows:

COEFFICIENT OF RETROREFLECTIVITY candlepower/footcandle/square foot {candelas/lux/m²}							
		Color					
		White or Silver-White #1		White or Silver-White #1		Yellow	
Incident Angle	Divergence Angle	.2	.5	.2	.5	.2	.5
- 4		20	10	40	20	10	5
- 40		7	4	11	8	3	3

Test panels of the materials shall be submitted for evaluation of the reflective capabilities by the Testing Engineer. Test panels shall be square, 12 inches X 12 inches {300 mm by 300 mm}, and shall be made of aluminum prepared with a good quality of white exterior primer. The reflective material shall be applied at the manufacturer's recommended wet film application rate and such rate shall be noted on the back of the test panel.

Drying time of the material shall be such that the surface treated shall be dust free within 10 minutes and dry to touch within 30 minutes after application.

Durability of the material shall be such that no appreciable discoloration, cracking, crazing or blistering occurs and at least 80% of the specified reflective requirements is retained after exposed for 1200 hours to Atlas twin arc weathering in accordance with ASTM D 822.

(b) NON-REFLECTIVE MATERIAL.

The non-reflective material furnished for use shall be a flat black color meeting one of the following requirements:

1. Comply with the requirements noted in Subarticle (a) above except that there will be no reflective requirements and the material shall have a gloss reading of less than 20 units at an angle of 45° when measured with a photovoltmeter or a meter capable of giving equal results.
2. Comply with the following requirements:
   a. Capability of readily adhering to a concrete surface.
   b. Provide a uniform high degree of hiding power with one application.
   c. Tests:

Total Solids	50 Min.	FSS-4041
Weight {Mass} per gallon {liter}	9 pounds {1 kg} Min.	FSS-4184
Viscosity	60 KU Min. - 80 KU Max.	FSS-4281
Dry Time	8 hrs. Max.	FSS-4061 with 0.0025 inches {0.06 mm} wet film
Fineness of Grind	4 Min.	Hegman Scale
Gloss Reading	20 units @ 45° Max.	Photovoltmeter or equivalent

708.03 Construction Requirements.

(a) PREPARATION OF SURFACE.

The surface directed to be treated shall be clean, dry and free of any loose laitance or foreign material. Cleaning may be accomplished by the use of soap and water, cleaning solvent, wire brushes or other acceptable means which will produce the desired results.

(b) APPLICATION OF REFLECTIVE AND NON-REFLECTIVE MATERIAL.

The material may be placed by brush, spray, silk screening or other means consistent with the recommendations of the manufacturer which will produce the desired results.

708.04 Method of Measurement.

The actual area of the various types of Object Safety Markings ordered and accepted will be computed in square feet {square meters} to the nearest square foot {0.1 m^2} from measurements taken on the surface of the prepared area.

708.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The area of Object Safety Markings measured as noted above will be paid for at the respective contract unit price bid for the various types of markings complete in place. Said unit price bid shall be full compensation for furnishing all materials, cleaning and preparation of the surface, application of the materials and for all labor, tools, equipment and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

708-A Type _____ Object Safety Marking - per square foot {square meter}

SECTION 709
MILE {KILOMETER} POSTS

709.01 Description.

The work under this Section shall cover furnishing and erection of mile {kilometer} post assemblies in accordance with the details shown on the plans and the following specifications.

The mile {kilometer} post, consisting of a mile {kilometer} marker mounted on a suitable post, shall be classified under one of the following types:

Type A: Consists of a single post with one mile {kilometer} marker mounted on the post with the marker facing the oncoming traffic.

Type B: Consists of a single post with two mile {kilometer} markers mounted back to back on the post so as to be seen by traffic in each direction.

In general, the mile {kilometer} posts will be established for the Federal and State Highways beginning at the south or west State Line, or at junctions where routes begin. The mile {kilometer} posts will then proceed continuously north and east along the routes through the State.

709.02 Materials.

Materials furnished for use under this Section shall comply with the requirements of Article 710.02, the detailed plans and the following:

Sign panels shall be limited to aluminum with reflective sheeting.

Posts shall be of the type designated on the plans. If the plans offer a choice and once this choice is made and erection begun, the Contractor will not be permitted to change to another type without written permission of the Engineer.

Reset units shall utilize existing material insofar as possible. Any replacement parts necessary shall comply with the requirements specified above in this Article.

709.03 Construction Details.

Construction details shall be as follows:

All signs shall be erected and supported in accordance with these specifications and as shown on the plans. Horizontal edges of signs shall be level and faces of signs shall be vertical.

The Engineer will mark the location and designate the numerical number for each mile {kilometer} post.

If man-made obstructions are encountered at the measured marker location (such as underground obstructions), the Engineer may direct one of the following:

1. Shifting of the mile {kilometer} post location not to exceed 50 feet {10 m} either forward or backward to a more suitable location.
2. If underground obstructions occur which cannot be by-passed by the method noted next above, the Engineer may order the deletion of the mile {kilometer} post from the contract.

However, regardless of which of the two methods noted above are used, no more than one marker may be omitted and the succeeding mile {kilometer} post shall be located, based on the established mile {kilometer} post location and not on any adjusted location.

If current construction in progress is at such a stage to warrant delaying installation, the Engineer may direct the delivery of the complete mile {kilometer} post assembly to the District Engineer's office. Under this condition, payment for the mile {kilometer} posts will be made in accordance with the provisions of Subarticle 109.06(b) of the Standard Specifications.

As soon as the work begins, it shall be prosecuted continuously until the work is complete.

Positioning of the mile {kilometer} post relative to the pavement or shoulder edge shall be as shown on the plans.

After installation of the posts and checking for position (horizontal and vertical), the sign faces shall be secured to the posts in the manner provided by the plans.

No sign posts shall be left standing without a sign face after daylight hours unless warning markers, reflectors, etc., are provided to warn the traveling public. In the same manner, no holes or other hazardous condition shall be left without proper warning markers and delineation.

The Contractor shall be responsible for any damage done to the signs or posts which occur from any cause prior to acceptance as mentioned in Article 709.05. Signs and posts are to be stored under cover and protected from the weather and other damage until they are erected.

Mile {kilometer} post assemblies designated to be reset shall be carefully removed and reinstalled at the designated new location. Removal methods will, in general, be at the option of the Contractor provided such does not damage the assembly. Any damage caused by the Contractor's operation or on account of carelessness negligence, loss of materials or failure to conduct the work properly shall require replacement in kind at no additional cost. Reinstallation shall be in the same manner as for new installation as noted above in this Article.

709.04 Public Convenience and Safety.

The Contractor's attention is directed to Article 107.07 and the following:

No highway will be closed to traffic for the purpose of erecting mile {kilometer} posts. The Contractor will be required, without extra compensation, to provide adequate and acceptable warning signs, temporary guide markers and/or flagmen for directing traffic during working hours. All of the above shall be in accordance with Part VI of the current MUTCD.

Traffic may be shifted to one 12 foot {3.6 m} lane, allowing the Contractor temporary use of one 12 foot {3.6 m} lane for the loading and unloading of materials. No loading or unloading of any kind will be permitted along the lane or lanes designated for highway traffic, nor will equipment be allowed to traverse roadways or lanes against normal traffic flow.

In addition, should the Contractor's equipment damage the shoulders, ditches, slopes or pavement during the performance of this work, he shall restore said areas to the original condition without cost to the State.

709.05 Acceptance of Contracts for Mile {Kilometer} Posts Only.

As soon as the installation of all mile {kilometer} posts on a route to be marked has been completed in accordance with the plans and specifications and to the satisfaction of the Engineer, the Engineer may make final acceptance of such work. After final acceptance of the mile {kilometer} posts on a particular route has been made, the Contractor will be relieved of any further maintenance of the mile {kilometer} posts for that particular route. Final acceptance of the entire contract will be made as soon as all work required by the contract has been completed and accepted.

Retainage on partial payments will be based on the entire contract regardless of whether acceptance of portions of the contract have been made.

709.06 Method of Measurement.

The measurement of Mile {Kilometer} Posts will be made for the actual number of complete mile {kilometer} post assemblies of each designated type, installed complete in place.

The measurement of Mile {Kilometer} Posts Reset will be made for the actual number of complete mile {kilometer} post assemblies, regardless of type, removed and reinstalled, complete in place.

709.07 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted Mile {Kilometer} Posts, furnished as directed and measured as noted above, will be paid for at the respective contract unit price bid for each of the items of the contract, which shall be full compensation for the furnishing and processing of all materials, fabrication, erection and assembling or assembly and delivery to the designated location, transportation, including excavation, backfilling and incidentals necessary to complete the work.

The accepted Mile {Kilometer} Posts Reset, measured as noted above, will be paid for at the contract unit price bid, which shall be full compensation for the removal and reinstallation of the mile {kilometer} post assembly which includes preparation of the new area, restoration of the area, disposal of any surplus or excess material and for all equipment, tools, labor, and any miscellaneous hardware and materials or incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

709-A Mile {Kilometer} Post, Type ____ - per each
709-B Mile {Kilometer} Post}, Reset ____ - per each

SECTION 710
ROADWAY SIGNS

710.01 Description.

This Section shall cover the work of furnishing and erecting roadway signs of the various types, sizes, wording, marking, etc., detailed by the plans in accordance with the latest edition of the MUTCD except as modified herein or by the plan details. The type and number of signs, sign supports, backing frames when required, foundations and reflectorization to be furnished and installed shall be as detailed on the plans. Concrete foundations, when required, shall be constructed as shown on the plans or as directed by the Engineer.

The items of work for Roadway Signs will indicate whether the sign is of a reflectorized or non-reflectorized type, and the kind of backing material.

Sheeting used in the fabrication of sign faces shall be one of the following types unless required otherwise on the plans or in the proposal:

Type I	Medium-intensity retroreflective sheeting, "engineering grade"
Type I-N	Non-reflective sheeting
Type II	Medium-high-intensity retroreflective sheeting, "super engineering grade"
Type III	High-intensity retroreflective sheeting
Type IV	High-intensity retroreflective sheeting, "microprismatic"
Type V	Super-high-intensity retroreflective sheeting, "microprismatic"
Type VI	Elastomeric high-intensity retroreflective sheeting without adhesive, "microprismatic"
Type VII	Super-high-intensity retroreflective sheeting (ASTM D 4956 Table 1)
Type VIII	Super-high-intensity retroreflective sheeting (ASTM D 4956 Table 2)
Type IX	Very-high-intensity retroreflective sheeting

The signs shall be divided into eight classes as follows:

Class 1	Non-reflectorized Background with Type III Reflectorized Demountable Copy
Class 1A	Non-reflectorized Background with Non-Reflectorized Demountable Copy
Class 2	Type III, IV, VII, or VIII Reflectorized Sheeting Background with the same Type Reflectorized Sheeting Demountable or Cut-Out Copy
Class 2A	Type III, IV , VII, or VIII Reflectorized Sheeting Background with Non-Reflectorized Demountable or Cut-Out Copy
Class 3	Non-reflectorized Background with Screen Copy
Class 4	Type III Reflectorized Background with Screen Copy
Class 5	Type IV, VII or VIII Reflectorized Sheeting Background with Screen Copy
Class 6	Type III Reflectorized Sheeting Background with Type IX Reflectorized Sheeting Demountable or Cut-out Copy
Class 7	Type IV, VII, VIII, or IX Reflectorized Sheeting Background with Screen Copy
Class 8	Type IX Reflectorized Sheeting Background with Screen Copy

When the Contractor has the choice of selecting the sheeting Type within a respective Class, the mixing of different sheeting types on signs on the same project will not be allowed unless shown otherwise on the plans or in the proposal.

In addition to the Classes noted above, signs will be designated by the method of fabrication as follows:

Flat Panel.

A sign face which can be fabricated from a single sheet of material normally not in excess of 4 feet {1200 mm} in width.

Multiple Flat Panel.

A sign face which because of size can not be fabricated from a single sheet of material. These panel sections shall be fabricated from sheets not less than 4 feet {1200 mm} in width, except that only one sheet for any one sign may be cut to less than 4 feet {1200 mm} in width to fabricate signs which are not multiples of 4 feet {1200 mm} in width. Multiple flat panel sign sections shall run from top edge to bottom edge of sign face without horizontal joints, except that signs greater than 11 feet {3.4 m} in height may have a horizontal joint but no sign shall have more than one horizontal joint.

The use of material sheets of greater width than the minimum 4 feet {1200 mm} noted to form sign panels will be acceptable; however, the backing, support, etc. must conform to the plan requirements for this classification of panel.

All panel joints shall be provided with backing strips firmly affixed to the sign to keep the panel sections in proper alignment as detailed on the plans.

Aluminum Laminated Panels.

These sign face panels shall consist of sheet aluminum laminated to a honeycomb core, sealed completely around the perimeter with an extruded aluminum frame to form a surface of the length, width and depth required.

Aluminum Louvered Panels.

These sign face panels shall consist of aluminum louvers assembled in such a manner as to provide a rigid sign panel which will have a wind loading normal to the face of the sign of at least 50 percent less than that of a solid panel of the same size and yet provide an opaque background when viewed from an angle of 10° or less below the horizontal line of sight.

710.02 Materials.

All materials furnished for use shall comply with the appropriate requirements of Division 800, Materials, and the requirements noted herein in this Section.

Special reference is made to Section 880 for Sign Materials, Section 501 for Concrete, Section 502 for Steel Reinforcement, and Section 508 for Structural Steel.

Design drawings covering details for legend and message layouts for sign panels will be shown on the plans.

Any deviation from details shown in the plans or furnished the successful bidder must be approved by the Engineer.

Letter series shall be the modified series E as approved by the U.S. Department of Transportation, Federal Highway Administration, unless otherwise provided by plan details.

Unless otherwise noted by plan details, the corners of Class 1, 2 and 6 signs may be square, but the borders shall be rounded with radius as shown on the plans, Class 3, 4 5, 7 and 8 signs shall have rounded corners in accordance plan details unless otherwise provided.

In the event the plans do not contain a detailed layout for a specific sign, such as a route marker, the layout shall be as approved by the Engineer.

710.03 Construction Requirements.

(a) GENERAL.

1. All signs shall be erected and supported in accordance with these specifications and as shown on the plans. Horizontal edges of sign shall be level and faces of signs shall be vertical.

2. After being authorized by the Department to proceed with the work, the Sign Contractor shall be required to begin with the erection of signs, on that portion of the project that, as determined by the Engineer, will best serve the traveling public.

In most instances sign work will of necessity be performed while the roadway is open to traffic. It is not intended that any section of road be left unmarked or in a hazardous condition; therefore, the Contractor shall plan his operation in such a manner as to accomplish the following, all of which shall be considered an integral part of the work required under this section.

a. Work shall be performed in such a manner as not to be hazardous to the traveling public.

b. Existing signs shall not be removed until the new replacement signs are installed and completed.

c. No sign posts, particularly adjacent to the shoulders, shall be left standing without a sign face after daylight hours unless warning markers, etc. are provided to warn the traveling public. In the same manner no holes or other hazardous condition shall be left without proper warning markers or delineation.

d. Once the work of installation of a sign structure is begun, the work shall be diligently prosecuted until its completion.

3. When a section of a project is completed to the state of use, the Contractor may be required to begin erection of signs within ten days after receipt of notice from the Engineer, even though the work on the roadway may not be completed and accepted by the State.

4. The contractor shall be responsible for any damage done to signs or posts which may occur from any cause, save an unavoidable natural cause, until the work is complete and accepted by the State. Signs and posts are to be stored under cover and protected from the weather and other damage until they are erected.

5. The plans indicate the extent and general arrangement of signs. The plans are to be used for the general guidance of the Contractor and any commission or omission shown or implied shall not be the cause for deviating from the intent of the plans and specifications. If any departures from the plans and specifications are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Engineer for approval. The decision of the Engineer shall be final and mandatory.

(b) STAKING OUT SIGNS.

The Contractor shall not order posts until the length has been established by the Engineer in the field. The Engineer shall stake out the location of each sign along the work. The Contractor, however, will be required to check all dimensions and clearances measured from such stakes and thereafter shall become responsible for orientation, elevation, offset and level of all signs erected.

(c) POSITIONING OF SIGN FACES.

Positioning of sign faces shall be such as to eliminate or minimize specular (mirror like) reflection and provide maximum readability.

Ground mounted signs shall be erected so that the face is truly vertical and at an angle to the roadway centerline as detailed by the plans unless otherwise directed by the Engineer. On curves, sign faces shall be oriented so as to be most effective, both day and night, to avoid specular reflection.

Overhead signs shall be erected so that the sign face is at the vertical angle with the roadway indicated by the plans or directed and is in the proper position over designated traffic lanes.

All sign panels shall be so mounted that the tops of panels or the messages on shaped panels are truly horizontal. Vertical and horizontal positioning of sign faces shall be as detailed by the plans or directed to provide the clearance and height required by MUTCD or noted on the plans.

(d) INSTALLATION OF GROUND MOUNTED SIGN SUPPORTS.

1. GENERAL.

The size, number and type of supports shall be shown on the plans. The support shall not extend above the sign panel, but in no case shall the support be less than 3 inches {75 mm} above the uppermost stringer mounting bolt. Cutting steel supports to length after they have been galvanized will be permitted provided the cutting is limited to sawing and the damaged area is regalvanized as shown on the plans or directed.

2. ERECTION OF POSTS.

a. General.

Posts shall be installed as indicated by plans. The length of the posts or supports shall be determined as noted in this Section.

Installation shall be accomplished in such a manner that the entire post is installed as one unit, unless shown otherwise by the plans, to insure proper alignment, etc. of the post. All posts shall be checked with a spirit level for vertical alignment. Posts with breakaway features may be adjusted slightly by the use of special shims as indicated by plan details; major adjustments shall require removal and resetting.

When breakaway features are incorporated into post assemblies, the requirements noted in this Item shall be complied with to insure their functioning properly under field conditions.

All Tubular posts after installation shall be provided with a proper cap.

b. Foundations.

When foundations require the use of concrete encasements, the posts shall be installed in pre-dug holes and backfilled with Class A-2 Concrete. Reinforcement, if required, shall be as detailed on the plans.

When plans and soil conditions permit the installation of posts by driving, a method of driving will be required that will not damage the posts. Any damage in driving shall be cause for rejecting the post and requiring it to be replaced. In lieu of driving, the Contractor may elect to install the posts by pre-dug holes and backfilling with sand. The sand backfill shall be thoroughly flooded with water to insure good compaction. If solid rock is encountered, the posts shall be placed in drilled holes and backfilled with concrete to the top of the rock as shown on the plans or directed and the remainder backfilled as noted above.

c. Breakaway Features.

(1) General.

Unless otherwise noted in the detailed plans, all bolts, nuts and washers used in the breakaway features shall be High Strength galvanized complying with the requirements of Article 836.33.

The functioning of the breakaway design is dependent upon the proper installation of these bolts so that the residual tension specified by the plans is obtained. To accomplish this, the following requirements shall apply:

All bolts, nuts and washers of each diameter bolt required in the work shall be from the same manufacturer. Bolts used in each type connection (hinge, fuse or base) shall be so sized that all bolts for a particular type connection in a support structure are of the same length. Said length shall be the minimum plan specified length plus any additional length necessary to provide at least two exposed threads on the bolt after the connection has been properly tightened.

The torque necessary to obtain the residual bolt tension required by the plans shall be determined by a "bolt-tension calibrator." The Department will provide the "bolt-tension calibrator" for calibration of the Contractor's torque wrench for the various sizes of bolts.

The Contractor shall supply five sets of bolts, nuts and washers of each diameter to be used in the work for determination of the bolt torque necessary to obtain the residual bolt tension specified by the plans.

(2) Setting of Bolt Tension.

All posts and sign panels shall be in place prior to setting of the bolt tension for the base connections and the post fuse and hinge plates.

After completion of the sign panel installation, all bolts, nuts and washers used in the hinge plates, fuse plates and base connections during the shipping and installation of the support assembly shall be removed and replaced with approved High Strength bolts, nuts and washers.

Prior to use of the H.S. bolts, etc. they shall be checked to insure they are free turning and are lubricated with a bee's wax based lubricant approved by the Engineer (some

commercial wax products have proven satisfactory). Installation of the bolts, etc., may then proceed using the appropriate calibrated torque wrenches for the size bolt being installed. All lubricating and torquing of the H.S. bolts and nuts shall be performed in the presence of an inspector. Any bolt not installed in the presence of an inspector shall be removed and examined to insure the nut is free turning for the full thread length (any binding shall be cause for rejection), lubricated and re-installed as noted.

(e) ERECTION OF FRAMEWORK AND SIGN PANELS.

Framework for erecting sign panels shall be assembled and attached to the ground supports as provided on the approved drawings. All horizontal members of supporting frames shall be truly horizontal and at correct height so that the bottom of the sign shall be at the height above pavement specified and proper horizontal position.

Erection of sign panels shall be done in a neat and workmanlike manner. Sign panels shall be attached to the supporting frames in accordance with the recommendations of the sign panel manufacturer. All nuts, bolts, screws and set screws shall be tightened securely.

Signs shall be inspected at night by the Engineer, and if specular (mirror like) reflection is apparent on any signs, its positioning shall be adjusted by the Contractor.

When sign panels are noted to be re-installed on another support assembly, removal of the old panel from its supports shall be done in such a manner as to prevent damage to the panels; remounting shall be accomplished in the same manner noted for new panels. It is intended to allow the use of dismantled hardware in remounting of the old panels; however, if the old hardware is unusable, the Contractor shall provide the appropriate new hardware necessary to install the panel.

(f) REMOVAL OF EXISTING SIGNS.

The Contractor shall dismantle and remove all existing signs designated to be removed; however, when they are to be replaced with another sign, the new sign shall be in place before the old sign is removed unless otherwise ordered by the Engineer.

All signs designated for removal are to be retained by the State. All materials (panels, supports and hardware) shall be removed in such a manner as to prevent undue damage and the materials stacked and stored at a site on the project designated by the Engineer, for later pickup by others. Care shall be taken during removal, handling and storage to protect the treated surfaces; especially sign faces; hardware shall be bagged or boxed; posts, especially those with breakaway features, shall be removed so that the bases are kept intact insofar as practical. Any damage to or loss of removed materials due to negligence on the part of the Contractor's removal methods shall be cause for ordering replacement in kind for the damaged or lost items.

Any posts or mounting supports to be removed shall either be pulled or removed or, at the discretion of the Contractor, cut off and removed to a depth of not less than 1 foot {0.5 m} below the actual ground surface and the area backfilled with suitable material. The area shall be cleaned and dressed out in a manner consistent with the surrounding area.

(g) CLEANUP OF AREA.

The Contractor shall be required to remove all rejected and unused materials and debris from the right of way. He shall restore shoulders and slope, including grass, to the original condition. Excess excavation will be disposed of off the right of way at the Contractor's expense, unless otherwise authorized by the Engineer, and other cleaning up as may be necessary to insure the effectiveness and neat appearance of the work.

(h) INSPECTIONS.

Attention is directed to the fact that sign panels as well as supports must be approved before installation will be permitted.

In addition to normal inspections particular attention will be directed to inspection of the unit after installation to insure that any damage caused by the installation operation or any defect which will affect the serviceability is promptly corrected.

Attention is directed to the special inspection requirements noted in Subitem 710.03(d)2c when setting base plate, hinge plate and fuse plate bolt tensions.

710.04 Method of Measurement.

Completed and accepted Sign Face Panels will be measured in square feet {square meters} between the outside edges of the signs (includes frame and border).

Installed and accepted posts will be measured in feet {meters} which will be the entire length of the installed post from tip to tip and includes any breakaway feature.

Unless a pay item is provided in the plans or proposal for the removal of Existing Roadway Signs, the removal, etc. of such signs will be considered incidental to the work and no measurement for pay purposes will be made. However, when the removal of existing signs is designated for pay purposes, measurement will be made on a lump sum basis for all signs designated to be removed.

710.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Sign Panels measured as noted above will be paid for at the contract unit price bid per square foot {square meter} which shall be full compensation for the sign face complete in place on its support assembly and includes all costs necessary for obtaining the material, processing, all copy, symbols, legend and the like, and for all hardware necessary to furnish and install the sign on its supports in accordance with plan details and for all equipment, tools, labor and incidentals necessary to complete the work.

Posts measured as noted above will be paid for at the contract unit price per linear foot {meter} which shall be full compensation for the particular size post involved completely installed in its proper position. Said unit price bid shall include all costs necessary to obtain materials, fabrication, processing, excavation, erecting, backfilling, backfill material, concrete, steel, clearing, all hardware, and miscellaneous parts necessary to furnish and install the post in accordance with plan details and for all equipment, tools, labor and incidentals necessary to complete the work.

Removal of existing signs under Item 710-C, measured as noted above, will be paid for at the contract lump sum price bid which shall be full compensation for the dismantling, removal of the designated sign assemblies or portion of the sign assembly, the salvaging of materials or reuse when designated, the stacking or storage of the salvaged materials in a designated location on the project, and for any materials, equipment, tools, labor and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

710-A Class __*_, _**_ Sign Panels _***_ - per square foot {square meter}
710-B Roadway Sign Post (Description & Size) - per linear foot {meter}
710-C Removal of Existing Roadway Signs - per lump sum

* Appropriate Class
** Aluminum Flat
Steel Flat
Aluminum Multiple Flat
Steel Multiple Flat
Aluminum Laminated
Aluminum Louvered
*** Approximate thickness of panel material desired.

SECTION 711
ROADWAY SIGN RELOCATION AND RENOVATION

711.01 Description.

This Section shall cover the work of removing and relocating designated existing ground mounted roadway signs. Said work requires the satisfactory removal of the existing signs, their supports and foundation and the reinstallation of the sign assembly on their supports and new foundations.

This Section shall also cover the work of renovating designated existing ground mounted roadway signs. The renovation may include, but not be limited to, cleaning the sign, replacing the sign copy, replacing sign panels and reworking the support system. The plans will show the extent of work to be performed under this item.

711.02 Materials.

Materials involved in the work under this Section will be basically the reuse of existing signs and their supports.

Any replacement or new materials required shall comply with the appropriate requirements of Article 710.02.

711.03 Construction Requirements.

(a) GENERAL.

The relocation of existing signs shall in general require the removal of a complete sign assembly (panel or panels and supports) and the re-installation of the assembly at a new designated location.

The method of removal shall be basically that of the Contractor provided such does not damage the assembly, Any damage shall require replacement of the damaged parts using materials complying with the provisions of Article 710.02 or repair of the parts as directed, without additional compensation.

Care shall be taken in removing the concrete from the support stubs so as to preclude undue damage to the stub. Any damage which will affect the reinstallation procedure shall be repaired as directed. Note is made of the fact that the shoe assemblies are matched plates and must be retained as such, otherwise the unit will not function as designed. In addition, the shoe assembly shall be reinstalled in the same manner prescribed in Subarticle 710.03(d).

Any support foundation which can not be satisfactorily removed may be left in place provided it will not be in the way of construction and it is removed to a depth of not less than 1 foot {0.5 m} below the actual ground surface and the area backfilled as directed with suitable material.

The renovation of existing roadway signs may include work to the existing sign, sign structure, or sign appurtenances. The plans will show the signs, and the work to be done to each sign, included under the renovation item.

Any dismantling of the sign assembly as well as reassembly to be done under either the relocation or renovation shall be performed in such a manner as to preclude damaging of the assembly materials.

The Sign Panels are essential for traffic control, hence, unless the road is closed to traffic, they shall not be down more than eight hours and in no case overnight. This may require the use of temporary supports during the relocation of the permanent supports. Any temporary support must be approved before use.

(b) INSTALLATION OF SIGN ASSEMBLIES.

The installation of the relocated supports and panels shall be as prescribed in Article 710.03 for new signs.

The existing supports may be reused provided they are not damaged during removal operations, or the Contractor may furnish new supports at his option.

After completion of the re-installation, the sign panels shall be cleaned with approved cleaning material.

711.04 Method of Measurement.

Measurement of relocated ground mounted roadway signs will be on a lump sum basis for all signs designated to be relocated.

Measurement of renovated ground mounted roadway signs will be on a lump sum basis for all signs designated on the plans to be renovated.

711.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Complete and accepted relocated ground mounted roadway sign assemblies, measured as noted above, will be paid for at the contract lump sum price bid, which shall be full compensation for the removal and relocation of the sign assembly (panel and supports) complete in place on its supports at the designated locations, for the cleaning of the panels, for furnishing all hardware or other material necessary for the re-installation of the sign assembly, for the satisfactory removal and re-installation of the supports including the excavation and backfill of the areas (old area and new area of the installation), disposal of excess materials for new foundations for supports and for all other materials, equipment, tools, labor, and incidentals necessary to complete this item of work.

Complete and accepted renovated ground mounted roadway sign assemblies, measured as noted above, will be paid for at the contract lump sum price bid which shall be full compensation for renovating the sign assembly according to plan details and for all materials, equipment, tools, labor, and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:
711-A Roadway Sign Relocation - per lump sum
711-B Roadway Sign Renovation - per lump sum

SECTION 713
PERMANENT BARRICADE

713.01 Description.

This Section shall cover the work of furnishing and installing a complete permanent barricade system at the location shown on the plans or designated and in conformity with plan requirements and these specifications.

713.02 Materials.

Materials furnished for use shall be new, complying with the requirements specified on the plans and with the appropriate sections of Division 800, Materials, with special reference made to Sections 864, 880 and 881.

713.03 Construction Requirements.

(a) GENERAL.

All the work performed in the installation of the permanent barricade system shall be performed in a competent, workmanlike manner.

(b) ERECTING POSTS.

Posts shall be erected as specified in Item 630.03(a)1 unless shown otherwise on the plans.

(c) ATTACHING PANELS AND HAZARD MARKERS.

Panels and hazard markers for the barricade shall be fastened to the rails in the manner shown on the plans. The reflectorized Type III sheeting may be affixed to the panels either before or after the panels have been fastened to the rails.

713.04 Method of Measurement.

Permanent Barricades installed as directed and accepted will be measured in linear feet {meters} to the nearest 0.1 foot {0.1 m} from end to end of each continuous installation. No separate payment will be made for any item or part of the barricade system.

713.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Accepted permanent barricade installed, measured as provided above, will be paid for at the contract bid price per linear foot {meter} for permanent barricade which shall be payment in full for the furnishing and installing of the barricade complete in place, including posts, rails, hardware, panels, reflectorized sheeting, and hazard markers and all equipment, tools, labor, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:
713-A Permanent Barricades - per linear foot {meter}

SECTION 715
OVERHEAD ROADWAY SIGN STRUCTURES

715.01 Description

(a) GENERAL.

This Section shall cover the work of designing, furnishing, fabricating and erecting a complete permanent overhead sign supporting structure, less sign panels, complete in place, ready for attachment of sign panels and includes such auxiliary equipment as maintenance walkways and illumination system and equipment for lighting of sign faces when such is specified by plan details. Such structures shall be designed in accordance with requirements noted hereinafter and plan details

to the lines, grades and dimensions designated on the plans. The total length and upright height of the structures shall be verified by the contractor before submitting the designs and details.

The Contractor shall prepare and submit as soon as possible, after issuance of the notice to proceed, all required design drawings, design computations and other necessary supporting data for approval.

(b) DESIGN, FABRICATION AND INSTALLATION.

The overhead roadway sign structures shall be designed, fabricated and installed in accordance with the requirements given in Section 718, STRUCTURES FOR TRAFFIC CONTROL DEVICES AND HIGHWAY LIGHTING.

Illuminating systems when required by the plans shall be provided in accordance with the requirements of Section 885 and the plan details.

Drawings for electrical details shall be incorporated into the structural detail sheets.

715.02 Materials.

Materials shall comply in general with the requirements given in the applicable Sections of Division 800, MATERIALS and in particular to the following:

Section 880, SIGN MATERIALS.

Section 885 SIGN LIGHTING MATERIALS AND SERVICES.

Section 891, STRUCTURAL MATERIALS FOR TRAFFIC CONTROL DEVICES AND HIGHWAY LIGHTING.

Materials shall also comply with requirements that may be given on the Plans.

Six sets of lists for all electrical items proposed for use shall be submitted for approval. Where the Contractor proposes to use materials other than those specified, he shall furnish complete descriptive data, including their performance capacities, lighting curves and such other information as may be pertinent or required by the Engineer. If requested by the Engineer, the Contractor shall submit for inspection and comparison samples of the proposed substitute items at no cost to the State.

Materials and equipment installed or used without approval of the Engineer shall be at the risk of subsequent rejection. The State will not be liable for materials purchased, work performed, or any delay incurred due to failure of the Contractor to secure prior approval. Failure of the Electrical Engineer to note unsatisfactory material as received will not relieve the Contractor of responsibility. Manufacturers' guarantees or warranties on materials customarily provided shall be delivered to the Engineer upon receipt of materials.

715.03 Construction Requirements.

(a) STRUCTURES.

The overhead roadway sign structures shall be installed in accordance with the requirements given in Section 718, STRUCTURES FOR TRAFFIC CONTROL DEVICES AND HIGHWAY LIGHTING.

The special brackets, braces, etc. which support the auxiliary equipment (light fixtures and catwalks) and to which the sign panels are affixed are classified as an integral part of the structure and shall be installed as noted in this Article or detailed on the plans or approved drawings.

(b) ELECTRICAL.

1. SCOPE.

The electrical work shall consist of furnishing and installing electrical equipment as shown on the detail plans and required by Section 885 so as to provide a complete sign lighting system ready for operation and connected to the utility company's service.

2. EXCAVATION.

Excavation for underground conduit runs shall include removal and satisfactory disposal of all surplus or unused material.

The excavation required for the installation of conduit and other appliances shall be performed in such a manner as to cause the least possible injury to the streets, sidewalks, and other improvements.

The trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations. Excavating shall not be performed until immediately before installation of conduit and other appliances. The material from the excavation shall be placed in a position where the least damage and obstruction to vehicular and pedestrian traffic, and the least interference with the surface drainage, will occur.

Excavations after backfilling shall be kept well filled and maintained in a smooth and well drained condition until permanent repairs are made.

Improvements such as sidewalks, curbs, gutters, portland cement concrete and asphaltic concrete pavement, bituminous surfacing, base material and any other improvements removed, broken or damaged by the Contractor shall be replaced or reconstructed with the same kind of materials as found on the work, or with materials of equal quality. The new work shall be left in a serviceable condition satisfactory to the Engineer.

The Contractor shall not allow any water to accumulate in any excavated areas.

Where large rocks are encountered in conduit trenches, they shall be removed to a depth of at least three inches {75 mm} below bottom of trench and a three inch {75 mm} layer of sand or earth shall be placed in the bottom of the trench.

3. BACKFILLING OF EXCAVATIONS.

All suitable material removed for conduit trenches shall be used in backfill. Aggregate larger than three inches {75 mm} shall not be in contact with conduit. Compaction shall be in accordance with Standard Specifications for backfill material.

4. INSULATION TESTING.

A test of all lighting secondary circuits to ground shall be made at the service/lighting control units on the load side of the contactors or circuit breakers for each lighting circuit. These shall be made with a 500 volt DC Megger Tester. Any reading of 250,000 ohms to ground or higher is satisfactory. Any reading of less than 250,000 ohms to ground will require the Contractor to isolate and identify the source of the low reading and correct the problem. A record shall be made at the time of the testing showing the type tester actually used, the serial number of the particular tester, the circuit identification, and the insulation readings obtained. This report shall be forwarded to the Engineer for review. The report shall be signed by an Electrical Contractor that has a licensee issued by the Alabama Board of Electrical Contractors.

5. GROUND RESISTANCE TESTING

A test shall be made of the ground rod(s) using a null balance earth tester with auxiliary ground rods placed no closer than 50 feet and 100 feet {15 m and 30 m} respectively, from the tested ground rod. A reading of 25 ohms or less is satisfactory. Any reading over 25 ohms will require the installation of additional ground rods to be placed in a pattern as directed by the Engineer. A report shall be made at the time of testing showing an identification of the circuit and the resistance obtained. This report shall be forwarded to the Engineer for review. The report shall be signed by an Electrical Contractor that has a licensee issued by the Alabama Board of Electrical Contractors.

715.04 Method of Measurement.

Overhead Roadway Sign Structures will be measured separately by individual structures, complete in place and fully operational.

Sign panels will be measured and paid for under Section 710, with the installation, mounting, etc. performed as provided therein.

715.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Complete and accepted overhead roadway sign structures, measured as noted above, will be paid for at the contract lump sum price bid for each structure. This payment shall be full compensation for all work and materials (except sign panels) necessary for an operational sign, complete in place on its supports at the designated locations. The contract lump sum price shall also include all costs for designing the sign structure, constructing foundations and furnishing and installing all other materials (including electrical materials) for the completion of the sign.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

715-A Overhead Roadway Sign Structure No. ___ - per lump sum

SECTION 717
OVERHEAD ROADWAY SIGN STRUCTURE RENOVATION AND RELOCATION

717.01 Description.

This Section shall cover the work of renovating designated existing overhead roadway sign structures. The renovation may include, but not be limited to, refurbishing the sign panels, reworking or replacing the electrical system, and reworking the support system. The plans will show the extent of work to be performed under this item.

This Section shall also cover the work of relocating, or partially relocating, designated existing overhead roadway sign structures. The relocation may include, but not be limited to, removal or relocation of the existing signs, their supports, and foundations, and the reinstallation of the sign assemblies on their supports with new foundations as detailed on the plans. The plans will show the extent of work to be performed under this item.

If new supports or foundations are required, the Contractor shall be responsible for the same design requirements as specified in Article 715.01.

717.02 Materials.

Materials involved in the work under this Section will be basically the reuse of existing signs and their supports. No bolts, nuts, or washers which are removed shall be reused; new materials shall be equal to or better in design than the old materials.

Any replacement or new materials required shall comply with the appropriate requirements of Article 715.02.

717.03 Construction Requirements.

(a) RENOVATION.

The renovation of existing overhead roadway sign structures may include work to the existing sign, sign structure, or sign appurtenances. The plans will show the work to be done under the renovation item.

After completion of the renovation, the sign panels shall be cleaned with approved cleaning material.

(b) RELOCATION.

The relocation of existing overhead roadway sign structures shall, in general, require the removal of a complete sign assembly (panels, lights, walkway, and supports), the construction of a new foundation, and the reinstallation of the assembly at a new designated location.

The Contractor shall notify the Project Engineer by letter, with a copy to the Bridge Engineer, of the date of the relocation of a sign structure. This notification shall be given no later than two weeks before the removal of the structure.

The Contractor shall arrange for the welds of relocated structures to be inspected and tested by an AWS Certified Welding Inspector in accordance with the requirements given in Section 891. The inspection and testing of the welds shall be done after the installation of the sign structure.

The method of removal shall be that of the Contractor, however, any damage to the sign structure caused by improper removal procedures shall be repaired by the Contractor without additional compensation. Damaged members or parts shall be repaired using materials complying with the provisions of Article 715.02 or as directed.

Any dismantling of the sign assembly as well as reassembly shall be performed in such a manner as to preclude damaging the assembly materials.

Structure foundations being abandoned shall be removed to a depth of not less than one foot below the existing ground surface and the area backfilled as directed with suitable material.

The installation of the relocated overhead sign structures shall be as prescribed in Article 715.03 for new structures.

After completion of the reinstallation, the sign panels shall be cleaned with approved cleaning material.

717.04 Method of Measurement.

Measurement of renovated overhead roadway sign structures will be on a lump sum basis for each individual structure renovated, complete in place and fully operational.

Measurement of relocated overhead roadway sign structures will be on a lump sum basis for each individual structure relocated, complete in place and fully operational.

Any new sign panels needed will be measured and paid for under Section 710, with the installation, mounting, etc. performed as outlined therein.

717.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Complete and accepted renovated overhead roadway sign structures, measured as noted above, will be paid for at the contract lump sum bid for each sign structure, which shall be full compensation for renovating the sign structure according to plan details and for all materials, except sign panel, equipment, tools, labor, and incidentals necessary to complete this item of work.

Complete and accepted relocated overhead roadway sign structures, measured as noted above, will be paid for at the contract lump sum price bid for each sign structure, which shall be full compensation for all work and materials, except sign panels, necessary for the removal and relocation of the sign structure (panel, lights, walkway, and supports) complete in place on its supports at the designated locations, for the cleaning of the panels, for furnishing all hardware or other material necessary for the reinstallation of the sign structure, for the satisfactory removal of the existing footings, if necessary, including the excavation and backfill of the areas (old area and new area of the installation), disposal of excess materials, for new foundations for supports, for inspection and testing of welds, and for all other materials, equipment, tools, labor, and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

717-A Overhead Roadway Sign Structure No. _____ Renovation - per lump sum
717-B Overhead Roadway Sign Structure No. _____ Relocation - per lump sum

SECTION 718
STRUCTURES FOR TRAFFIC CONTROL DEVICES AND HIGHWAY LIGHTING

718.01 Description.

This Section shall cover the design, fabrication, and construction of overhead roadway sign, luminaire, traffic signal, and traffic surveillance support structures.

All designs, details and shop drawings must be approved before actual fabrication of a structure is started. Within 30 days after the award of the contract, the Contractor shall notify the Project Engineer by letter, with a copy to the Bridge Engineer, of the names, addresses and telephone numbers of all structural fabricators along with the fabricator's proposed fabrication schedule.The notification shall be furnished for all structural fabricators that are subcontractors to a structural fabricator.

718.02 Materials.

(a) GENERAL.

Materials shall comply in general with the requirements given in the applicable Sections of Division 800, MATERIALS. Particular structural material and fabrication requirements are given in Section 891, STRUCTURAL MATERIALS FOR TRAFFIC CONTROL DEVICES AND HIGHWAY LIGHTING. Materials shall also comply with requirements that may be given on the Plans.

Concrete for foundations shall comply with the requirements of Section 501 for Class A, Type 2a concrete.

Reinforcing steel shall meet the requirements of Section 502, Steel Reinforcement, and shall be Grade 40 {300} or Grade 60 {400} billet steel.

(b) OVERHEAD ROADWAY SIGN STRUCTURES.

Overhead sign structures shall be constructed of steel only.

(c) TRAFFIC SIGNAL POLES.

Unless otherwise shown on the plans, traffic signal poles may be constructed from steel, concrete or aluminum.

(d) LUMINAIRE AND TRAFFIC SURVEILLANCE POLES.

Unless otherwise shown on the plans, luminaire and surveillance poles may be constructed of steel, concrete, glass fiber reinforced polymer (GFRP), or aluminum.

718.03 Design.

(a) GENERAL.

When details of a structure or foundation are not shown on the Plans or if the Contractor proposes alternate structure or foundation details, the Contractor shall submit complete designs and details.

Geotechnical borings and, when applicable, passive pressure versus depth graphs will be shown on the plans along with notes to indicate which borings are to represent which foundation elements. If borings and graphs are not provided, the Contractor shall obtain all required geotechnical data to complete the required design.

All structures (except GFRP) shall be designed in accordance with the requirements given in the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 1994 Edition*, and the requirements given in this Section. GFRP poles shall meet the design requirements given in the latest edition of the American Society of Civil Engineers (ASCE) Structural Plastics Design Manual and the requirements given in this Section.

Minimum design wind speed shall be 100 miles per hour {165 km/hr} for Mobile and Baldwin Counties and 80 miles per hour {130 km/hr} elsewhere in the State.

The Combined Stress Ratio (CSR), shall be less than or equal to 0.9, for all load cases.

Foundations shall be located to avoid damaging existing underground installations and avoid conflicting with known future installations such as pipes, conduits, guardrail posts, lighting standards, etc. The design shall be sufficient to provide a minimum factor of safety of 2.0 against overturning.

(b) SUBMITTAL OF DESIGNS AND DETAILS.

Details shall be submitted on six sets of prints of drawings on standard size plan sheets (22” x 34”){559 mm x 864 mm} including footing details. Each sheet shall be stamped and signed by a Professional Engineer registered in the State of Alabama, and not employed by the State of Alabama.

Design computations shall be submitted in duplicate. Each set of design computations shall be prepared, stamped and signed by a Professional Engineer registered in the State of Alabama, and not employed by the State of Alabama. The design computations shall address all members, connections (welds, bolts, etc.), anchor bolts, and foundations. The designer shall note on the design computations where the design of each member meets the design requirements and deflection tolerances.

Design computations, shall include all formulas used and a copy of all calculations and/or computer printouts for each structure that cover all members, connections (welds, etc.), footings and details necessary for a complete structure design. Where computer generated designs are used, the printouts shall consist of the applied loadings, structure geometry, effective wind area and location of attachments (sign panels, signals and light fixtures), component sizes, moments, shears, reactions, component forces, component stresses, allowable component stresses, combined stress ratios, and deflections for each group loading specified in the AASHTO Sign Specifications. The method of solution used by the computer program, including all formulas used, shall be submitted.

For overhead roadway sign structures only, the Contractor shall furnish one set of reproducible drawings (mylar or equal) on standard size plan sheets (22” x 34”){559 mm x 864 mm} for record and distribution purposes, after final approval.

(c) DRILLED SHAFT FOUNDATIONS.

Drilled shaft foundations shall be placed only in undisturbed material or in fill made by controlled compaction. Drilled shaft foundations for cantilever structures shall be designed to resist the torsional effects of the wind loads.

(d) CONCRETE SPREAD FOOTINGS.

Footings shall be placed only in undisturbed material or in fill areas constructed by controlled compaction. Footings for cantilever structures shall be designed to resist the torsional effects of the wind loads.

(e) DIRECT EMBEDMENT OF SUPPORT.

Prestressed concrete poles shall be installed by direct embedment in the ground. GFRP poles may be installed by direct embedment in the ground. The design and details of the direct embedment shall be submitted as Working Drawings for Structures. The required embedment is the responsibility

of the contractor, however the minimum depth of embedment shall not be less than L/6, where L is the above ground length of the upright member or pole.

(f) AUGER BASE FOUNDATIONS.

Auger base (screw-in helix) foundations may be installed for steel, GFRP or aluminum poles. They shall be sized by the manufacturer based on calculated pole parameters and soil characteristics.

The Contractor shall furnish the Engineer with a list of the proposed details of the auger base foundations. The Contractor shall not order the auger base assemblies until the Engineer informs the Contractor in writing that a review of the proposed auger base details has been completed. The Engineer will not approve the proposed auger base details but will review them to assure that sufficient information has been provided to allow the proper installation of the bases.

(g) PILE FOUNDATIONS.

Pile foundations may be required in areas where the upper soil layers will not support a drilled shaft or spread footing. The foundations may be designed with steel piles or prestressed concrete piles. However, steel piles shall not be used in brackish or salt water locations in Mobile or Baldwin counties, or other locations with corrosive environments. Piles shall meet the requirements of Section 505, Piling.

(h) ANCHOR BOLTS.

Foundation anchor bolts for overhead highway sign structures and high mast lighting assemblies shall be Charpy V-Notch tested in accordance with the requirement provided in Section 891. Anchor bolts shall be a minimum one inch in diameter.

Overhead sign structures with single pole uprights shall be anchored with at least eight anchor bolts, four in each base plate.

Overhead sign structures with truss type uprights shall be anchored with at least four anchor bolts in each base plate.

Traffic signal poles and luminaire poles shall be anchored with at least four anchor bolts.

High mast lighting assembly poles shall be anchored with at least eight anchor bolts.

(i) OVERHEAD ROADWAY SIGN STRUCTURES.

All overhead highway sign structures shall be supported by a reinforced concrete footing. The overhead portion of the structure shall be attached to the footing by means of base plates and anchor bolts.

The vertical dead load deflection of cantilever sign structures shall not exceed L/120, where "L" is the cantilever length in inches {millimeters}. The vertical support for a cantilever structure shall be a round uniform diameter tube which has adequate moment of inertia, without additional reinforcement, to limit the dead load deflection of the arm, including the deflection caused by bending in the vertical support, to L/120 and to a maximum angular deflection of the centerline of the upright, at the top, in relation to the centerline at its base, of 1°40'. Horizontal trusses (span type) shall be limited to a vertical dead plus ice load deflection of L/240, where "L" is the total truss length center to center of supports in inches {millimeters}. A uniform camber, in accordance with the requirements of Section 9 of the AASHTO Sign Specifications, shall be provided for all horizontal portions of a structure.

The use of full penetration circumferential welds on upright poles is not allowed.

Horizontal trusses of triangular cross-section are not allowed.

Design and basic member shape once selected shall be used throughout the project. The detail drawings shall list all ASTM or AASHTO material specifications to be used for all the structural elements.

Brackets shall be provided for the mounting of the required signs. These brackets shall permit mounting the sign faces at an angle of five (5) degrees from vertical except for louvered panels which shall be mounted vertically. This five degree angle shall be obtained by rotating the front top edge of the sign away from the vertical position. All brackets shall be of lengths sufficient for the heights of the signs being supported.

Where required by the contract plans, tubular structures shall have electrical outlets provided on a front chord member and shall have hand holes within twelve inches of the base of vertical supports. If necessary, in order to comply with design requirements, compensation for loss in section shall be accomplished by reinforcement.

Maintenance walkways, when required by the plans, shall be provided in front of the lower front chord. These walkways shall have a railing along the front side which can be folded, when not in

use, to an inconspicuous position. No part of the walkway shall be located so as to obstruct normal viewing of the lower portion of the sign.

(j) TRAFFIC SIGNAL POLES.

The structural analysis of a pole shall be made at the base of the pole, and at every tenth point interval up the pole.

The maximum deflection of the centerline at the top of the pole in relation to the centerline at its base, due to the moment load of the signal and support bracket, shall not exceed two and one half percent of the pole height. Calculations shall be submitted to verify this deflection.

At intersections involving four traffic signal poles, each pole shall be designed equally for the most severe loading condition at the intersection.

(k) LUMINAIRE POLES.

High mast lighting assembly poles shall be supported by a reinforced concrete footing.

A luminaire pole shall be analyzed at the base of the pole, at every tenth point interval up the pole, at section changes and at the points above and below each slip joint splice.

Design calculations shall be submitted to verify that the maximum allowable deflections will not be exceeded.

(l) TRAFFIC SURVEILLANCE POLES.

Poles used for mounting traffic surveillance devices, or other similar devices, shall be designed in accordance with the requirements given for luminaire poles and any additional criteria (i.e., more stringent deflection, vibration damping, etc.) provided on the contract plans.

718.04 Construction.

(a) GENERAL.

The overhead roadway sign structures, luminaire supports and traffic signal supports shall be constructed in accordance with the plans, specifications, foundation design calculations and approved shop drawings. All parts of a structure unit shall be assembled on the project and the Engineer shall be provided with adequate field erection details before permission will be given to erect the structure. Once the installation of structure is started, the work shall be diligently prosecuted until its completion.

(b) CONCRETE FOUNDATIONS.

Excavation for foundations shall conform to the neat lines shown on the plans. The Contractor shall inform the Project Engineer when the excavation is complete, and no concrete shall be poured until the Project Engineer has approved the excavation for each individual footing.

The foundations may be cast directly against earth or cast with forms. When forms are used they shall be true to line and grade and securely braced in place. Both forms and ground, which will be in contact with the concrete, shall be thoroughly moistened before placing concrete. Forms shall not be removed until the concrete has thoroughly set. Tops of foundations shall be finished to the elevations shown on the plans. Ordinary surface finish shall be applied to the exposed surfaces of concrete. Exposed edges shall be chamfered.

All concrete foundations and bases shall reach a compressive strength of 2400 psi {17 MPa} before any structures are installed thereon.

All embedded items shall be installed securely and inspected by the Project Engineer before concrete is poured.

(c) DIRECT BURIAL.

Excavation shall be to the depth and diameter determined from the design calculations. The pole shall be placed in position and temporarily braced, prior to backfilling. The backfill material shall be limestone screenings or washed sand. The backfill shall be saturated with water to consolidate the backfill material during placement.

(d) AUGER BASE.

Auger base foundations may be installed by auguring into place (if recommended by the manufacturer), to the depth required by the design calculations. Otherwise, the auger base shall be installed by excavating to the depth and diameter required by the design calculations. The auger base shall then be placed in position, temporarily braced and backfilled. The backfill material shall be Class A, Type 2a concrete in accordance with the requirements given in Section 501.

(e) ANCHOR BOLTS.

A steel template shall be required at least 6 inches {155 mm} from the top and bottom of anchor bolts such that the anchor bolts remain plumb, after placement of the concrete for the foundation. The template shall be fabricated with openings to facilitate the placement of concrete above and below the template. Care shall be taken to ensure that the anchor bolt threads are not damaged prior to installation of the support structure. Out-of-position anchor bolts and anchor bolts greater than 1:40 out-of-plumb are cause for rejection of the base. Bending of the anchor bolts to straighten or move into position will not be permitted.

Anchor bolts for slip bases shall have the nuts installed in accordance with the requirements given in Section 710.

Anchor bolts for non slip bases shall have their top (double) nuts tightened by the turn of the nut method as follows:

- All leveling nuts (bottom nuts) shall be brought to full bearing on the bottom of the base plate. The bottom of the leveling nuts must be kept as close to the concrete base as practical, and shall not be greater than 1 inch {25 mm} away from the top of the concrete base. Leveling nuts must be threaded onto the anchor bolt to provide at least 1/4 inch {6 mm} projection above the lock nut (when in its final position).
- Tighten all top nuts to a "snug" condition defined as the tightness that exists when the plies of the joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.
- At this point, the top nut and leveling nut must be in full bearing on the base plate. If any gap exists between either nut and the base plate, a beveled washer shall be added between the nut and the base plate to eliminate the gap. The beveled washer shall be stainless steel type 304, shall be the same diameter as the hardened washer, and shall be beveled as required to eliminate the gap between the nut and the base plate.
- Using an extension on the nut wrench as required, rotate all top nuts an additional one third turn. There shall be no rotation of the leveling nut during top nut tightening.
- Tightness of the nuts shall be checked in the presence of Department personnel a minimum of forty eight hours after the nuts have been rotated the additional one third turn. Any nuts found loose shall be tightened in accordance with the above procedure.
- Lock nuts shall be brought to a "snug" condition as previously described.

(f) OVERHEAD ROADWAY SIGN STRUCTURES

Attention is directed to the fact that the structure design as well as shop drawings for the fabrication of the structure must be approved before actual fabrication of a structure is started.

All parts of a structural unit shall be assembled on the project and the Engineer provided with adequate field erection details before permission will be given to erect the structure. The Contractor shall temporarily brace the structure as needed.

(g) TRAFFIC SIGNAL POLES

Strain and mast arm poles shall be installed with the proper vertical offset (or rake), as recommended by the manufacturers so as to assure a substantially vertical set when the load is applied. Threaded adjusting nuts shall be used to establish the "rake" in accordance with the requirements for the installation of leveling nuts on anchor bolts. The use of shims or other leveling devices will not be permitted. Hardware and fittings shall be installed as shown on the contract plans and approved shop drawings.

Messenger cable supporting traffic signal heads shall not be sagged to a vertical distance greater than five percent of the length of the span between strain poles. Messenger cable supporting signal control cable only shall be sagged to a vertical distance not greater than two percent of the length of the span between strain poles. Tether cables shall not be sagged to a vertical distance greater than five percent of the length of the span between strain poles.

(h) LUMINAIRE AND TRAFFIC SURVEILLANCE POLES

Extreme care shall be taken during installation of the luminaire assembly and surveillance devices to ensure that no damage occurs to these devices. Double nuts and washers shall be used to plumb the pole about its center axis if a twin bracket is used. When a single arm type is used, the back side of the pole shall be plumbed after the luminaire and surveillance devices and hardware have been installed, thus providing a slight rake from the traveled way.

SECTION 720
VEHICULAR IMPACT ATTENUATOR ASSEMBLY

720.01 Description.

This Section shall cover the work of furnishing and installing vehicular impact attenuator assemblies of the design shown in the detailed plans at the locations designated by the plans, the proposals or directed.

720.02 Materials.

Materials furnished for use in the manufacture of the assemblies shall comply with the requirements noted in the detailed plans. Materials used in the actual installation of the attenuation in the work shall comply with appropriate provisions of these specifications.

720.03 Construction Requirements.

Any installation which is to be performed under traffic shall be provided with adequate warning and protective devices until such time as the assembly becomes usable. Once work is begun, it shall be prosecuted diligently and continuously until the assembly is completely installed.

720.04 Method of Measurement.

Vehicular impact attenuators of the design designated by the plans or proposal will be measured in assembly installations, complete in place at the designated locations.

720.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted impact attenuator assemblies, measured as noted above, will be paid for at the contract price bid for each assembly. Said unit price bid shall be full compensation for the furnishing of all materials and the installation of the designated assembly on its foundation, in its designated location, and includes furnishing of all equipment, tools, labor and other incidentals necessary to complete the work and provide an operational assembly complete in place.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

720-A Vehicular Impact Attenuator Assembly (_*_) - per each

* Description and Model of Attenuator Assembly

SECTION 726
PORTABLE CONCRETE SAFETY BARRIERS AND IMPACT ATTENUATORS

726.01 Description.

This Section shall cover the work of furnishing and installing a portable concrete safety barrier and impact attenuators at the locations shown on the plans, designated in the proposal or directed, along with the satisfactory removal thereof, if so directed. This Section shall also cover the work of picking up State furnished portable concrete barrier units at a designated State storage yard, their installation at the designated location shown on the plans, and the returning of the units to the State storage yard.

Portable Safety Barriers shall be classified as to "Type" which will designate the size, shape, height, etc., all in accordance with details shown in the plans. Unless specified otherwise, the type shall be optional, but once a type is selected it shall be used throughout the contract, unless otherwise approved by the Engineer. Portable Impact Attenuators shall be in accordance with details shown in the plans.

726.02 Materials.

All materials furnished for use shall conform to the appropriate requirements of Division 800, Materials, the details shown on the plans and the following:

Concrete, unless otherwise provided by plan details, shall meet the requirements for Class A, Type 1 of Section 501.

Steel Reinforcement shall meet the requirements of Section 502.

726.03 Construction Requirements.

(a) GENERAL.

The Construction of barrier units shall be in accordance with the appropriate provisions of Section 501, unless otherwise noted on the plans or directed.

The finished concrete shall be within reasonably close conformity to the lines, grades and dimensions shown on the plans or directed. The barrier unit shall present a smooth uniform appearance free of objectionable cavities or projections. Where a 10 foot {3 m} straightedge is placed horizontally on the exposed faces of the unit, the surface shall not vary more than 0.02 feet {6 mm} from the edge of the straightedge.

The exposed concrete surfaces shall be finished in accordance with the provisions of Subarticle 501.03(l) for a Class 2 finish on exposed surfaces, unless otherwise specified by plan details.

Portable Impact Attenuators shall be constructed in accordance with plan details.

(b) HANDLING, STORAGE, TRANSPORTING AND INSTALLATION.

The Contractor shall be responsible for the proper handling, transporting and installation of the barrier units and impact attenuators, complete in place, at the designated locations.

Unless otherwise approved by the Engineer, the units shall be lifted and supported at the points shown on the plans or directed.

Damage to any unit caused by improper handling, transporting or installation on the part of the Contractor shall be cause for the Engineer to order it to be repaired or replaced at no additional cost to the State.

726.04 Method of Measurement.

The Portable Concrete Safety Barriers of the type designated will be measured in linear feet {meters} to the nearest 0.1 feet {0.1 m} along the top surface of the barrier.

The Portable Impact Attenuators will be measured per each in accordance with the plan details for one complete attenuator and its accessories. State Furnished Portable Impact Attenuators will be measured per each.

726.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. ITEM 726-A.

The ordered and accepted Portable Concrete Safety Barrier of the designated type, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the fabrication and furnishing of the complete barrier unit and its exclusive use for the duration of the contract, all handling, hauling, installation, relocation, maintenance, removal and satisfactory disposal of the units when deemed of no further use on the project by the Engineer includes all tools, equipment, labor and incidentals necessary to complete the work.

2. ITEM 726-B.

The ordered and accepted Portable Concrete Safety Barrier of the designated type, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the fabrication and furnishing of the complete barrier unit and its exclusive use for the duration of the contract, all handling, hauling, installation, relocation, maintenance, and when deemed of no further use on the project by the Engineer, the removal, repair, if necessary, and delivery of the units to the Department's local storage yard and includes all materials, tools, equipment, labor and incidentals necessary to complete the work.

3. ITEM 726-C.

The ordered and accepted State Furnished Portable Safety Barrier units, measured as noted above, shall be paid for at the contract unit price bid which shall be full compensation for the pick-up of barrier units from Departmental storage sites, all handling, hauling, installation, relocation, maintenance, and when deemed of no further use on the project by the Engineer, the satisfactory removal and delivery of the units to the Department's local storage yard, including all materials, tools, equipment, labor and incidentals necessary to complete the work.

4. ITEM 726-D.

The ordered and accepted Portable Impact Attenuators of the designated design, measured as noted above, will be paid for at the contract unit price bid which shall be full

compensation for the fabrication and furnishing of the complete impact attenuator unit and its exclusive use for the duration of the contract, all handling, hauling, installation, relocation, maintenance, removal and satisfactory disposal of the units when deemed of no further use on the project by the Engineer and includes all tools, equipment, labor and incidentals necessary to complete the work.

5. ITEM 726-E.

The ordered and accepted State Furnished Portable Impact Attenuators, measured as noted above, shall be paid for at the contract unit price bid which shall be full compensation for the pick-up of Attenuator units from Departmental storage sites, all handling, hauling, installation, relocation, maintenance, and when deemed of no further use on the project by the Engineer, the satisfactory removal and delivery of the units to the Department's local storage yard, including all materials, tools, equipment, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

726-A Portable Concrete Safety Barriers, Type __*__ - per linear foot {meter}
726-B Portable Concrete Safety Barriers, Type __*__ - per linear foot {meter}
726-C State Furnished Portable Concrete Safety Barriers - per linear foot {meter}
726-D Portable Impact Attenuator (__**__) - per each
726-E State Furnished Portable Impact Attenuator - per each

* Show specific type, if required.
** Description and model of attenuator assembly

SECTION 728
TRUCK MOUNTED IMPACT ATTENUATOR

728.01 Description.

This Section shall cover the work of furnishing Truck Mounted Impact Attenuator Units and all services and operational supplies necessary to provide a functional unit during the life of the contract.

The Contractor shall retain ownership of the truck and impact attenuator unit, including all hardware and attachments, after their use on the project is complete.

728.02 Materials.

All truck mounted impact attenuator units furnished for use under this Section shall be new or acceptable used units which include all of the latest modifications to manufacturers current production models. Each truck mounted impact attenuator unit shall be self contained and include all hardware necessary to attach the unit to a truck having a 10,000 to 24,000 pound {4500 kg to 11 000 kg} gross vehicle weight {mass}. The weight {mass} of the entire attenuator system shall not be more than 1500 pounds {700 kg} when fully functional and ready for mounting to the rear of a truck.

Each truck mounted attenuator unit shall be self contained consisting of three major components; (1) a crushable cartridge, (2) a back-up and (3) a support structure for attaching the back-up to a truck all of which meet the following design criteria.

The height of the attenuator shall be adjustable to compensate for truck load variation during usage and to permit elevating the unit to a safe height for transporting when not in use.

The Contractor shall furnish the Engineer a copy of the certification by the testing agency that the attenuator meets the performance standards given in NCHRP Report 350, TL-2 (unless another level of testing is required as shown on the plans) for attenuators purchased after January, 2001. Attenuators purchased prior to January, 2001 may be used if they have been stamped for date of purchase and have been certified to meet the crash test criteria given in NCHRP Report 230.

When impacted at a speed of 45 miles per hour {72 km/h} by an errant vehicle within the weight {mass} range of 1800 to 4500 pounds {800 kg to 2000 kg}, the attenuator shall have the following affect on the truck that the attenuator is mounted on:

- for a vehicle having a weight {mass} of up to 4500 pounds {2000 kg}, limit the roll-ahead distance for the truck, with steering wheel locked and parking brake set on clean, dry pavement, to 20 feet {6 m};

- for a vehicle having a weight {mass} of 1800 pounds {800 kg}, limit the roll-ahead distance for the truck to 10 feet {3 m}.

The impact attenuator shall have a standard trailer lighting system, including brake lights, tail lights, and turn signals.

728.03 Construction Requirements.

(a) GENERAL.

The truck mounted attenuator unit furnished under this Section shall be used when work is performed under traffic.

(b) MAINTENANCE.

All truck mounted impact attenuator units shall be maintained in such a manner as to provide continuous service during their use on the project. Units which become non-operational during use will require the Contractor to suspend work until the units can be repaired or replaced.

The truck mounted impact attenuator units shall be stored in an approved secure storage area when not in use.

728.04 Method of Measurement.

Measurement of Truck Mounted Impact Attenuator Units will be made in complete functional units.

728.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The ordered and accepted truck mounted impact attenuator units under this item, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the furnishing of the unit, complete with truck, and its exclusive use on the project, for providing all equipment, supplies, services, labor and incidentals necessary to operate and to maintain the units in good serviceable condition during the life of the contract.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

728-A Truck Mounted Impact Attenuator Unit - per each

SECTION 730
TRAFFIC SIGNALS

730.01 Description.

This Section shall cover the work of furnishing and installing of traffic signal control equipment. These requirements may be supplemented or amended by the requirements given elsewhere in the specifications, or on the plans and Special and Standard Highway Drawings.

Descriptions and definitions of the equipment, words and terminology used in the furnishing and installing of traffic signal control equipment are given in the Manual of Uniform Traffic Control Devices (MUTCD) publications of the Institute of Transportation Engineers (ITE), the National Electrical Manufactures Association (NEMA), and the National Electrical Code (NEC).

730.02 Materials.

All materials furnished for use shall conform to the requirements given in Section 890 and the requirements shown on the plans. All materials and equipment furnished shall be new, except when the plans specifically provide for the re-use of existing equipment.

730.03 Construction.

(a) GENERAL.

All installations shall comply with the regulations of the latest edition of the National Electrical Code and the latest edition of the National Electrical Safety Code, and with the service rules of the Utility Company providing the electricity.

Structures for the support of traffic signal control equipment shall be furnished and installed in accordance with the requirements given in Section 718 and 891.

Coordination of the work with roadway and bridge work will be of prime importance to prevent undue damage to completed items of work and existing facilities. Any damage to existing facilities caused by the installation of the material or equipment required under this Section shall be repaired by the Contractor at no additional cost to the Department.

(b) DRAWINGS AND SPECIFICATIONS.

Omissions from the plans and specifications or the misdescription of details of work which are evidently necessary to carry out the intent of the plans and specifications or which are customarily performed, shall not relieve the Contractor from performing such omissions and details of work. In any case of discrepancy in descriptions on the plans or in these Specifications, the matter shall be promptly submitted to the Engineer, who will make a determination in writing. Any adjustments in the plans, details, specifications, and proposal by the Contractor without written permission of the Engineer shall be at the Contractor's own risk and expense.

(c) MATERIAL AND EQUIPMENT LISTS, SHOP DRAWING AND APPROVAL.

Material and equipment listings shall be submitted to the Engineer for approval within thirty days after the issuance of the "Notice to Proceed". Partial listings and shop drawings will not be accepted for consideration.

Submissions shall be clear, complete and in quadruplicate. Material and equipment lists shall include catalog cutouts or published data sheets and a completed Material Submittal form as provided by the Engineer. Unacceptable submittal data will be returned for corrective action. A copy of the approved material and equipment listings will be returned to the Contractor.

Any changes to the approved material and equipment lists must be requested in writing through proper channels.

If requested by the Engineer, the Contractor shall submit for inspection and approval samples of both the specified and proposed substitute items at no cost to the Department. The Department will not be liable for any materials purchased or work done or any delay incurred before such approval. Failure of the Engineer to note unsatisfactory material as received will not relieve the Contractor from responsibility. Manufacturers' warranties and guaranties furnished on equipment used in the work shall be delivered to the Engineer; likewise, instruction sheets and parts lists shall be delivered to the Engineer upon receipt of the equipment.

Throughout the entire project, the same manufacturer shall make all units of any one item, such as poles, signal heads, detectors, controllers, cabinets, etc.

Reference to a particular product by manufacturer, trade name, or catalog number establishes the quality standards of material and equipment required for this installation and is not intended to exclude products equal in quality and similar in design. Whenever any article, material, or equipment is defined by using the name of a manufacturer or vendor, the term "or approved equal" if not inserted, shall be implied.

(d) TESTING OF MATERIALS AND EQUIPMENT.

Some materials and equipment required to be furnished under this Section will be standard production type products. Acceptance will be made by the Engineer based on selected confirmation tests, the manufacturer's certification of the materials and equipment, and visual inspection at the job site. The manufacturer shall make available to the Department test data and material samples from the production runs for use in evaluation of these items. Title 32, Chapter 5A, Subsection 36 of the Code of Alabama states that all traffic control devices shall be approved by the Transportation Director before they can be used, sold, or offered for sale. Approved devices are shown on the Department's Approved Traffic Control Devices and Materials list. Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355 concerning this list.

(e) AS-BUILT DRAWINGS.

After all equipment has been installed and the operational check has been instigated, the Contractor shall submit a set of plans showing in detail all changes on construction from the original plan details with special notation given to conduit location and elevation and schematic circuit diagrams.

(f) OPERATIONAL MANUALS.

All controllers shall be furnished with a copy of operational manuals and as-built wiring diagrams for all equipment and accessories required in the controller cabinet. These manuals and wiring diagrams shall be mounted to the cabinet in an appropriate manner. In addition, two copies of these manuals and wiring diagrams shall be transmitted to the Department's Traffic Engineer.

(g) PRE-INSTALLATION TEST AND ACCESSORY TEST.

Before the installation of the traffic control system(s) or unit(s), the Contractor shall perform a pre-installation test. This test shall include the bench testing of all controllers, signals, detectors, etc., under signal load conditions for fourteen consecutive days.

The Contractor shall secure an acceptable site, approved by the Engineer, for the bench test and shall perform all work required in the performance of the test. The Contractor shall notify the Engineer of the date that the test is to begin a minimum of seven days before that date.

None of the equipment shall be installed on the project until the bench test has been completed and the Contractor has submitted a letter to the Engineer certifying that the equipment performed satisfactorily during the test. The Engineer, at his discretion, may shorten the length of time required for the bench testing. There will be no direct payment to the Contractor for the cost of the pre-installation test including the cost of a suitable test site and the setting up of equipment for the test.

(h) REMOVAL OF EQUIPMENT.

All equipment designated or directed to be removed shall be removed in such a manner that the removed equipment will not be damaged. Any damage due to negligence on the part of the Contractor because of lack of proper care of equipment shall be cause for the Engineer to order its replacement. The cost of such replacement shall be borne fully by the Contractor. Any equipment or materials not authorized by the Engineer for re-use into a new facility shall be stored by the Contractor for pickup by the Department at a later date. Storage facilities shall be provided so that the equipment will be protected from the elements and damage by vandalism.

(i) CONCRETE FOUNDATIONS.

All conduit systems, elbows, etc., shall be installed securely and inspected by the Project Engineer before concrete is poured.

The Contractor shall contact the utility companies to determine the location of underground utilities in the area where the foundations are to be located and shall be responsible for repairing, to the satisfaction of the utility company, any damaged utilities.

(j) ABANDONING FOUNDATIONS.

All foundations, when abandoned, the top of the foundation, anchor bolts frame and conduit shall be removed to a depth of not less than 6 inches {150 mm} or as directed below the surface of existing pavement. The resulting hole shall be backfilled with material to match the existing surface.

(k) INTERCONNECT CABLE.

1. GENERAL.

Interconnect cable wire shall be installed at locations as shown on the plans or as directed by the Engineer.

Splices shall be made only where shown on the plans or in the controller cabinet.

A minimum of 6 feet {1.8 m} or as directed, of slack shall be provided at each controller.

2. UNDERGROUND INTERCONNECT CABLE.

Underground interconnect cable shall be run in conduit.

3. AERIAL INTERCONNECT CABLE.

Aerial interconnect cable shall be supported on new or existing utility poles and/or signal poles as shown on the plans.

Interconnect support cable wire supporting signal control cable only will be sagged to a vertical distance not greater than 2 percent of the length of the span between poles.

When support cable is not an integral part of the interconnect cable, interconnect cable shall be attached to a support wire.

(l) ELECTRICAL POWER SERVICE ASSEMBLY.

The location of the utility service point and power source shown on the Signalization Plans is approximate. The Contractor shall determine the exact location.

When the service equipment is to be installed on a utility-owned pole, the contractor shall furnish and install conduit, conductors, and other necessary material to complete the installation of the service. The position of the riser and equipment will be determined by the utility.

When the Contractor is to provide a lateral drop from the power source to the service pole, the Contractor shall arrange with the serving utility to complete the service connections. The Contractor shall install the conduit, conductors, enclosure and accessories, and service pole.

(m) SPAN WIRE.

The installation of span wire shall meet all provisions of the National Electric Safety Code (ANSI-C2) regarding clearance from electric lines.

The length of the messenger wire shall be adjusted under the load of traffic control equipment so that the sag at the lowest point shall not be greater than the requirements in Section 718.

(n) VEHICULAR AND PEDESTRIAN SIGNAL HEADS.

Traffic or pedestrian signal heads shall not be installed until all other signal equipment, including the controller, is in place and ready for operation except that signal heads may be installed if no face of the head is directed toward traffic or if the entire assembly is hooded.

Each signal face shall be so adjusted vertically and horizontally in order that its beams will be of maximum effectiveness to the approaching traffic for which it is intended.

(o) LOOP WIRE.

1. LOOPS.

Before cutting required loops into the pavement, any existing loops that are not quadrupole loops shall be sawed into in two locations and quadrupole loops shall be sawed into in three locations on the long side to prevent false readings when the required loops are placed into the pavement.

Loop wire shall be one continuous run without splices.

Loop wire shall be pushed to the bottom of the saw cut with a non-metallic tool that will not damage the insulation.

Each loop wire shall be placed in an individual sawcut.

No portion of the loop shall be located within 3 feet {1 m} of any conductive material in the pavement such as manhole covers, water valves, and grates, etc.

After installation of the loops, the slots shall be sealed with an approved sealant manufactured specifically for embedding loop detector wire in concrete or bituminous pavements.

All loop connectors shall be connected to a shielded home-run cable located in junction box or when so directed or shown on plans at base of traffic signal strain pole.

2. SAWCUTS FOR LOOPS.

Slots for installing the loops shall be formed by sawing with approved equipment designed for sawing pavement, to the width and depth indicated by the plan details or directed.

The slot shall be cleaned of all foreign loose debris using compressed air or other approved means before installation of the loop wires.

Sawcut corners shall be cut at a diagonal. No sharp bends shall be accepted.

3. LOOP SEALANT.

Loop sealant shall be placed in sawcuts in accordance with manufacturer's recommendations.

Loop sealant will not be permitted when there is moisture on the surface, the air temperature is below 4.4 °C, or other conditions exist that in the opinion of the Engineer would affect the bonding of the material.

4. TESTING.

Loops shall be tested prior to sealing sawcuts.

The Contractor shall perform a leakage to ground test on all loops using a MEG-OHM meter with 500 V applied. The loops shall also be tested after the lead-ins are pulled to the amplifier to detect any damage done during installation. A State Inspector will perform this same test to check for leakage. Any loop failing to read 100 MEGS or better shall be replaced by the Contractor at no additional cost to the project.

(p) LOOP DETECTOR LEAD-IN.

A separate run of shielded home-run cable shall be provided for each loop unless otherwise directed.

Lead-in cable installed underground shall be in conduit.

The lead-in shall be one continuous run from controller to loop connection with no splices.

(q) INSTALLATION OF CONDUIT.

Metallic conduit shall be used above ground and may be used below ground.

Non-metallic conduit shall only be used underground.

Where non-metallic conduits join metal conduits, connection shall be made using appropriate couplings to form a watertight raceway. All conduits entering concrete foundations shall be provided with appropriate bushings at the ends. Conduits shall be stubbed approximately 1 inch {25 mm} above

concrete and shall be provided grounding type bushings on conduit ends in base of poles with copper bonding jumpers.

Bends and offsets shall be avoided where possible, but where necessary, shall be made with a proper hickey, pipe bender, or conduit bending machine. Conduit that has been crushed or deformed due to improper bending or handling shall not be installed.

Conduits shall be installed in a manner to insure against trouble from collection of trapped condensation where possible.

Conduits shall be capped to prevent entrance of deleterious materials during construction. For underground conduit adjacent to gasoline service stations or other installations of underground gasoline or diesel storage, piping or pumps, and which lead to a cabinet, circuit breaker panel, service or any enclosure where an arc may occur during normal operation, the Contractor shall refer to the National Electrical Code (NEC) for Class 1, Hazardous Locations.

Conduit for future use shall be threaded and capped.

All conduit installed under paved areas shall be encased.

Encasement shall meet the requirements of Section 756 and shall be Type 1, Type 2, and/or Type 5 installation as shown in the details.

If the Contractor should encounter extraordinary circumstances such as major utilities under existing pavement which the location cannot be accurately determined, he may request in writing permission to open cut a trench in lieu of jacking or boring. This request shall also include detailed proposed sequence of excavating, backfilling, method of handling traffic, etc. for the Engineer's consideration. No such work shall be performed without written permission of the Engineer.

All conduit systems shall be completely installed before the conductors are installed.

(r) LUMINAIRES.

The light control surfaces and glassware shall be cleaned after installation.

Cleaning shall be performed in accordance with luminaire manufacture's recommendations.

Luminaires shall be leveled, plumbed, and installed as per the manufacturer's recommendations and as directed by the Engineer to achieve the most suitable light pattern.

(s) WIRING INSTALLATION REQUIREMENTS.

Wiring within junction boxes shall be neatly arranged and laced.

Powdered soapstone, talc, or other approved lubricant may be used in pulling cable in conduit.

All cables within a single conduit shall be pulled at the same time.

All ends of cable shall be taped to exclude moisture and shall be so kept until splices are made and terminal appliances attached.

The ends of spare conductors shall be taped.

All conductor splices that will be direct buried in earth and all loop detection conductor splices shall be soldered and encased in an approved splicing kit and with sealing tape.

All other signal conductor splices shall be spliced using a twisted connection made by a suitable wire nut or crimp and then properly covered by insulating tape or other insulating materials.

(t) GROUNDING ENCLOSURES.

All metal enclosures containing electric wires and/or equipment shall be grounded.

Ground rods shall be installed at all service equipment and traffic signal pole foundations.

Single ground rods shall be driven vertically until the top of the rod is at least 12 inches {305 mm} below the finished grade.

Where a grounding conductor passes through a metal conduit, a suitable grounding bushing shall be placed on each end of the conduit and connected to a ground wire.

Each messenger cable shall be attached to the supporting structure with separate span wire clamps.

(u) EXCAVATING AND BACKFILLING.

All excavation required for the installation and placement of conduits, foundations, junction boxes, poles and other appliances shall be performed in such manner as to cause the least possible injury to pavement, curbs or other improvements. All conduits required under pavement, sidewalks, etc. shall be in place prior to commencing of base and paving operations. The trenches shall not be excavated wider than necessary for the proper installation of the electrical appliance and foundations. Excavating shall not be performed until immediately before installation of conduit and other

appliances. The material from the excavation shall be placed in a position where the least interference with the surface drainage will occur.

Should large rocks be encountered in conduit trenches, they shall be removed to a depth of 3 inches {75 mm} below the proposed elevation and replaced with a 3 inch {75 mm} layer of suitable material. All suitable material removed from the conduit trenches shall be used in backfilling of the trenches; however, no stone larger than 3 inches {75 mm} shall be in contact with any conduit.

All surplus excavated material shall be removed from and disposed of by the Contractor, as directed by the Engineer.

Excavations, after backfilling, shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made.

Compaction shall be accomplished to the extent necessary to prevent future settlement of the backfill.

The Contractor will be required to restore any areas disturbed by his work to their original condition without additional cost to the State.

(v) INSULATION TESTING.

Isolation test for testing insulation resistance shall be preformed for each conductor in the cable. Testing shall be made using Article 110-19 of the NEC, as a guide. If resistance measured with all protective devices in place is less than 250,000 Ω, the contractor shall remove the defective cable, install new cable, and repeat the test.

For interconnect cable, upon completion of run from one controller installation to the next controller installation, the Contractor shall conduct a test for insulation resistance in the presence of the Engineer.

(w) CIRCUIT CONTINUITY TEST.

Each circuit branch shall be temporarily jumpered at its termination and the temporarily loop circuit measured for continuity to assure that no open circuits exist, that the circuit branch is according to plan, that no high resistance connections exist and that each circuit is properly identified. Lead-in cable for loop detector wire shall be tested before and after the cable is spliced to the loop wire. As an alternative, circuit continuity testing of signal head cable may be done by applying 120 V to each outgoing circuit and observing that only the proper lamps are lighted.

(x) GROUND RESISTANCE TEST.

At each ground rod location, a test shall be made. The effectiveness of the ground rod shall be determined by measuring resistance from the pole enclosure to a convenient underground water line, with a 0-50 ohm megger where a water line is available and with auxiliary ground method where the water line is not available. The two auxiliary ground rods shall be not less than 50 feet and 100 feet {15 m and 30 m}, respectively, from the tested rod. If reading is greater than 25 Ω, additional rods shall be installed until a reading of 25 Ω is obtained.

(y) OPERATIONAL CHECK AND ADJUSTMENT OF EQUIPMENT.

After completion of the installation and the related work and before final acceptance of the system, a full operational check of the system under actual traffic conditions shall be made. The period of test shall cover thirty calendar days. During the test period the Contractor shall expeditiously perform any necessary adjustment and replace any malfunctioning parts of the equipment required to place the system in an acceptable operational condition. Once repairs have been started, the Contractor shall have the Traffic Control Equipment in an acceptable operational condition before leaving the project site. No extra compensation will be allowed for any work so required, such being considered incidental to furnishing and installing a complete operational signal system.

During the test period, time charges shall be suspended if all other work has been completed and acceptance of the work is dependent upon the results of the "operational check." The period of the test shall cover thirty continuous calendar days.

In case of emergency or failure on the Contractor's part to expeditiously pursue repairs, the Department reserves the right to make such repairs as it deems necessary. The cost for this work will be deducted from the contract bid amount for the project. The Department will not assume responsibility for the repairs or alter any of the requirements of the test period because of the repairs. The aforementioned shall in no way relieve the Contractor of his liability or responsibility related to maintaining the traffic signal as required by these specifications.

730.04 Method of Measurement.

(a) REMOVAL OF TRAFFIC CONTROL UNIT.

A single intersection (Unit) where all the existing traffic signal control equipment at an intersection, as shown on the plans or as directed by the Engineer, is removed will be measured as a Lump Sum, Removal of Traffic Control Unit.

A single intersection (Unit) where only some of the existing traffic signal control equipment at an intersection, as shown on the plans or directed by the Engineer, is removed will be measured as a Lump Sum, Removal of Traffic Control Unit (Partial).

A single intersection (Unit) where wood poles are used for a temporary installation and shall be removed during or at the end of construction, as shown on the plans or as directed by the Engineer, will be measured as a Lump Sum, Removal of Traffic Control Unit (Temporary).

(b) FURNISHING AND INSTALLING TRAFFIC CONTROL UNIT.

1. A single intersection (Unit) where items for which no pay items exist, including but not limited to span wire, signal cable, miscellaneous hardware, electrical power service, signs, and any other items as shown on the plans or required to have a complete and operational installation, will be measured as Lump Sum, Furnishing and Installing Traffic Control Unit.

2. The Electrical Power Source, paid for under pay item 730-A, shall include weatherhead; 1 inch {27 mm} metallic conduit from weatherhead to disconnect switch; complete disconnect switch including but not limited to enclosure, load center complete with circuit breaker, padlock and key; 1 inch {27 mm} metallic conduit from disconnect switch to a vertical distance below the ground line, attachment hardware, ground rod and related equipment, service cables, No. 10 AWG service cable (luminaires), attachment to local utility, and all incidentals to provide a complete and operational power to controller assembly and luminaires.

The removal and/or furnishing and installation of traffic control equipment when so scheduled on the plans or proposal will be measured for payment by the appropriate items, complete, in place, acceptably installed and operational in accordance with the following:

Pay items 730-A, C, and V, will be measured per lump sum.

Pay items 730-E, F, G, J, K, N, O, P, Q, R, and T will be measured per each.

Pay items 730-H, I, L, and M will be measured per linear foot.

730.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

Item 730-A. The accepted work for the removal of existing units, measured as noted above, will be paid for at the contract lump sum price bid which shall be full compensation for the satisfactory removal and storage of the equipment and materials ordered removed, and shall include all equipment, tools, labor, services, storage facilities and incidentals necessary to complete the work.

Item 730-C. The accepted work of furnishing and installing the traffic control unit, measured as noted above, shall be paid for at the contract lump sum price bid, which shall be full compensation for the furnishing of the equipment, installation in accordance with these Specifications, plans, proposal, and details, and for all tools, equipment, labor, materials, operational facility connected to the local utility.

Item 730-E. Metal Traffic Signal Pole Foundation, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for excavation, backfilling, forming, concrete, reinforcing steel, anchor bolts, ground rod, seeding and mulching of disturbed areas, disposal of debris and for all materials, labor, equipment, tools, testing, services and incidentals necessary to complete this item of work.

Item 730-F. Metal Traffic Signal Pole with Mast Arm Assembly, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for furnishing and installing the metal traffic signal pole and mast arm assembly and for all materials, equipment, tools, labor, services, and incidentals necessary to complete this item of work. The required foundation shall be measured separately with payment being made under Item 730-E.

Item 730-G. Traffic Signal Strain Pole, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for furnishing and installing the traffic signal strain pole, and for all materials, equipment, tools, labor, services, and incidentals necessary to complete this item of work. The required foundation shall be measured separately with payment being made under Item 730-E.

Item 730-H. Loop Wire, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for the saw cutting, loop wire, loop sealant, trenching, backfilling, electrical connections, splicing, and for all materials, labor, equipment, and tools to provide a complete and operational loop detector.

Item 730-I. Loop Detector Lead-In Cable, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for furnishing and installing the shielded home-run cable, including electrical connections and for all materials, equipment, tools, labor, testing, and incidentals necessary to provide a complete and operational detector loop.

Item 730-J. Vehicle Loop Detector, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for the furnishing and installing the loop detector amplifier, electrical connections and for all materials, equipment, tools, labor and incidentals necessary for a complete and operational loop detector amplifier.

Item 730-K. Traffic Signal Junction Box, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for furnishing and installing the junction box, excavation, backfilling, and for all materials, labor, equipment, tools, and incidentals necessary to complete this item of work.

Item 730-L. Conduit, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for furnishing and installing the conduit including fittings, trenching, placing, joining, attaching to structure, backfilling, seeding and mulching of disturbed areas, disposal of debris, and all materials, labor, equipment, tools and incidentals necessary to complete this item of work.

Item 730-M. Interconnect Cable, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for furnishing and installing the interconnect cable with the number of conductors and type as designated by the plans, including all hardware for aerial installation, connecting to controller assemblies, splicing, electrical connections, and for all materials, testing, labor, equipment, tools, and incidentals necessary for a complete and functional interconnect cable.

Item 730-N. Luminaire Extension Assembly, measured as noted above, will be paid for at the contract unit price bid, complete in place, which shall be full compensation for furnishing and installing the luminaire arm, sodium vapor luminaire, surge arrestor, connections, ground rod, No. 10 AWG, cable, and for all materials, labor, equipment, tools, and incidentals necessary for a complete and operational luminaire.

Item 730-O. Illuminated School Zone, Speed Limit Signs, measured as noted above, will be paid for at the contract unit price bid, which shall be full compensation for the furnishing and installing the illuminated school zone sign including all attachment hardware, connections, and for all materials, labor, equipment, tools, and incidentals necessary for a complete operational illuminated school zone speed limit sign.

Item 730-P. Vehicular Signal Head, measured as noted above will be paid for at the contract unit price bid complete in place, which shall be full compensation for furnishing and installing the vehicular signal head, trunnions, brackets, attachment hardware, connections, splicing, and for all materials, labor, equipment, tools, and incidentals necessary for a complete and operational vehicular signal head.

Item 730-Q. Pedestrian Signal Head, measured as noted above, will be paid for at the contract unit price bid, which shall be full compensation for furnishing and installing the pedestrian signal head including attachment hardware, electrical connections, splicing, and for all materials, labor, equipment, tools, and incidentals necessary for a complete and operation pedestrian signal head.

Item 730-R. Controller Assembly, measured as noted above will be paid for at the contract lump sum price bid complete in place, which shall be full compensation for furnishing and installing the cabinet, controller unit, auxiliary devices, electrical devices, surge protection, terminals, concrete foundation or side mounting hardware, mounting and wiring of controller assembly, and for all materials, labor, equipment, tools, testing, and incidentals necessary for a complete and operational controller assembly.

Item 730-T. Wood Pole, measured as noted above, will be paid for at the contract unit price bid complete in place, which shall be full compensation for furnishing and installing the wood pole, excavating, backfilling, attachment hardware, grounding, weatherhead, guy wire, and for all materials, labor, equipment, tools, and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.

730-A Removal of Existing Traffic Control Unit (1) - per lump sum
730-A Removal of Existing Traffic Control Unit (Partial)(1) - per lump sum
730-A Removal of Existing Traffic Control Unit (Temporary)(1) - per lump sum
730-C Furnishing and Installing Traffic Control Unit (1) - per lump sum
730-E Metal Traffic Signal Pole Foundation – per each
730-F Metal Traffic Signal Pole with (2) Mast Arm Assembly - per each
730-G (3) Traffic Signal Strain Pole - per each
730-H Loop Wire - per linear foot {meter}
730-I Loop Detector Lead-In Cable - per linear foot {meter}
730-J Vehicle Loop Detector - per each
730-K Traffic Signal Junction Box - per each
730-L (4) , (5) , Conduit - per linear foot {meter}
730-M Interconnect Cable, (6), (7) AWG, (8), (9) - per linear foot {meter}
730-N Luminaire Extension Assembly, (10) feet {meters} - per each
730-0 Illuminated School Zone Speed Limit Sign - per each
730-P Vehicular Signal Head, (11) Inch, (12) Section, Type (13) - per each
730-Q Pedestrian Signal Head, Type(14) - per each
730-R Controller Assembly, Type (15), (16) phase - per each
730-T Wood Pole - per each

(1) Specify Intersection Location
(2) Specify Length of Mast Arm
(3) Specify Type (Metal or Concrete)
(4) Specify Size (1 inch, 2 inch, or 3 inch) {27 mm, 53 mm, or 78 mm}
(5) Specify Type (metallic or non-metallic)
(6) Specify Type (Aerial Self-supporting, Aerial Lashed, or Underground)
(7) Specify Cable Size (No. 14 AWG or No. 19 AWG)
(8) Specify Number of Conductors or Pairs (9 Conductors or 6 Pairs)
(9) Specify (IMSA 20-1, IMSA 20-3, REA PE-22, REA PE-38, or REA PE-39)
(10) Specify Arm Length in Feet {Meters}
(11) Specify Lens Size (8 inch or 12 inch) {200 mm or 305 mm}
(12) Specify Number of Sections (1, 2, 3, 4, or 5)
(13) Specify Type (Incandescent, Optically Programmed, or LED)
(14) Specify Type (Incandescent or LED)
(15) Specify Type (II or III)
(16) Specify Number of Phases (2, 4, 8, or Master)

SECTION 731
TRAFFIC COUNTING EQUIPMENT

731.01 Description.

This Section shall cover the work of furnishing and installing, complete in place, traffic counting equipment as shown on the plans, at locations shown on the plans, all in accordance with the details shown on the plans and these Specifications.

For the purpose of these Specifications traffic counting equipment will be classified as operational units. Traffic Counting Units shall be classified by "Type" which will designate the number and design of the loops, etc., in accordance with details shown in the plans.

For the definition of equipment, words, and terminology used in the furnishing and installing of Traffic Counting Equipment, refer to the appropriate publications of the Institute of Transportation Engineers (I.T.E.) and to the Manual of Uniform Traffic Control (MUTCD).

731.02 Materials.

(a) GENERAL.

Material and equipment listings shall be furnished to the Engineer within thirty days after the issuance of the "Notice to Proceed". The Contractor shall submit to the Engineer for approval, seven copies of a complete list of all materials and equipment. Partial listings will not be accepted for consideration. Material and equipment lists shall include catalog cutouts or published data sheets and

a completed Material Submittal Form. Unacceptable submittal data will be returned for corrective action. A copy of the approved material and equipment listings will be returned to the Contractor.

Any changes to the approved material or equipment lists shall be requested in writing through proper channels. If requested by the Engineer, the Contractor shall submit for inspection and approval samples of both the specified and proposed substitute item at no cost to the Department. Materials and equipment installed or used without prior approval of the Engineer shall be at the risk of subsequent rejection. The State shall not be liable for materials purchased, work performed, or any delay incurred due to the failure of the Contractor to secure prior approval. Failure of the Engineer to note unsatisfactory material as received will not relieve the Contractor of responsibility.

Manufacturers' warranties and guaranties furnished on material and equipment used in the work shall be delivered to the Engineer; likewise, instruction sheets and parts listed supplied shall be delivered to the Engineer upon receipt of the equipment.

Reference to a particular product by manufacturer, trade name, or catalog number establishes the quality standards of material and equipment required for this installation and is not intended to exclude products equal in quality and similar in design. Whenever any article, material, or equipment is defined by describing a proprietary product or by using the name of a manufacturer or vendor, the term "or approved equal" if not inserted, shall be implied.

Electrical materials shall conform to the Standards of the National Electrical Manufactures Association (NEMA) and/or the Underwriters Laboratories, Inc. (UL), in every case where a standard has been established for that particular article, material, or equipment.

All material and equipment shall be of the best quality and workmanship and shall be new unless otherwise noted on the plans. Throughout the entire project, all units of any one item, such as enclosures, and associated equipment, etc., shall be made by the same manufacturer.

Inasmuch as certain materials and equipment furnished for use under this Section will be standard production type products, acceptance will be made by the Engineer based on selected confirmation tests, the manufacturer's certification of the material and/or design conformance to the requirements noted in this Section, details shown on the plans, and visual inspection at the job site. The manufacturer shall make available to the Department test data and material samples from the production runs for use in evaluation of their product.

Title 32, Chapter 5A, Subsection 36 of the Code of Alabama states that all traffic control devices shall be approved by the Transportation Director before they can be used, sold, or offered for sale. Approved products can be found in the Departments "Materials, Sources, and Devices With Special Acceptance Requirements" manual. The Contractor may choose from any of these products, unless otherwise noted. Refer to Subarticle 106.01(f) and BMTP-355 concerning this list.

(b) TERMINAL STRIP ENCLOSURE.

Terminal Strip Enclosure shall include, but not limited to, the enclosure, terminal strips, pin connectors, ground rod, ground rod clamp, ground wire, and ground lug. Terminal Strip Enclosure and associated equipment shall conform to the detailed plans.

(c) LOOP WIRE.

Loop wire conductors shall be stranded soft annealed stranded wire of not less than 98 percent conductivity with not less than 98 percent conductivity and shall be insulated for 600 volts or more with a cross-linked polyethylene insulation. Conductors shall be Type RHH or RHW or Use or XHHW.

(d) CONDUIT SYSTEMS.

1. NON-METALLIC CONDUIT.

Non-metallic conduits shall be Type II, Schedule 40, PVC unless otherwise noted on the plans. All non-metallic conduits and fittings shall conform to UL Standard 651 or NEMA TC-2 latest edition.

2. LIQUIDTIGHT FLEXIBLE METAL CONDUIT.

Liquidtight flexible metal conduits shall conform to UL listed Type UA for the intended use.

(e) TERMINAL STRIP ENCLOSURE SUPPORT.

The Terminal Support Enclosure support structure shall be in accordance with the details shown on the plans and meet the requirements of Article 840.04.

731.03 Construction Requirements.

(a) GENERAL.

All required material and equipment shall be installed in accordance with the manufacture's recommendations, details shown in the plans, and as designated in the proposal. All installations shall comply with the regulations of the latest edition of the National Electrical Code (NEC) and the latest edition of the National Electrical Safety Code.

Coordination of this work with regular roadway or bridge work will be of prime importance to prevent undue damage to completed items of work or existing facilities. Any damage to existing facilities caused by the installation of the material and/or equipment required under this section of work, shall be repaired by the Contractor at no additional cost to the State.

After all equipment has been installed and an operational check has been instigated, the Contractor shall furnish the Engineer with a corrected set of plans showing in detail all changes on construction from the original plan details.

(b) GROUNDING.

All metal enclosures containing electric wires and/or equipment shall be grounded. Ground rods shall be installed at all the terminal strip enclosure. Single ground rods shall be driven vertically until the top of the rod is at least 12 inches {305 mm} below the finished grade. A length of No. 4 bare soft drawn copper shall be attached to the ground rod clamp as shown on the plan details. Where a grounding conductor passes through a metal conduit, a suitable grounding bushing shall be placed on each end of the conduit and connected to the ground wire.

Where non-metallic conduit is used, a separate continuous grounding conductor shall be extended from the service ground to all equipment and shall be used for grounding purposes only.

Testing of Grounding System: The effectiveness of the ground rod shall be determined by measuring resistance from the pole enclosure to a convenient underground water line, with a 0-50 ohm megger (J.H. Biddle Company or equal) where a water line is available and with auxiliary ground method where the water line is not available. The two auxiliary ground rods shall be not less than 50 feet and 100 feet {15 m and 30 m}, respectively, from the tested rod. If reading is greater than 25 ohms, additional rods shall be installed until a reading of 25 ohms is obtained.

(c) WIRING.

All wiring shall be installed in a neat and workmanlike manner. Wiring within enclosure cabinet shall be neatly arranged and laced. Loop wire shall be one continuous run without splicing. All ends of cable shall be taped to exclude moisture and shall be so kept until terminal strips are attached.

(d) LOOP WIRE INSTALLATION.

A conduit run shall be completely installed before the installation of wire. Wires in conduits shall be carefully pulled into place using approved methods so that the cable will be installed free from any electrical or mechanical injury. Powdered soapstone, talc, or other inert lubricant specifically designed for the purpose shall be used. A conduit run shall be completely installed before the installation of wire. Wires in conduits shall be carefully pulled into place using approved methods so that the cable will be installed free from any electrical or mechanical injury. Conductors shall be handled and installed in such a manner as to prevent kinks, bends or other distortion which could damage the conductor or outer covering. All cables within a single conduit shall be pulled at the same time.

Loop wire shall be installed in slots cut in the pavement, at locations designated on the plans or as directed by the Engineer. The slot shall be formed by sawing pavement with approved equipment designed for sawing pavement, to the width and depth indicated by the plan details or directed. The slot shall be cleaned of all foreign loose debris using compressed air or other approved means before installation of the loop wire. After installation of the loops, the slots shall be sealed with an approved sealant manufactured specifically for embedding loop detector wire in concrete or bituminous pavements.

All conductors installed under paved areas shall be encased. Installation of the casing shall be made either prior to placement of the pavement with thick wall rigid metallic or rigid casing, or it shall be jacked or bored through the roadbed under the pavement using thick wall rigid metallic casing providing a minimum cover of 30 inches {762 mm}.

The sealant proposed for use shall be shown in the proposed list of materials to be used.

(e) CONDUIT SYSTEM INSTALLATION.

Conduits shall be joined by approved fittings using methods prescribed the manufacturer of the conduit. Where non-metallic conduit join metal conduits, connection shall be made using appropriate couplings to form a watertight raceway. Bushings shall be installed as shown on the plan details. Underground conduit shall be installed as shown on the plans with a minimum cover of 30 inches {762 mm }.

When rock is encountered is encountered in the in the bottom of the trench, the conduit shall be installed in a bed of well compacted, fine grained soil at least 2 inches {50 mm} thick. If 30 inches {762 mm} cannot be attained, convert the conduit to asphaltum painted metallic conduit installed as deep as practical but no less than 6 inches {152 mm}. Seeding and mulching of disturbed areas shall be backfilled and compacted to prevent future settling. Seeding and mulching of disturbed areas shall be as directed by the Engineer as a subsidiary obligation of the conduit installation.

Precautions shall be taken to be sure that the conduit will be located to avoid conflict with proposed guardrail, signpost, etc. Where possible, a minimum of 12 inches {305 mm} shall be provided between the finished lines of conduit runs and utility facilities, such as gas lines, water mains, or other underground facilities not associated with the electrical system. Where the conduit run is adjacent to concrete walls, piers, footings, etc., a minimum of 4 inches {102 mm} of undisturbed earth or firmly compacted soil shall be maintained between the conduit and the adjacent concrete.

Unless specified on the plans, trenches shall not be excavated in existing pavement or paved shoulders to install conduit. When it is necessary to place conduit under an existing pavement, the conduit shall be installed in accordance with Section 756. Unless approved otherwise by the Engineer, no trenches shall remain open after normal work hours each day. All trenches shall be protected from the accumulation of water which might cause an undermining of adjacent structures or utilities. The Contractor shall adequately support all pipes and other structures exposed in trenches.

(f) EXCAVATING AND BACKFILLING.

Before beginning any excavation, the Contractor shall determine the location of any electrical, drainage or utility lines in the vicinity and shall conduct his work in such a manner as to avoid damage to the same.

All excavation required for the installation and placement of conduits and other materials shall be performed in such manner as to cause the least possible injury to pavement, curbs or other improvements. All conduits required to be under pavement, sidewalks, etc. shall be in place prior to commencing of base and paving operations. The trenches shall not be excavated wider than necessary for the proper installation of the material. Excavating shall not be performed until immediately before installation of conduit and other appliances. The material from the excavation shall be placed in a position where the least interference with the surface drainage will occur.

Should large rocks be encountered in conduit trenches, they shall be removed to a depth of 3 inches {75 mm} below the proposed elevation and replaced with 3 inches {75 mm} layer of suitable material. All suitable material removed from the conduit trenches shall be used in backfilling of the trenches; however, no stone larger than 3 inches {75 mm} shall be in contact with any conduit.

All surplus excavated material shall be removed from and disposed of by the Contractor, as directed by the Engineer.

Excavations, after backfilling, shall be kept well filled and maintained in a smooth and well drained condition until permanent repairs are made.

The Contractor will be required to restore any areas disturbed by his work to their original condition without additional cost to the State.

(g) ENCASEMENT.

All encasement shall meet the requirements of Section 756 and the requirements set forth in this proposal.

If the Contractor should encounter extraordinary circumstances such as major utilities under existing pavement which the location cannot be accurately determined, he may request in writing permission to open cut a trench in lieu of jacking or boring. This request shall also include a detailed proposed sequence of excavating, backfilling, method of handling of traffic etc. for the Engineer's consideration. No such work shall be performed without written permission of the Engineer.

731.04 Guarantee.

The Contractor shall guarantee all work performed under this Section, against defective materials and workmanship for a period of six (6) months after the final acceptance of the project. The

Contractor shall replace materials and workmanship found defective during the guarantee period at no cost to the State.

731.05 Method Of Measurement.

Furnishing and installing of traffic counting equipment when so scheduled on the plans or proposal shall be measured in complete units in accordance with the following:

Each complete operational traffic counting facility will be measured separately with single locations classified as units.

731.06 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted work of furnishing and installing the traffic counting units measured as noted above, shall be paid for at the contract price bid per each, which shall be full compensation for the furnishing of the traffic counting unit terminal strip enclosure, conduit, encasing, grounding materials, loop wire and sealant, and all incidentals necessary for furnishing in accordance with plan details; and for all tools, equipment, labor to complete the installation.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

731-A Traffic Counting Units, Type ____ per Each

SECTION 740
TRAFFIC CONTROL DEVICES FOR CONSTRUCTION WORK ZONES

740.01 Description.

This Section shall cover the work of furnishing, erecting, lighting as directed, handling and maintaining all construction signs (warning, regulatory and guide), barricades and other traffic control devices installed at locations specified by plan details, directed or approved by the Engineer for the purpose of handling traffic safely through construction work zones.

The traffic control devices covered by this Section shall meet the requirements specified in the MUTCD and as detailed on the plans. In case of conflict or discrepancy, the plans shall govern over the MUTCD.

This Section shall also cover the work of furnishing and operating pilot cars and furnishing flaggers to control traffic at such locations and for such periods as are necessary to handle traffic safely through construction work zones.

740.02 Materials.

All signs, barricades, markers, lights and other warning devices shall be previously approved for use in highway construction under the provisions of Section 32-5A-36 of the Alabama Code prior to their installation.

Materials used in the fabrication, construction and installation of the construction signs, barricades and other devices shall conform to the requirements of Article 104.04, plan details, the MUTCD and the details noted in this Section:

Sign panels may be fabricated from one of the types of material shown below:

Material	Min. Panel Thickness	* Sign Face Area
Aluminum Flat Sheets	0.080 inches {2.00 mm}	All sizes
Steel Flat Sheets	0.075 inches {1.90 mm}	All sizes
Plastic Flat Sheets	0.250 inches {6.35 mm}	All sizes
Exterior Plywood Sheets, Grade A-C	0.50 inches {13 mm} 0.75 inches {19 mm}	Up to 16 square feet {1.5 m^2} Over 16 square feet {1.5 m^2}

*NOTE: Any sign panel installation using Standard Mounting procedures, which in the opinion of the Engineer does not provide a reasonably rigid sign installation, shall be strengthened by the use of additional supports and/or backing stringers.

Sign background and messages shall be formed using materials noted for such in Articles 880.02 and 880.03. To permit visual verification of proper use, each type sheeting shall display an identifiable symbol, on the face of the sheeting, in a repeat pattern.

When no pre-requirements are specified for units, they shall comply with the manufacturer's specifications as approved by the Department under the provisions of Section 32-5-36 of the Alabama Code.

Items are not required to be new. Used items may be acceptable provided the following conditions are met:

1. Units are in good repair, clean and structurally sound.
2. Reflective sheeting on any unit is clean and in good repair.
3. All legends and messages are sharp, clean and legible.
4. Reflectivity of said units during the hours of darkness shall provide acceptable, clear and uniform delineation without dead spots.

No test reports are required, but the Engineer shall visually inspect all units and accessories for compliance with the various dimensional and material stipulations noted before approving their use in the work. The approval of any unit for use is subject to satisfactory field performance and does not preclude the Engineer ordering replacements of units; said replacements for these previously approved units shall be without additional compensation.

The pilot car, flaggers, and all flagging equipment shall meet the requirements of the MUTCD. The pilot car shall be a registered motor vehicle designed for use upon a highway. "Off-road" type vehicles will not be allowed.

740.03 Construction Requirements.

(a) GENERAL.

The Contractor shall designate or otherwise provide personnel to furnish continuous surveillance over his traffic control operations. This designee will also be available at night to respond to calls involving damage to barricades, lights, signs, etc., either through vandalism or traffic accident. The Contractor shall make known the name of the person providing the surveillance both at the preconstruction conference and to local police establishments.

All traffic control devices necessary for the first stage of construction shall be properly placed and in operation before any construction is allowed to start. When work of a progressive nature is involved, such as resurfacing a road under traffic, the necessary signs shall be moved concurrently with advancing operation.

All construction signs shall be erected in a workmanlike manner such that all supports are vertical, sign panels generally perpendicular to the travelway and legends horizontal so that they effectively convey the intended message. These signs shall be mounted on stationary or temporary supports as directed by the Engineer and dependent on the type work being performed. In general work being performed at spot locations and of short duration will necessitate the use of temporary supports properly ballasted for stability. If the construction signs are not to be lighted, the supports shall not extend above the top edge of the sign panel.

The location, legends, sheeting, dimensions, spacing of supports, and horizontal and vertical placement with respect to the pavement of warning signs, barricades and other traffic control devices shall be as required by plan details, MUTCD and as directed or approved by the Engineer. The Contractor must advise and have the approval of the Engineer prior to installing or removing traffic control devices from the project.

During periods of non-use, construction signs and other devices shall be removed from the work area, covered with specified material or otherwise positioned so they do not convey their message to the traveling public. If covered, the covering material shall be 1/2 inch {13 mm} (nominal size) exterior plywood cut to fit the shape of the sign panel. The covering material shall be installed in accordance with the plan details and in such manner that no damage will occur to the sign panel during installation. Covering material shall be maintained in a neat and workmanlike manner during its use,

All construction signs, barricades and other devices which require lighting, as designated by plan details or directed by the Engineer, shall be provided with warning lights or electric incandescent or fluorescent lighting. It will be the Contractor's responsibility to install electric lighting in a safe workmanlike manner and in accordance with the latest edition of the National Electrical Code, National Electrical Safety Code and/or all local codes. The Contractor will be responsible for investigating, procuring and bearing the expense of a continuous power source whether by battery, generator or commercial A.C. supply.

Flagmen with proper attire and flags shall be provided when ordered by the Engineer or when the Contractor deems flagmen necessary to safely handle traffic through the construction zone.

Flagmen are considered a general requirement of all traffic control schemes and no direct payment will be made for such.

If at any time the Engineer determines that proper provisions for safe traffic control are not being provided or maintained, he may order suspension of the work until the proper level is achieved. In cases of serious or willful disregard for safety of the public or his employees by the Contractor, the Engineer may proceed forthwith to replace the traffic control measures in proper condition and deduct the cost thereof from monies due or becoming due the Contractor.

(b) SUPPLEMENTARY ITEMS.

1. AREA LIGHTING.

Area lighting is designated for use at locations where standard delineation devices are not considered sufficient to properly guide the traveling public through the construction work nor advise them of the hazardous conditions which exist. The primary use will be in the areas of crossovers and intersections which are not clearly distinguishable during hours of darkness. Area lighting may consist of one or more area lights.

An area light shall consist of a 250 watt mercury vapor light or equivalent, mounted on a 12 foot {3.6 m} mast arm attached to a Class 7 wood pole of sufficient length to provide a 30 foot {9 m} luminaire mounting height above the elevation of the outside edge of paving, unless otherwise shown by plan details. These lights will be placed at locations designated by the Engineer. If possible, the locations should be such that the lights will adequately light the area, but not present a hazard to the traveling public. Bracing or guying of poles which is unsightly or presents a hazard will not be allowed. It will be the Contractor's responsibility to investigate, procure and bear the expense of the power source for these lights whether by commercial A.C. current or generator and to insure that these light sources are installed in a safe workmanlike manner and in accordance with the latest editions of the National Electrical Code, National Electrical Safety Code and/or all local codes.

2. SPECIAL CONSTRUCTION SIGNS.

Special construction signs shall consist of signs which require special fabricated sign panels or special mounting requirements; such signs will be designated as "Special" on the construction plans.

3. PILOT CAR OPERATION.

Pilot car operation and associated flagging shall be performed as described in the MUTCD. Flagmen and flagging devices are considered a necessary requirement of the pilot car operation and no direct payment will be made for such.

(c) MAINTENANCE.

The Contractor shall assume full responsibility for the continuous and expeditious maintenance of all construction warning signs, barricades and other traffic control devices. Maintenance shall include but shall not be limited to replacement of sign panels, barricades and other devices which in the opinion of the Engineer are damaged or deteriorated beyond effective use, replacement of broken supports, plumbing of leaning signs, cleaning of dirty signs, barricades and other devices, repair of defaced signs, replacement of stolen items, etc.

All items used for traffic control shall be generally maintained in its original placement condition and such maintenance will be considered a part of the original installation cost. Failure to maintain all traffic control devices in such manner as to provide adequate continuous safety to the public will be cause for action by the Engineer as noted in the last paragraph of Subarticle 740.03(a).

(d) LIABILITY.

Reference is made to Section 107 of the Specifications which covers the legal responsibilities of the Contractor to the traveling public. Although the Department will be designating and directing the placement of certain traffic control devices, the Contractor is not relieved of his responsibility to continuously review and maintain all traffic handling measures and insure himself that adequate provisions have been made for the safety of the public and workmen.

Construction signs and other traffic control devices specified by plan details are considered the necessary requirements for satisfactory traffic control. This does not preclude the Engineer from ordering, or the Contractor from requesting for approval, additional signs or traffic control devices to safely handle unforeseen traffic situations, in which case they would be paid for. The Contractor may, with the approval of the Engineer, furnish additional traffic control devices, at no cost to the Department, to protect his work and/or workmen.

740.04 Method of Measurement.

The various items used in the handling of traffic through construction zones will be measured for payment as follows:

Construction Signs and Special Construction Signs which are specified by plan details or ordered by the Engineer and approved for use will be measured in square feet {square meters} computed from measurements of the actual sign panel installed (no deductions will be made for corner radii). The sign supports and mounting hardware are considered incidental to the use of these sign units; hence no separate measurement or payment will be made for the supports and hardware. Measurement for payment under the Item of Special Construction Signs will only be made on signs designated as "Special" by plan details or ordered as "Special" by the Engineer.

Drums will be measured individually for the number ordered and furnished.

Cones will be measured per each and shall be 36 inches {900 mm} high with a ballasted base. Cones of smaller height may be used for operations such as pavement striping and marking, but no direct payment will be made.

Ballasts for cones will be measured per each for each weight {mass} ordered, accepted, and used.

Barricades will be measured individually for the type designated and furnished.

Delineators will be measured per each which includes a 3 inches {75 mm} in diameter reflector of designated color, mounted on a #2 {3 kg/m} steel post or equivalent aluminum post as specified by Part VI of the MUTCD.

Warning lights will be measured per each for the type furnished.

Electrical incandescent or fluorescent lights will be measured individually for each light installed.

Area lights will be measured individually for each light assembly installed.

Vertical panels will be measured per each installation for the number of installations ordered and furnished, which shall include the panel, or panels, post, and hardware. A single-sided installation shall be an installation requiring a panel on only one side of the post. A double-sided installation shall be an installation requiring a panel on each side of the post.

The construction plans may contain traffic handling schemes detailing the signs, barricades and other traffic control devices to be installed at certain locations or in some cases for the entire project. If specified on these traffic handling schemes, and a lump sum pay item is provided, payment shall be made on a Lump Sum basis for all signs and devices detailed on these schemes. Signs, barricades, and other traffic control devices included in this Lump Sum measurement shall meet all requirements as outlined in this Section.

Other traffic control items such as traffic control stripes, legends and markings, portable concrete barriers, sequential chevron and arrow boards and pavement markers when so required will be measured and paid for under the appropriate Section for such provided in the Specifications.

Measurement of Item 740-O, Pilot Car, will be the actual number of units (per Each) ordered and accepted. No direct measurement or payment will be made for a pilot car unless it is listed in the pay items of the contract.

740.05 Basis of Payment.

(a) GENERAL.

Payment for Construction Signs and Special Construction Signs measured as noted above will be paid for at the contract unit price bid which shall be full compensation for fabrication of sign panel with proper sheeting and legend, furnishing and erecting on proper supports, furnishing all mounting hardware, covering when not in use, handling and maintaining until project completion.

Payment for drums, barricades, cones, delineators, warning lights, vertical panels, and ballasts for cones, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for fabrication, erection at designated locations whenever required, furnishing continuous power source for lights, handling and maintenance until project completion.

Electric incandescent or fluorescent lights measured as noted above will be paid for at the contract unit price bid which shall be full compensation for furnishing all materials and mounting hardware, wiring, erecting, maintaining and investigating, procuring and bearing the expense of continuous power supply.

Area Lights measured as noted above will be paid for at the contract unit price bid which shall be full compensation for furnishing all materials and mounting hardware including 250 watt

mercury vapor lamp or equivalent luminaire and luminaire mounting arm and Class 7 wood pole, wiring, erecting, maintaining and investigating, procuring and bearing the expense of continuous power supply.

Item 740-O, Pilot Car, measured as noted above will be paid for at the contract unit price bid which shall be full compensation for furnishing and operating the pilot car, for furnishing the pilot car driver and flaggers, for all equipment and materials necessary to complete the work.

Payment for Items 740-B - M will further include all costs in relocating, removing and returning these Items to the project when required to provide a complete traffic control system throughout the life of the project. No payment will be made beyond the maximum quantity of signs, barricades or other traffic control devices provided at any one time except when alternate sign panels are required for proper handling of the traffic, in such case both alternate panels will be measured for payment.

The Lump Sum payment for traffic control devices specified by plan details shall be full compensation for furnishing all materials, power sources and mounting hardware, erecting, handling, relocating signs and devices within the indicated "Traffic Handling Scheme" and maintaining all traffic control devices until project completion. If traffic control devices are deleted from the traffic handling scheme that is to be paid on a lump sum basis, deductions for the items deleted will be made from the lump sum cost in the amount of the contract unit prices bid for the quantity of individual traffic control items so deleted. Traffic control items which are added to the lump sum traffic handling scheme will be paid for at the contract unit price for the item added. A lump sum payment will be considered as full compensation for "traffic handling scheme". Once construction signs or other warning devices are no longer needed within the designated limits of the lump sum "traffic handling scheme", they may be used in other areas of traffic control and payment will be made under the appropriate pay item.

Unless otherwise designated on the construction plans, all signs, barricades, and other traffic control devices covered by this Section shall become the property of the Contractor at the completion of the project. The salvage value for these items shall be reflected in the contract unit prices bid.

No payment will be made for stored materials under this Section unless the material in storage was either manufactured or purchased new for specific use on the project.

No payment will be made for devices installed solely for the protection of the Contractor's work and which serve no useful purpose in protecting the safety of the public or workmen such as traffic cones for paint protection, devices installed to protect fresh concrete presenting no hazard, etc.

The Contractor will be expected to submit a balanced bid for all traffic control items. The submission of unbalanced bid prices may result in loss of contract award.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

740-A Traffic Control Scheme - per lump sum
740-B Construction Signs - per square foot {square meter}
740-C Special Construction Signs - per square foot {square meter}
740-D Channelizing Drums - per each
740-E Cones (36 inches {900 mm} high) - per each
740-F Barricades, Type ____ - per each
740-G Barricades, Type I, (Portable, 24 inches {600 mm} wide) - per each
740-H Delineators - per each
740-I Warning Lights, Type ____ - per each
740-J Electric Incandescent or Fluorescent Light - per each
740-K Area Light - per each
740-L Vertical Panel Type __*__ , __**__ Sided – per Each
740-M Ballast for Cone - per each
740-O Pilot Car - per each

* Specify either I or II
** Specify either Single or Double

SECTION 741
PORTABLE SEQUENTIAL ARROW AND CHEVRON SIGN UNIT

741.01 Description.

This Section shall cover the work of furnishing Portable Sequential Arrow and Chevron Sign Units and all services and operational supplies necessary to provide a functional sign unit during the life of the contract.

Three categories of furnishing and use of these type sign units are covered by this Section. These categories are as follows:

Pay Item 741-A - The furnishing of a new sign unit, its use during the contract, its re-conditioning and title transfer to the Department upon completion of the project.

Pay Item 741-B - The use of Department furnished units during the contract, the re-conditioning of the unit after completion of the project and its return to the Department's storage yard.

Pay Item 741-C - The furnishing and use of units during the contract with the title remaining with the Contractor.

741.02 Materials.

(a) ITEM 741-A.

All sign units furnished by the Contractor for use under this Item shall be listed on List IV-3, WORK ZONE TRAFFIC CONTROL DEVICES, of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

All sign units furnished for use under this Item shall be new units which include all of the latest modifications to manufacturers current production models. Each sign unit shall be self contained and include message board, power supply and trailer.

(b) ITEM 741-B.

These units will generally meet the requirements of Subarticle (a) above and will be made available to the Contractor by the Alabama Department of Transportation for use during the course of the project. These units will have automatic dimming of lamp intensity for day and/or night operation. Operation manuals for these units will be furnished.

(c) ITEM 741-C.

All sign units furnished for use under this Item may be new or reconditioned units which were designed and manufactured specifically for use in traffic control which provide at least the following:

1. A minimum 4 foot x 7.8 foot {1.2 m x 2.4 m} message board of an appropriate design capable of producing a left or right hand mode for a sequential chevron (min. of 3 chevrons), flashing arrow, sequential arrow or sequential stem arrow using 5 inch {125 mm} diameter sealed beam lamps.
2. Electronic controls for operating messages at 30-50 FPM with automatic dimming of lamp intensity for day and/or night operation capability.
3. Power source shall be capable of providing an adequate continuous power supply for at least 24 hours without refueling.
4. A trailer of substantial design for transporting the sign unit from one location to another and to provide a stable setup at location of use.

741.03 Construction Requirements.

(a) GENERAL.

The portable sign unit furnished or provided under this Section is to be used in conjunction with the handling of traffic through the work. The use thereof is shown on the plan details for traffic handling.

(b) MAINTENANCE.

All sign units shall be maintained in such a manner as to provide continuous service during their use on the project. Units which become nonoperational during use will require the Contractor to provide flagmen or other approved traffic handling methods until the units can be repaired or replaced.

In addition to the above the maintenance of units furnished by the Alabama Department of Transportation or which are to become the property of the Alabama Department of Transportation upon project completion shall include the following:

1. The sign units shall be stored in an approved secured storage area when not in use.
2. The Contractor will be required to perform all maintenance operations recommended by the manufacturer of the units keeping adequate records of such operation. The units shall be kept in good repair at all times. This includes cleaning of the unit and maintenance of the exposed protective coatings on the unit.

(c) RETURN OR TRANSFER OF TITLE TO THE DEPARTMENT.

Prior to completion of the project and when the units are deemed of no further use in handling of traffic, each unit shall be cleaned, checked and repaired as necessary to place the unit in good operation condition prior to transfer of title or return of the unit to the Department.

After inspection by Departmental personnel and the units are found to be in good operational condition with all working parts functioning, the units along with a copy of the unit's operating manual, maintenance records and title transfer, if required, shall be delivered to the designated Department storage yard.

741.04 Method of Measurement.

Measurement of Sign Units will be made in complete functional units.

741.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

1. ITEM 741-A.

The ordered and accepted sign units under this Item, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the furnishing of a new sign unit and its exclusive use on the project, for providing all equipment, supplies, services, labor and incidentals necessary to operate and to maintain the units in good serviceable condition during the life of the contract, for transporting of the units as necessary, and upon completion of the project, the reconditioning of the units and the transfer of title of the unit to the Department along with its service records and operating manuals.

2. ITEM 741-B.

The ordered and accepted sign units under this Item, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the handling of the unit, for providing all equipment, supplies, services, labor and incidentals necessary to operate and to maintain the units in a good serviceable condition during the life of the contract and upon completion of the project the reconditioning of the unit to the same condition they were in upon their receipt and the return of the unit, its service records and operating manuals to the Department's storage facility.

3. ITEM 741-C.

The ordered and accepted sign units under this Item, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the furnishing of acceptable new or reconditioned sign units and its exclusive use during the life of the contract, for the handling of the unit and for providing all equipment, supplies, services, tools, labor and incidentals necessary to operate and to maintain the units in a good serviceable condition during the life of the contract.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

741-A State Retained Portable Sequential Arrow and Chevron Sign Unit - per each
741-B State Furnished Portable Sequential Arrow and Chevron Sign Unit - per each
741-C Portable Sequential Arrow and Chevron Sign Unit - per each

SECTION 742
PORTABLE CHANGEABLE MESSAGE SIGNS

742.01 Description.

This section shall cover the work of furnishing new portable changeable message signs or utilizing State furnished portable changeable message signs. The furnishing of new signs includes all services

and operational supplies necessary to provide a functional sign unit. All changeable message signs shall be in compliance with the current edition of the MUTCD (Manual on Uniform Traffic Control Devices).

742.02 Materials.

(a) GENERAL.

All changeable message signs shall be designated according to "Type" with a Type 1 having a one-line message display panel, a Type 2 having a three-line message display panel, and a Type 3 having a Full Matrix display panel. If ownership of the sign is to be retained by the State and the sign is vehicle mounted, the sign unit shall be suitably adaptable, including all connections, for mounting onto a standard size 1/2-ton pickup truck. The sign framework and installation shall be structurally adequate to allow complete sign operation, including raising and lowering the sign panel at sustained highway speeds of 62.5 miles per hour {100 km per hour}.

(b) TYPE 1 MESSAGE SIGN.

A Type 1 sign shall be a portable, one-line, changeable message sign suitable for mounting on either a truck or on a two-wheeled trailer. The sign system shall consist of a single line sign panel assembly, controller, power supply, structural support system, all applicable software, and manuals.

(c) TYPE 2 MESSAGE SIGN.

A Type 2 sign shall be a portable, three-line, changeable message sign mounted on a two-wheeled trailer. The sign system shall consist of a three-line sign panel assembly, controller, power supply, and structural support system, all mounted on a two-wheeled trailer. The sign unit shall be furnished with all necessary cabling, software and manuals.

(d) TYPE 3 MESSAGE SIGN.

A Type 3 sign shall be a portable, full matrix (variable letter, graphic, and symbols), changeable message sign. The system shall consist of a full matrix sign panel assembly capable of producing an inverse display with a programmable controller capable of displaying standard traffic safety and custom symbols. The sign and power plant shall be trailer mounted. The sign shall be furnished with all necessary cabling, software, and manuals.

742.03 Construction Requirements.

(a) GENERAL.

The Contractor shall utilize to the fullest extent the Changeable Message Sign whenever any potential hazardous condition exists that would require extra emphasis in warning the driver of any emergencies that might arise during the construction, or at any location directed by the Engineer. Any message used on the sign shall be approved by the Engineer.

(b) PAY ITEM 742-A.

The Contractor shall furnish a new or used sign unit, and shall be totally responsible for the required performance of the sign.

An acceptable sign unit shall be one of the units listed on List IV-3, WORK ZONE TRAFFIC CONTROL DEVICES, Sub-Heading "Message Signs" of the Department's "Materials, Sources, and Devices with Special Acceptance Requirements" manual. Information concerning this list can also be found in Sub-article 106.01(f).

The Contractor shall retain ownership of the sign unit when the Engineer determines that the sign is no longer needed.

(c) PAY ITEM 742-B.

The Contractor shall furnish a new and fully functional sign unit. An acceptable sign unit shall be one of the units listed on List IV-3, WORK ZONE TRAFFIC CONTROL DEVICES, Sub-Heading "Message Signs" of the Department's "Materials, Sources, and Devices with Special Acceptance Requirements" manual.

When the Engineer determines that the sign unit is no longer needed, ownership shall be transferred to the Department.

(d) PAY ITEM 742-C.

The Contractor shall use a Department furnished sign unit. The Contractor shall clean, service and repair the sign unit when the Engineer determines that the sign unit is no longer needed, and shall return the sign unit to the Department and transfer the title of the unit to the Department.

742.04 Maintenance Requirements.

The sign unit shall be kept in good repair at all times. Failure, malfunction or damage to the unit for any reason shall require the Contractor to expedite the repair, or replacement, and furnish adequate flagmen or other approved means, at his expense, to provide a safe means for the control of traffic until the unit is put back into service. Maintenance shall include the periodic cleaning of the unit along with the repair of damage to the protective coating of the unit.

Sign units furnished under Pay Items 742-B (Contractor furnished) and 742-C (State furnished) shall be stored in an approved, secure storage area when not in use. The Contractor shall perform all maintenance operations recommended by the manufacturer of the sign and keep complete records of this maintenance.

742.05 Delivery of Unit and Transfer of Title, Pay Items 742-B and 742-C.

Prior to the completion of the project, and when the Engineer determines that the sign unit is no longer needed, the Contractor shall clean and service the unit to insure that the unit is in good operational condition. After Departmental personnel inspect the sign unit and find it to be in good operational condition with all working parts functioning, the unit, along with a copy of the unit's operating manual, maintenance records and title transfer (title transfer required under Pay Item 742-B), shall be delivered to the location designated by the Engineer.

742.06 Method of Measurement.

Measurement of Portable Changeable Message Signs will be by complete individual sign units for the type sign furnished.

There will be no overrun of this item without written permission of the State Construction Engineer.

742.07 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The ordered and accepted sign units, measured as noted above, will be paid for at the contract unit prices which shall be full compensation for fabricating and furnishing the unit to the project, if required, for the exclusive use during the project, for maintenance and operation of the unit during the life of the contract, and includes all equipment, tools, labor, services, supplies, and incidentals necessary to complete this item of work.

The contract price for Pay Items 742-A and 742-B shall also include the reconditioning of the unit, transfer of the title of the unit, if required, and delivery to the designated storage location.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

742-A Portable Changeable Message Signs, Type ____ - per Each
742-B State Retained Portable Changeable Message Signs, Type ____ - per Each
742-C State Furnished Portable Changeable Message Signs, Type ____ - per Each

SECTION 745
TRAFFIC CONTROL OFFICERS

745.01 Description.

This Section shall cover the work of furnishing Uniformed Police Officers to assist in directing traffic through work zones. Officers furnished and paid for under this Section will be allowed only at the direction of, or with the approval of, the Engineer. The officers shall be employed by and paid by the Contractor.

745.02 Qualifications.

Officers furnished under this Section shall be employees of the law enforcement agency having jurisdiction over the location where they are performing the duties covered by this Section. Officers shall have arrest powers for the location in which they are working and shall wear their complete police uniform while working.

745.03 Duties.

The duties of police officers under this Section shall consist of assisting in the directing of public traffic through construction work zones. This shall be done at such locations and for such periods as

deemed necessary and appropriate by the Engineer for the control and protection of vehicular and pedestrian traffic in accordance with the MUTCD.

745.04 Method of Measurement.

The item of Uniformed Police Officer measured for payment will be the number of hours this item was ordered and acceptably performed. The number of hours measured for payment will be the total number of hours for each officer performing work under this item.

Only those locations and times this item was directed, or approved, to be used for safe and orderly passage of the traveling public through the construction work zone will be measured for payment.

745.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The number of hours this item of work was ordered and acceptably performed, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for furnishing all personnel, materials, labor, equipment, tools and incidentals necessary to complete this item of work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

745-A Uniformed Police Officer - per hour

SECTION 756
ELECTRICAL CONDUITS UNDER ROADWAYS

756.01 Description.

This Section shall cover the work of furnishing and installing electrical conduits as detailed by the plans and these specifications. The installation shall include placement of the conduit at the location shown on the plans or directed by the Engineer.

All electrical conduits installed under this Section shall be encased, with the kind of encasement depending on the type of installation as follows:

Type 1 installation - conduit installed by open trench method and having a concrete encasement.

Type 2 installation - conduit installed by an approved jacking or boring procedure and having a steel pipe encasement.

Type 3 installation - conduit installed by open trench method and having a bituminous plant mix backfill and surface treatment (when required).

Type 4 installation - conduit installed by open trench method, having a pipe encasement as shown on the plans, and backfilled as shown on the plans.

Type 5 installation - conduit installed by a precision directional boring method and having a high-density polyethylene (HDPE) encasement.

756.02 Materials.

Materials shall meet the appropriate requirements of Division 800, Materials, and the requirements noted in this Article.

Conduit shall meet the requirements of Article 885.06.

Metal encasement pipe shall meet the requirements of Section 862.

Concrete used to encase conduit in a Type 1 installation shall be Class A concrete meeting the requirements of Section 501.

All electrical equipment shall conform to the standards of the National Electrical Manufacturers' Association (N.E.M.A.), or Underwriters Laboratory, whichever is applicable. Workmanship and materials shall conform to the requirements of the National Electrical Codes, National Electrical Safety Code and with any local codes or ordinances governing electrical installations. All materials and equipment shall be new, except where the plans specifically provide for re-using existing equipment.

Within 30 days after execution of the contract, the Contractor shall submit to the Engineer a list of materials which he proposes to use. The list shall show the name of the manufacturer, size, name and identifying catalog number of each item.

If requested by the Engineer, the Contractor shall submit for inspection and approval samples of the proposed substitute item and bear any extra costs of evaluating the quality of the materials. All

lists shall be submitted in quintuplicate for checking and approval. The Department will not be liable for any materials purchased or work done or any delay incurred prior to such approval. Failure of the Engineer to note unsatisfactory material as received will not relieve the Contractor from responsibility.

Omissions from the drawings and specifications, or the misdescription of details of work which are evidently necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omissions and details of work, but they shall be performed as if fully and correctly set forth and described in the drawings and specifications. In any case of discrepancy in figures, catalog numbers, descriptions in the drawings or in the specifications, the matter shall be promptly submitted to the Engineer who shall promptly make a determination in writing. Any adjustment by the Contractor shall be at the Contractor's own risk and expense.

For a Type 3 installation, the trench backfill shall be ALDOT #100 concrete sand and Bituminous Concrete Plant Mix, ALDOT 429, as shown on the plans.

For a Type 4 installation, the trench backfill shall be as shown on the plans.

For a Type 5 installation, the encasement conduit shall be formed of black high-density polyethylene Type III, Category 5, Class C, Grade P-34, in accordance with ASTM D 1248 (latest edition). The conduit shall be formed to Standard Schedule 80 or SDR 11 dimensions for diameter, wall thickness, and weight per thousand feet {mass per unit length} to respectively meet ASTM D 2447 or ASTM D 3035 (latest edition).

756.03 Construction Requirements.

(a) GENERAL.

All construction and installation of electrical conduits shall be done under direction of specially qualified supervisors. All workmanship shall be in accordance with the latest accepted standard of the industry, as determined by the Engineer.

Upon completion of the contract, the Contractor shall deliver to the Engineer a corrected plan showing in detail the actual location and depth of conduits.

Improvements, such as sidewalks, curbs, gutters, Portland cement concrete and asphaltic concrete pavement, bituminous surfacing, base material, and any other improvements broken or damaged by the Contractor, shall be replaced or reconstructed with the same kind of materials as found on the work, or with materials of equal quality. The new work shall be left in a serviceable condition satisfactory to the Engineer.

Whenever a part of a square or slab of existing concrete sidewalk or driveway is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed as above specified.

The outline of all areas to be removed in Portland cement concrete sidewalks and pavements shall be cut to a minimum depth of 1.5 inches {40 mm} with a saw, prior to removing the sidewalk and pavement materials. Cut for the remainder of the required depth may be made by a method satisfactory to the Engineer. Cuts shall be neat and true with no shatter outside the removal area.

(b) OPEN TRENCH METHOD.

The excavations required for the installation of conduits shall be performed in such a manner as to cause the least possible injury to the street, sidewalks, and other improvements. The trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations. Excavating shall not be performed until immediately before installation of conduit and other appliances. The material from the excavation shall be placed in a position where the least damage and obstruction to vehicular and pedestrian traffic, and the least interference with the surface will occur.

All surplus excavated material shall be removed and disposed of by the Contractor, as directed by the Engineer.

Excavations after backfilling shall be kept well filled and maintained in a smooth and well drained condition until permanent repairs are made.

At the end of each day's work and at all other times when construction operations are suspended, all equipment and other obstructions shall be removed from that portion of the roadway open for public travel.

Coordination of this type work with regular roadway or bridge work will be of prime importance to prevent undue damage to completed items of work or existing facilities. Any damage to

existing facilities caused by the installation of the ducts shall be repaired by the Contractor at no additional cost to the State.

(c) JACKING OR BORING METHOD.

All conduits installed under paved areas shall be encased in steel pipe. Installation of the casing shall be made prior to placement of the pavement or it shall be jacked or bored through the roadbed under the pavement providing a minimum cover of 30 inches {750 mm}.

The jacking or boring procedure and equipment shall be such that placement of the casement shall be accomplished without producing an unsupported opening through the roadbed between the established ends of the required length of casing. In no event should casing lengths be less than the distance between shoulder limits of a roadway.

The drilling and mud bore method will be acceptable provided the requirements noted in Subarticle 730.03(a) are complied with.

(d) PRECISION DIRECTIONAL BORING METHOD.

All conduits installed under paved areas shall be encased in HDPE duct. Installation of the casing shall be made prior to placement of the pavement or it shall be precision directional bored through the roadbed under the pavement providing a minimum cover of 30 inches {762 mm} or as approved by the Engineer.

The precision directional boring procedure and equipment shall be such that placement of the casement shall be accomplished without producing an unsupported opening through the roadbed between the established ends of the required length of casing. In no event should casing lengths be less than the distance between shoulder limits of a roadway.

The casing shall be installed by drilling a hole with an open type bit that leaves the cuttings in place. A gel-forming colloidal drilling fluid consisting of at least 20%* high grade carefully processed Bentonite may be used to consolidate cuttings of the cutting bit, seal the walls of the hole and furnish lubrication for subsequent removal of cuttings and installations of the casing immediately thereafter. In this method, when drilling through a dense formation, cuttings may be partially removed from the hole in 3 foot {0.9 m} plugs by use of compressed air as drilling progresses. However, in low density soils of a sandy or silty nature, a plug shall be installed in the mouth of the bore (hole) to prevent the movement of any cuttings from the hole until immediately before installation of the casing. No bit larger than 3 inches {76.2 mm} in diameter shall have holes therein larger than 5/16 inches {8 mm} in diameter through which drilling fluid is forced during boring. The casing shall be installed immediately after the casing hole is completed. In no case will water be used to flush cuttings from the drill hole. The cuttings shall remain in the bore hole except as previously provided for as drilling progresses so as to consolidate them to support the bore wall. The filter cake which is formed by the cuttings and drilling fluid prevents cave-in or sloughing of the drill hole. On completion of the boring, the hole will be swabbed out by pulling through the hole the casing attached to a suitable swab. Violation of any of the above provisions by the Contractor will result in the suspension of work.

* NOTE: By Volume. For instance, 20 gallons {20 L} Bentonite to 80 gallons {80 L} of water.

756.04 Method of Measurement.

The accepted amount of electrical conduit of the type installation required shall be measured by the linear foot {meter} to the nearest foot {0.1 m}.

756.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted electrical conduit, measured as noted above, will be paid at the contract unit price bid for the type installation involved. Said unit price bid shall be full compensation for the furnishing and installation of the electrical conduit, for the specified pipe or concrete encasement, for any required backfill material, for all excavation and backfill, jacking or boring, disposal of excess material, and for all labor, tools, equipment, and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

756-A ___ inch {mm} Electrical Conduit, ___*__ Lines, Type ___**___ Installation
- per linear foot {meter}

* Specify number of lines in installation

** Specify type of installation

DIVISION 800
MATERIALS

SECTION 800
MATERIALS

800.01 General.

All materials used in the work shall be new, unused material that will meet the requirements described in this Division unless the same are altered by specific requirements of any Section of these Specifications, Supplemental Specifications, Special Provisions, or by modifying notes on the plans. All materials shall also meet the requirements of applicable portions of Section 106 which will supplement the requirements of this Section.

All tests shall be in accordance with the current Departmental testing schedule.

800.02 Inspection Arrangements.

(a) CONTRACTORS' NOTIFICATION.

It shall be the duty of the Contractor to notify the Engineer of the source of the various materials required for each project. This notice shall be received sufficiently in advance of any shipment of materials so that inspection may be arranged at the producing plant if the Engineer so elects.

(b) PLANT INSPECTION.

Whenever the quantity of materials warrants such an arrangement and/or it is economically advantageous to the Department, the inspection of materials at the original or immediate source of supply will be made. However, the Department is under no obligation to the Contractor to inspect materials until it arrives at the site of the work. In general, all aggregates, soil, brick, reinforcing and structural steel, bituminous materials, timber, lumber, piling, and posts which are to become a part of the completed work will be inspected at the point of production. For timber, lumber, piling, and posts which are to be given preservation treatment, this inspection will be performed at the treating plant in conjunction with inspection of the treating process.

(c) GENERAL DETAILS.

1. For lumber and timber products, the producer shall have sorted his stock and shall have separated a sufficient quantity of material to insure that all of each item for inspection is available before the Inspector is called. In the event that part of the shipment is rejected because of failure to meet the specification requirements, the producer shall furnish other stock to replace the rejected items.

2. Should the quantity of any material rejected for failure to meet specification requirements amount to 20 percent or more of the material inspected and tested at that time, the inspection operation will be suspended until the producer shall have regraded his stock or revised his production methods to produce material uniformly conforming with the specifications.

When sampling stockpiles of aggregates, base materials, etc., the average of all samples must be within the gradation band required for the size aggregate specified. In no case will stockpiles be acceptable if more than 20% of the total samples fall outside the gradation band. In addition, any failing sample must be within 20% of the range specified for any designated sieve.

3. In case the stock has not been properly prepared or separated before calling an Inspector, or in case of delay in replacement of rejected material, the extra inspection cost occasioned by such delay will be charged against the Contractor for whom the material is being produced and will be deducted from any sums due or which may become due the Contractor.

4. Where a Contractor's producer or jobber requests inspection of material for warehouse stock or for use in plants where stocks of materials inspected and accepted for use in highway construction or maintenance cannot be kept separated from materials which are to be used on other work, the cost of inspection of those materials which have been approved for highway work, but are later diverted to other uses not connected with the Department's highway construction or maintenance, will be charged to the Contractor who requested such inspections.

800.03 Testing, General.

Where maximum and minimum specification limits are given, it is intended and expected that materials having approximately mean values will be furnished under the respective specifications. The established allowances for variations in the determination of these values are considered in establishing the limits and no tolerances in excess of the established variation allowances will be permitted unless so specifically stated in the proposal or on the plans.

Unless otherwise specified in the test procedure or material specification, all test results will be rounded off in accordance with AASHTO R 11 and reported to the same number of places as the specification.

Where material is fabricated of or treated with another material or any combination of materials is assembled to form a product, any or all of which are covered by these specifications, the failure of any of the components of the product to comply with the designated specifications shall be deemed sufficient cause for the rejection of the whole.

The sieves used for testing materials shall be woven wire cloth conforming to AASHTO M 92.

800.04 Tests for Concrete Materials.

Preliminary samples of fine aggregate, water, and cement shall be subject to both 7 and 28 day tests or their equivalent and acceptance based thereon. During the progress of the work, these materials may be accepted on the basis of the 7 day test, except that Type III cement may be accepted on the basis of the 3 day test.

800.05 Bituminous Mixture Stability and Density Test.

These tests shall conform to the current methods as described in ALDOT-307 or ALDOT-344, depending on the maximum aggregate size.

800.06 Measurement of Liquid Bituminous Materials.

(a) MEASUREMENT.

Actual measurement shall be in accordance with the provisions of Subarticle 109.02(a) and/or (b).

(b) PROCEDURE.

Unless otherwise provided in the proposal form, the procedure in conjunction with all shipments in tank cars or trucks shall be as follows:

1. The producer or supplier shall furnish to the Engineer in charge of the project a shipping notice (Form BMT-146) for each shipment, containing the following information:

   Tank number and initials, if any.
   Type, grade, and weight {mass} of bituminous material contained.
   Date of Shipment.
   Shipping Point.
   Destination.
   Consignee.
   Project Number.
   Temperature of bituminous materials, degrees Fahrenheit {Celsius}, at time truck tank was measured.

   Failure to furnish data will be cause for rejecting the shipment.

2. Before each shipment of bituminous material is unloaded, the Engineer shall be given opportunity to make such measurement as necessary to determine the net quantity of materials delivered.

3. Conversion of verified weight to gallons {mass to liters} may be used for measurement purposes provided prior written approval is obtained from the Engineer.

800.07 Soil Analysis Test.

(a) MECHANICAL ANALYSIS.

This test shall be performed in accordance with AASHTO T 88.

(b) ELUTRIATION TEST FOR CLAY.

This test shall be performed in accordance with AASHTO T 88.

(c) CALIFORNIA BEARING TEST.

The California Bearing Test shall be performed in conformity with AASHTO T 193 as modified by ALDOT-115.

(d) LIQUID LIMIT.

This test shall be performed in accordance with AASHTO T 89 as modified by ALDOT-232.

800.08 Field Performance Test.

In addition to specifications and tests specified, it may be necessary to have certain materials undergo field performance testing for a prescribed period. The materials involved and the specified field performance testing will be determined by the Department's Product Evaluation Board (PEB). The PEB will determine which type of material will require this field performance testing and the duration thereof. In general, this will include materials such as Pavement Markers, Concrete Joint Fillers and Sealants, Concrete Patching Materials, Epoxies, Reflective Material for Object Safety Markings, Membranes for Waterproofing Joints, and certain pavement marking materials.

SECTION 801
COARSE AGGREGATE

801.01 Description.

(a) GENERAL.

Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone, or crushed slag, having hard, strong, durable pieces, free from adherent coatings and conforming to the requirements provided in this Section. Gravel aggregate for use in bituminous plant mixes and bridge superstructure concrete (except prestressed concrete) shall have a bulk specific gravity greater than 2.550 (AASHTO T 85).

(b) ACCEPTANCE.

The Department has established a list of qualified producers of coarse aggregates. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

All coarse aggregates furnished shall come from an approved producer who is participating in and meeting the requirements of ALDOT-249, "Quality Control Program for Acceptance of Fine and Coarse Aggregates". The producer's name shall be listed in the Department's "Materials, Sources and Devices With Special Acceptance Requirements" manual, List I-1.

801.02 Deleterious Substances.

The amount of deleterious substances in coarse aggregates shall not exceed the following limits:

		TABLE I Bituminous Surface Treatments and Concrete Types 1, 5, 6, & 7	TABLE II All Other Uses
(a)	Coal and Lignite (Visual)	0.25 %	0.25 %
(b)	Clay Lumps (AASHTO T 112)	0.25 %	0.25 %
(c)	Material Passing the No. 200 {75 µm} Sieve (AASHTO T 11)	1.0 %	2.0 %
(d)	Flat or Elongated particles (5:1 Ratio) (ASTM D 4791 by Weight {Mass}) Flat or Elongated particles (3:1 Ratio) (ASTM D 4791 by Weight {Mass})	10.0 % 20.0 %	10.0 % 20.0 %
(e)	Other local deleterious substances (Shale, Mica, Marcasite, etc.) (Visual)	2.0 %	2.0 %
(f)	Reactive Silica (via ASTM C 25) * (in limestone used in Portland Cement Concrete)	8.0 %	8.0 %
(g)	Absorption	**	**

* If ASTM C 25 indicates an amount in excess of 8.0 %, AASHTO T 299 will be used to verify the reactive nature of the detected silica. In such cases, ASTM C 295 will also be utilized as required to make a final determination.

** Applies to gravel aggregates only for the following applications. Gravel for use in bituminous plant mixes and bridge superstructure concrete (except prestressed concrete) shall have a total sample absorption not greater than 2.0 percent on the material passing the 3/4 inch {19.0 mm} sieve and retained on the No. 4 {4.75 mm} sieve as per modified AASHTO T 85. Section 8.1 of AASHTO T 85 shall be modified to require a 15 minute vacuum saturation period as per Section 6.3 of AASHTO T 209 prior to the required 15-19 hour soaking period.

Material suspected of containing deleterious substances will be examined in the laboratory and will be rejected if the amount is considered objectionable.

Coarse aggregate for Portland cement concrete and cover aggregate for bituminous treatment shall be washed and shall be free from adherent coatings. Coating on crushed stone shall be dust of fracture as determined by washing the material passing the No. 200 {75 µm} sieve in accordance with AASHTO T 11 or visual inspection using a petrographic microscope. Adherent coating will be checked by washing in a large container without scrubbing or applying water pressure. The aggregate will then be checked for adherent coating by visual inspection. Aggregate that has an adherent coating will not be acceptable.

801.03 Crushed Stone, Gravel, and Crushed Gravel.

(a) GENERAL.

Crushed stone shall be from approved ledges or working strata within an approved source and shall consist of clean, tough, durable fragments, reasonably free of shale, conforming to requirements for the type use noted in Subarticle 801.03(b) and the gradation specified.

Gravel shall consist of a clean, tough, durable, natural rounded or semi-rounded siliceous rock, free from coatings of any character, and conforming to the gradation specified. Crushed gravel shall consist of crushed fragments of gravel, conforming to the requirements of Subarticles (a) and (b) of this Article.

Gravel for use in bituminous plant mixes and bridge superstructure concrete (except prestressed concrete) shall have a bulk specific gravity greater than 2.550 (AASHTO T 85).

Unless otherwise specified, at least 80 percent by weight {mass} of the blended aggregate retained on the No. 4 {4.75 mm} sieve shall have at least two fully fractured faces measured in accordance with ASTM D 5821.

(b) PHYSICAL TESTS.

Crushed stone, gravel, and crushed gravel shall meet the following requirements for the respective physical tests:

		Cement Concrete	Bituminous Work	All Other Uses
1.	Percent Wear Los Angeles Test (AASHTO T 96)	50 Max.	48 Max. *	60 Max.
2.	Percent Sound, Soundness Test (AASHTO T 104 using Sodium Sulphate and 5 Cycles)	90 Min.	90 Min.	90 Min.
* Except for Sandstone and Blast Furnace Slag, 55 Max.				

801.04 Blank.

801.05 Crushed Slag.

(a) GENERAL.

Slag is defined as a stone-like siliceous material with porous faces produced as a by-product of various manufacturing processes.

Crushed slag produced from processing slag obtained from sources approved by the Materials and Tests Engineer shall consist of clean, tough, durable pieces, reasonably uniform in density and quality without thin or elongated pieces, free from deleterious substances, and conforming to the specified gradation.

Crushed slag furnished for use in Bituminous Wearing Surface layers shall, in addition to the above, be restricted in its glassy particles content, when tested in accordance with ALDOT-321 to the following:

Type Wearing Surface	Glassy Particle Content
Surface Treatments	10% Maximum
Open Graded P.M.	10% Maximum
Dense Graded P.M.	25% Maximum

(b) PHYSICAL TESTS.

Physical tests for crushed slag shall be the same as provided by Subarticle 801.03(b) for the type of construction specified, i.e., soil type, or bituminous.

801.06 Coarse Aggregate for White Concrete.

This coarse aggregate shall be white or very light colored gravel, limestone, marble, or granite, subject to the approval of the Engineer for color and otherwise conforming to the specifications of this section for coarse aggregate. The size number will be shown on the plans and/or proposal.

801.07 Coarse Aggregate for Mastic (For Water Proofing Concrete Surfaces).

Coarse aggregate for mastic shall be a well crushed stone, slag, or washed gravel that will pass a 3/8 inch {9.5 mm} sieve and be retained on a No. 8 {2.36 mm} sieve. It shall be free from soft particles and organic matter.

801.08 Gradation.

Coarse aggregate shall be graded between the limits specified and the size or sizes designated shall conform to the limits shown in the following Coarse Aggregate Gradation Table provided in Subarticle 801.11(d).

801.09 Aggregates for Base.

Aggregates for base layers shall consist of gravel, crushed gravel, crushed slag, or crushed stone as specified for the type of base designated; however, sand and gravel from local roadside pits will only be required to comply with the applicable portion of Section 826.

801.10 Aggregates for Bituminous Work.

Aggregate for bituminous work shall be one or a combination of the aggregates specified for the type of bituminous work involved. It shall be uniformly graded so as to meet the gradation requirements for the size designated to be used. The aggregate shall be of such nature that, when once thoroughly dried and coated with the bituminous material proposed for construction, the coating will not strip off upon contact with water.

801.11 Use, Care, and Handling: Gradation Table and Explanation.

(a) CARE AND HANDLING.

Care and handling shall be as provided by Article 106.05.

(b) STORAGE.

1. Attention is directed to the requirements of Article 106.05 and the following:

The Contractor shall prepare the storage area as needed; any stockpiled material that cannot be removed without including dirt or other foreign matter shall be rejected.

2. Stockpiling shall be as provided by ALDOT-175.

3. Different sizes of aggregate and aggregate from different sources shall be stored in separate stockpiles sufficiently separated from each other so that the material will not become intermixed. Any material which segregates so that the grading no longer conforms to that specified shall be rejected for use.

(c) USE.

1. At the time of their use, the aggregates shall be free from all foreign materials.

2. When more than one size of aggregate is required, the various sizes shall be combined in proper proportions at the mixer or plant.

3. Aggregates stored in proportioning bins shall be protected from rain by waterproof coverings.

(d) COARSE AGGREGATE GRADATION TABLE.

TABLE OF ALDOT COARSE AGGREGATE SIZES *																
PERCENT PASSING BY WEIGHT {MASS}, EACH LABORATORY SIEVE (U.S.A. STANDARD SERIES)																
Size > Number ∨	4 inch {100 mm}	3.5 inch {90 mm}	3 inch {75 mm}	2.5 inch {63 mm}	2 inch {50 mm}	1.5 inch {37.5 mm}	1 inch {25.0 mm}	3/4 inch {19.0 mm}	1/2 inch {12.5 mm}	3/8 inch {9.5 mm}	# 4 {4.75 mm}	# 8 {2.36 mm}	# 16 {1.18 mm}	# 50 {300 µm}	# 100 {150 µm}	# 200 {75 µm}
1	100	90-100		25-60		0-15		0-5								
2			100	90-100	35-70	0-15		0-5								
24			100	90-100		25-60		0-10	0-5							
3				100	90-100	35-70	0-15		0-5							
357				100	95-100		35-70		10-30		0-5					
4					100	90-100	20-55	0-15		0-5						
467					100	95-100		35-70		10-30	0-5					
410					100	85-100	60-85		30-60		18-30	11-20	8-15	5-9		2-6
5						100	90-100	20-55	0-10	0-5						
56						100	90-100	40-85	10-40	0-15	0-5					
57						100	95-100		25-60		0-10	0-5				
6							100	90-100	20-55	0-15	0-5					
67							100	90-100		20-55	0-10	0-5				
68							100	90-100		30-65	5-25	0-10	0-5			
610							100	90-100		25-60		7-30		0-15		
7								100	90-100	40-70	0-15	0-5				
78								100	90-100	40-75	5-25	0-10	0-5			
710								100	90-100	50-85		12-35		0-15		
8									100	85-100	10-30	0-10	0-5			
89									100	90-100	20-55	5-30	0-10	0-5		
810									100		70-90	50-74	38-62	20-42		9-24
8910									100	90-100	60-85	40-70		10-25		1-5
9										100	85-100	10-40	0-10	0-5		
10										100	85-100				10-30	

* Explanation of Table

1. Tabulated figures are percentages by weight {mass} of material finer than each laboratory sieve.

2. Exclusive of lightweight aggregates, the minimum dry rodded weight per cubic foot {mass per cubic meter} shall be 65 pounds {1040 kg} for Sizes 1, 3, and 4, and 70 pounds {1120 kg} for other sizes. See Article 801.12 for weight {mass} of lightweight aggregate.

The following coarse aggregate (gravel only) gradation may be substituted for use in concrete types 2, 3, and 4 for those coarse aggregate size numbers designated in the Master Proportion Table:

Sieve Size (Square Openings)	Percent Passing By Weight {Mass}
1.5 inches {37.5 mm}	100
1 inch {25.0 mm}	80 – 100
3/4 inch {19.0 mm}	70 – 100
1/2 inch {12.5 mm}	25 - 80
# 4 {4.75 mm}	0 - 15
# 8 {2.36 mm}	0 - 10

801.12 Lightweight Aggregates for Bituminous Work.

Lightweight Aggregates of expanded clays or shales produced by the Rotary Kiln Method shall meet the requirements noted herein in this Section except the maximum dry rodded weight {mass} shall be 55 pounds per cubic foot {880 kg/m³} and the L.A. Abrasion Test (AASHTO T 96) shall be modified to compensate for lightweight aggregate by the use of the following method.

Modification to AASHTO T 96 for Lightweight Aggregate:

To avoid the excessive volume of material in the testing machine which will occur when the lightweight aggregate sample is prepared according to AASHTO T 96, it is necessary to reduce the weight {mass} proportionately to obtain an equal volume of lightweight aggregate comparable to that normally obtained with a conventional aggregate sample.

The abrasive charge must also be reduced in a similar manner.

1. Determine the unit weight {mass} (U_L) of the lightweight aggregate by AASHTO T 19.
2. Assume an average unit weight {mass} of conventional aggregate to be 97.0 pounds per cubic foot {1554 kg/m³}.
3. Reduce the lightweight aggregate sample.

$$\frac{U_L}{97.0} = \frac{X}{C} \qquad \left\{ \frac{U_L}{1554} = \frac{X}{C} \right\}$$

$$X = \frac{(C)\,(U_L)}{97.0} \qquad \left\{ X = \frac{(C)\,(U_L)}{1554} \right\}$$

Where:

U_L = Unit weight {mass} of lightweight aggregate sample (pounds per cubic foot {kilograms per cubic meter})

C = Weight {Mass} of Conventional aggregate required for grading in AASHTO T 96.

X = Reduced lightweight aggregate sample charge.

4. Reduce the abrasive charge:

$$\frac{U_L}{97.0} = \frac{X_1}{C_L} \qquad \left\{ \frac{U_L}{1554} = \frac{X_1}{C_L} \right\}$$

$$X_1 = \frac{(C_L)\,(U_L)}{97.0} \qquad \left\{ X_1 = \frac{(C_L)\,(U_L)}{1554} \right\}$$

Where:

U_L = Unit weight {mass} of lightweight aggregate (pounds per cubic foot {kilograms per cubic meter})

C_L = Weight {Mass} of abrasive charge required for grading in AASHTO T 96.

X_1 = Reduced abrasive charge for lightweight aggregate.

5. Remainder of procedure as set forth in AASHTO T 96.

NOTE: It is sometimes impossible to obtain the exact abrasive charge with the steel balls available. In this case, obtain the closest abrasive charge possible to the reduced value and then adjust the weight {mass} of the sample in proportion to the new abrasive charge.

SECTION 802
FINE AGGREGATES

802.01 Description.

(a) GENERAL.

Fine aggregate shall consist of natural or manufactured sand having hard, clean, durable, uncoated particles and conforming to the requirements provided in this Section.

(b) ACCEPTANCE.

The Department has established a list of qualified producers of fine aggregates. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

All fine aggregates furnished shall come from an approved producer who is participating in and meeting the requirements of ALDOT-249, "Quality Control Program for Acceptance of Fine and Coarse Aggregates". The producer's name shall be listed in the Department's "Materials, Sources and Devices With Special Acceptance Requirements" manual, List I-1.

802.02 Concrete Sand.

(a) DESCRIPTION.

Concrete sand shall consist of natural sand, blends of natural sand, blends of natural and manufactured sand, or manufactured sand. The use of manufactured sand shall be limited to the conditions noted in Article 802.06.

Blended sand shall be mixed and tested for gradation after blending has been completed.

The sand shall be washed and have strong, hard, clean, durable particles meeting the physical requirements noted below and the gradation requirements of ALDOT Size No. 100. There will be no F.M. or mortar strength requirements for concrete sand used in bituminous pavements.

(b) DELETERIOUS SUBSTANCES.

1. The maximum weight {mass} of deleterious substances shall not exceed the following requirements:

Materials passing the # 200 {75 µm} sieve removed by decantation shall be subject to approval or rejection based on the following:

a. If any sample has more than 2.5% material passing the # 200 {75 µm} sieve by decantation, the stockpile will be rejected.

b. An average will be made of the samples tested by decantation through the # 200 {75 µm} sieve. If the average is greater than 2.0%, the stockpile will be rejected. If the average is 2.0% or less, the stockpile will be accepted.

c. If smaller quantities of the fine aggregate are being tested where only one sample would be required, this sample will be required to comply with a 2.0% maximum removed by decantation, not to exceed the following percentages:

Shale	1.0 %
Coal and/or Lignite	0.5 %
Clay Lumps	0.5 %
Cinders and Clinkers	0.5 %
Other local deleterious substances (such as alkali, mica, coated grains, soft and flaky particles)	1.0 %
Total shale, coal, and/or lignite, clay lumps, cinders and clinkers, and other local deleterious substances	3.0 % Maximum

Concrete sand to be used in Concrete Type 2, 3, and 4 shall comply with the above except that not more than 3.0 percent shall pass the # 200 {75 µm} sieve by decantation.

2. The percentage of clay lumps shall be determined by examining the various fractions which remain after the test for grading. An indication of clay lumps shall require testing in accordance with AASHTO T 112 to determine the amount of clay lumps.

3. The diameter of deleterious substances shall not exceed the maximum size of aggregate.

(c) ORGANIC IMPURITIES.

All fine aggregate shall be free from injurious amounts of organic impurities. Aggregates subjected to the colorimetric test for organic impurities and producing a color darker than the

standard shall be rejected unless they pass the mortar strength or concrete strength tests as outlined in Subarticles 802.02(e) and (f).

(d) SOUNDNESS.

When subjected to five cycles of the soundness test of fine aggregate by the use of sodium sulphate the measured percentage of loss shall not be more than 10 percent by weight {mass} when tested by AASHTO T 104. In lieu of the soundness test, satisfactory evidence may be provided that the fine aggregate has been exposed to natural weathering, either directly or in concrete for a period of at least five years without appreciable disintegration.

(e) MORTAR STRENGTH.

When tested in accordance with AASHTO T 71, fine aggregate shall have compressive strength not less than 95% of treated sand as prescribed in AASHTO T 71 at 3 days and 14 days with the use of Type III Portland cement or at 7 days and 28 days with Type I or Type II Portland cement.

(f) CONCRETE STRENGTH.

Fine aggregate failing to meet the requirements herein provided for mortar strength may be used if (1) when tested in combination with the cement and coarse aggregate to be used in the work, the crushing or tensile strength of the concrete at the end of 7 days (3 days with Type III cement used) and 28 days is at least equal to the strength obtained from specimens made with sand meeting the requirements for the class of concrete in which the material is to be used, or (2) when the past performance record of the aggregate with the particular cement has been satisfactory.

(g) GRADATION UNIFORMITY.

The gradation of ALDOT Size No. 100 fine aggregate from any one source shall be reasonably uniform. For the purpose of determining the degree of uniformity, a fineness modulus determination shall be made upon representative samples from the source in accordance with the provisions of AASHTO M 6 for fineness modulus (F.M.) determination.

The following schedule will apply to ALDOT Size No. 100 fine aggregate for various kinds of concrete.

Portland Cement Concrete Pavement, Bridge Superstructure Concrete, and Prestressed Concrete:

F.M. 2.30 Min. 3.00 Max.

Establish Working F.M. (W.F.M.)

Tolerance from W.F.M. is plus or minus 0.20

Structure Concrete (Other Than Bridge Superstructure Concrete):

F.M. 2.30 Min. 3.00 Max.

Working F.M. is not required, however, if the F.M. exceeds 2.80 the Contractor will be required to increase the designated cement volume by 0.25 bags per cubic yard {0.25 bags per cubic meter} without additional cost to the State. If requested in writing by the Contractor, consideration will be given to using fly ash in the mix to increase the fines. The fly ash will be substituted for cement as directed by the Materials and Tests Engineer.

There will be no F.M. requirements on concrete sand used in Concrete Types 2, 3, and 4.

802.03 Mortar Sand.

Sand for mortar, ALDOT Size No. 101, shall consist of washed, hard, strong, durable, uncoated mineral or rock particles, reasonably free from injurious amounts of organic or other deleterious substances and meeting applicable requirements of Article 802.02.

802.04 Bituminous Pavement Fine Aggregate.

Fine aggregate for use in bituminous paving mixtures is defined as aggregate passing the 3/8 inch {9.5 mm} sieve and with a minimum 80 percent passing the No. 4 {4.75 mm} sieve. The aggregate may be natural fine aggregate or manufactured fine aggregate. The fine aggregate shall be non-plastic when tested in accordance with AASHTO T 89, as modified by ALDOT-232, and AASHTO T 90 and shall have a maximum of 1.0 percent clay lumps and friable particles as determined by AASHTO T 112. It shall consist of hard tough grain, free of injurious amounts of clay, loam, or other deleterious substances.

Manufactured fine aggregate shall be the product produced from the crushing of aggregates meeting the requirements of Section 801 and shall have 100 percent passing the 3/8 inch {9.5 mm} sieve with 95 percent of the material retained on the No. 8 {2.36 mm} sieve having at least one freshly fractured face.

Natural fine aggregate is defined as any fine aggregate that is not manufactured fine aggregate. Natural fine aggregate shall be reasonably clean, non-plastic, and uniformly graded sand which shall pass the 3/8 inch {9.5 mm} sieve and not have more than 10 percent passing the No. 200 {75 µm} sieve when tested in accordance with AASHTO T 11 and T 27.

Mineral filler meeting the requirements of Section 805, agricultural limestone, or carbonate stone screenings may be used when additional fines are needed.

802.05 Blank.

802.06 Manufactured Sand for Portland Cement Concrete.

Manufactured sand shall meet all of the requirements for ALDOT #100 concrete sand, Article 802.02, except the requirement of Subitem 802.02(b)1a may be increased to five percent if the material is "Dust of Fracture."

Manufactured sand may be produced from crushing gravel, granite, sandstone, or quartzite which may be used either as a blend with natural sand or as one hundred percent of the total fine aggregate. Gravel used to produce manufactured sand for use in concrete pavement or bridge superstructure concrete (except prestress concrete) shall have a bulk specific gravity greater than 2.550 (AASHTO T 85).

Manufactured sand produced from crushing limestone shall not be used in bridge decks or concrete pavement. However, manufactured limestone sand may be used in prestressed or precast concrete, or cast in place concrete, which will not be exposed to vehicular traffic, if approved by the Engineer.

802.07 Fine Aggregate for White Concrete.

Fine aggregate for white concrete shall be a natural white, washed sand and/or an artificial sand made from white quartz, crushed white limestone, white marble, or white granite and shall contain no discoloring material, clay loam, or other foreign matter. It shall be secured from sources previously tested and approved by the Department for whiteness and light reflecting qualities or by visual comparison shall be, in the opinion of the Engineer, at least as white as the approved standard sample on file in the Engineer's office. Other requirements for this fine aggregate shall conform to Article 802.02, with the gradation requirements in accordance with ALDOT Size No. 106.

802.08 Blank.

802.09 Gradation.

Fine aggregate shall be well graded between the limits specified and the size or sizes designated shall conform to the limits shown in the Fine Aggregate Gradation Table.

TABLE OF ALDOT FINE AGGREGATE SIZES								
Aggregate Size Number	DESCRIPTION	PERCENT PASSING BY WEIGHT {MASS}, SIEVE SIZE [1]						
		3/8 inch {9.5 mm}	No. 4 {4.75 mm}	No. 8 {2.36 mm}	No. 16 {1.18 mm}	No. 50 {300 µm}	No. 100 {150µm}	No. 200 {75µm}
100	Concrete Sand	100	95-100	80-100	50-90	5-30	0-10	
101	Mortar Sand			100		15-40	0-10	
104	Plant Mix Sand	100						0-12
105	Manufactured Sand	100	95-100		50-80	20-50	10-25	5-12
106	White Concrete Fine Aggregate	100	95-100	75-100	50-90	10-35	5-15	0-5

NOTES: 1. Figures are percentages by weight {mass} of material finer than each sieve.
2.The F.M. for Size No. 100 when used in Portland cement concrete pavement shall be 2.30 minimum, 3.00 maximum.
3. See Articles No. 802.02 to 802.07 for descriptions.

OPTIONAL TABLE OF ALDOT FINE AGGREGATE SIZES FOR CONCRETE TYPES 2, 3, & 4								
DESCRIPTION	PERCENT PASSING BY WEIGHT {MASS}, SIEVE SIZE							
	1/2 inch {12.5 mm}	3/8 inch {9.5mm}	No. 4 {4.75 mm}	No. 8 {2.36 mm}	No 16 {1.18 mm}	No. 30 {600 µm}	No. 50 {300 µm}	No. 100 {150 µm}
Concrete Sand	100	95-100	85-100	75-100	50-90	30-80	5-45	0-10

NOTE: Concrete sand for concrete Types 2, 3, and 4 may meet this gradation in lieu of the ALDOT Size No. 100 Concrete Sand gradation given above.

802.10 Aggregate for Bituminous Work.

The provisions of Article 801.10 are applicable to all Fine Aggregate used in bituminous work.

802.11 Use, Care, and Handling; Gradation Table.

Use, care, and handling of fine aggregate shall be in accordance with the provisions of Article 801.11, modified with respect to fine aggregate where necessary.

SECTION 804
ASPHALT MATERIALS

804.01 General.

The asphalt materials furnished shall be of approved quality and shall meet the requirements shown under its respective type in the following tables and referenced specifications for the kind of material furnished. For any contract, the material furnished shall show uniform test results. Where more than one grade of material is permitted for any item of work, the Engineer shall specify the grade . In all cases, the Engineer will specify the consistency limits for the grade of material shown on the plans and/or proposal. The Contractor may, without extra compensation, supply asphalt material containing approved additives for producing non-stripping characteristics. For such materials, an adjustment in the total asphalt requirements of this subdivision will be made as deemed necessary.

Sampling of tank cars, tank trucks, distributor trucks, or recirculating storage tanks shall be by the use of a sampling valve, as prescribed in Figure 3 of AASHTO T 40, installed in the tanks.

All products furnished for use shall be from an approved producer who is participating in and meeting the requirements of ALDOT-243, ACCEPTANCE PROGRAM FOR ASPHALT MATERIALS, and listed on List I-4, PRODUCERS OF ASPHALT PRODUCTS, of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

804.02 Performance Graded Asphalt Binders (PGAB).

The material supplied under this Article shall be asphalt prepared by the refining of asphaltic petroleum. No air-blown or oxidized asphalt will be allowed. The refined asphalt binder shall be homogeneous, free of water, shall not foam when heated at 347 °F {175 °C}, and shall conform to the requirements of AASHTO MP1 for PG 58-22, PG 64-22, and PG 76-22. PG 67-22 shall conform to AASHTO MP-1 and Table 3 of Article 804.07.

Shipping temperature of the asphalt from the refinery shall not exceed 356 °F {180 °C} for unmodified binders. For polymer modified binders, shipping temperatures in excess of 356 °F {180 °C} may be allowed with the approval of the Materials and Tests Engineer. At the time of use, the asphalt temperature shall comply with the requirements of Item 401.03(d)2. or Subarticle 410.02(b) whichever is applicable.

804.03 Cutback Asphalt.

The materials supplied under this Article shall be made from liquid asphalt binder and naphtha solvent, so proportioned and mixed that the finished product shall be homogeneous and conform to the requirements of AASHTO M 81 for rapid curing cutback and AASHTO M 82 for medium curing cutback.

804.04 Emulsified Asphalt.

The materials supplied under this Article shall be homogeneous emulsification of asphalt and shall show no separation of asphalt or objectionable change in viscosity within three months after delivery. Separation at any time caused by freezing or contamination shall be cause for rejection. Emulsified asphalt shall conform to the requirements as shown in Asphalt Materials Table No. 5 in Article 804.07.

804.05 Emulsified Petroleum Resin.

The material supplied under this Article shall be a homogeneous emulsification of petroleum resin. The emulsified petroleum resin shall be supplied from the producer in the form in which it shall be placed. No dilution of the product will be allowed after the product has left the supplier’s facility. Emulsified petroleum resin shall conform to the requirements as shown in Asphalt Materials Table No. 6. in Article 804.07.

804.06 Blank.

804.07 Tables of Asphalt Materials.

ASPHALT MATERIALS TABLE NO. 1 SPECIFICATIONS FOR PERFORMANCE GRADED ASPHALT BINDER		
Property	**Grade PG 58-22**	
	Specification	Test Method
Original Binder		
Flash Point Temperature	Minimum 230 °C	AASHTO T 48
Rotational Viscosity	Maximum 3 Pa•s @ 135 °C	AASHTO TP48
Dynamic Shear, G*/sin δ	Minimum 1.00 kPa @ 58 °C	AASHTO TP5
Rolling Thin Film Oven Residue (AASHTO T 240)		
Mass Loss (RTFO)	Maximum 1.00 %	AASHTO T 240
Dynamic Shear, G*/sin δ	Minimum 2.20 kPa @ 58 °C	AASHTO TP5
Pressure Aging Vessel Residue (AASHTO PP1)		
Dynamic Shear, G*•sin δ	Maximum 5000 kPa @ 19 °C	AASHTO TP5
Creep Stiffness, S	Maximum 300 MPa @ -12 °C	AASHTO TP1
m-value	Minimum 0.300 @ -12 °C	AASHTO TP1

ASPHALT MATERIALS TABLE NO. 2 SPECIFICATIONS FOR PERFORMANCE GRADED ASPHALT BINDER		
Property	**Grade PG 64-22**	
	Specification	Test Method
Original Binder		
Flash Point Temperature	minimum 230 °C	AASHTO T 48
Rotational Viscosity	Maximum 3 Pa•s @ 135 °C	AASHTO TP48
Dynamic Shear, G*/sin δ	Minimum 1.00 kPa @ 64°C	AASHTO TP5
Rolling Thin Film Oven Residue (AASHTO T 240)		
Mass Loss (RTFO)	Maximum 1.00 %	AASHTO T 240
Dynamic Shear, G*/sin δ	Minimum 2.20 kPa @ 64 °C	AASHTO TP5
Pressure Aging Vessel Residue (AASHTO PP1)		
Dynamic Shear, G*•sin δ	Maximum 5000 kPa @ 25 °C	AASHTO TP5
Creep Stiffness, S	Maximum 300 MPa @ -12 °C	AASHTO TP1
m-value	Minimum 0.300 @ -12 °C	AASHTO TP1

The binder shown in Table No. 2 shall be made by adding polymer to a refined grade of PG 58-22 or shall be blended from PG 76-22 using an ALDOT approved blending procedure at the refinery. Air blown and oxidized asphalt shall not be used.

All PG 64-22 shall contain a minimum of 1.5 wt.-% polymer solids.

A sample and infrared trace using the ALDOT 408 test method to determine the styrene and butadiene peaks and polymer percentage at the appropriate polymer loading shall be submitted to the Materials and Tests Engineer for laboratory evaluation prior to use.

All polymers shall conform to Section 811 for polymer additives.

All Polymer Modified Asphalt Binder manufacturers shall submit the information required in Article 811.01 annually or upon request by the Department.

ASPHALT MATERIALS TABLE NO. 3 SPECIFICATIONS FOR PERFORMANCE GRADED ASPHALT BINDERS NOT ADDRESSED BY AASHTO MP1		
Property	**Grade PG 67-22**	
	Specification	Test Method
Original Binder		
Flash Point Temperature	minimum 230 °C	AASHTO T 48
Rotational Viscosity	Maximum 3 Pa•s @ 135 °C	AASHTO TP48
Dynamic Shear, G*/sin δ	Minimum 1.00 kPa @ 67 °C	AASHTO TP5
Rolling Thin Film Oven Residue (AASHTO T 240)		
Mass Loss (RTFO)	maximum 1.00 %	AASHTO T 240
Dynamic Shear, G*/sin δ	Minimum 2.20 kPa @ 67 °C	AASHTO TP5
Pressure Aging Vessel Residue (AASHTO PP1)		
Dynamic Shear, G*•sin δ	maximum 5000 kPa @ 25 °C	AASHTO TP5
Creep Stiffness, S	maximum 300 MPa @ -12 °C	AASHTO TP1
m-value	minimum 0.300 @ -12 °C	AASHTO TP1

ASPHALT MATERIALS TABLE NO. 4 SPECIFICATIONS FOR PERFORMANCE GRADED ASPHALT BINDER		
Property	**Grade PG 76-22**	
	Specification	Test Method
Original Binder		
Flash Point Temperature	minimum 230 °C	AASHTO T 48
Rotational Viscosity	Maximum 3 Pa•s @ 135 °C	AASHTO TP48
Dynamic Shear, G*/sin δ	Minimum 1.00 kPa @ 76°C	AASHTO TP5
Rolling Thin Film Oven Residue (AASHTO T 240)		
Mass Loss (RTFO)	maximum 1.00 %	AASHTO T 240
Dynamic Shear, G*/sin δ	Minimum 2.20 kPa @ 76 °C	AASHTO TP5
Pressure Aging Vessel Residue (AASHTO PP1)		
Dynamic Shear, G*•sin δ	Maximum 5000 kPa @ 25 °C	AASHTO TP5
Creep Stiffness, S	Maximum 300 MPa @ -12 °C	AASHTO TP1
m-value	Minimum 0.300 @ -12 °C	AASHTO TP1

A sample and infrared trace using the ALDOT 408 test method to determine the styrene and butadiene peaks along with the percentage of polymer added at the appropriate polymer loading shall be submitted to the Materials and Tests Engineer for laboratory evaluation prior to use.

All binders used in Table 4 shall be made by the addition of polymer to refined grades or PG 67-22 without using air blown or oxidized asphalt.

All PG 76-22 shall contain a minimum of 2.5 wt.-% polymer solids.

All polymers shall conform to Section 811 for polymer additives.

All Polymer Modified Asphalt Binder manufacturers shall submit the information required in Article 811.01 annually or upon request by the Department.

ASPHALT MATERIALS TABLE NO. 5
SPECIFICATIONS FOR EMULSIFIED ASPHALTS

	VISCOSITY GRADE						
	MS-1, MS-2, MS-2h	CMS-2, CMS-2h, CSS-1, CSS-1h, CRS-2 CRS-2p*	AE-P Min-Max	MP Min-Max	CRS-2h CRS-2hp* Min-Max	CQS-1h CQS-1hp* Min-Max	AASHTO TESTS
AASHTO M 140	Meet	- -					T 59
AASHTO M 208	- -	Meet					T 59
Viscosity, Saybolt-Furol:							
@ 77 °F {25 °C}, Sec	- -	- -	10 50	- - - -		20 150	T 59
@ 122 °F {50 °C}, Sec *	- -	- -	- - - -	50 - -	200 500	- - - -	T 59 *See Note #5
Settlement, 5 days, %	- -	- -	- - 5	- - 5	- - - -	- - - -	T 59
Storage Stability Test 24 hr., %	- -	- -	- - - -	- - - -	- - 1.0	- - 1.0	T 59
Demulsibility, 35 m/0.8% Sod. Dioctyl Sulfosucinate, %	- -	- -	- - - -	- - - -	60 - -	- - - -	T 59
Classification Test	- -	- -	- - - -	- - - -	Passes	- - - -	T 59
Particle Charge	- -	- -	- - - -	- - - -	Positive	Positive	T 59
Sieve Test, %	- -	- -	- - 0.1	- - - -	- - 0.10	- - 0.10	T 59
Distillation:							
Oil Distillate, by Volume of Emulsion, %	- -	- -	- - 12	- - 6	- - 3.0	- - - -	T 59
Residue by Distillation, %	- -	- -	45 - -	70 - -	65 - -	60 - -	T 59
Stone Coating Test, % Coated	- -	- -	- - - -	90 - -	- - - -	- - - -	See Note #1
Modified Sand Coating	- -	- -	- - - -	Meet	- - - -	- - - -	See Note #2
Tests on Residue from Distillation:							
Float Test @ 140 °F {60 °C}, Sec.	- -	- -	20 - -	1200 - -	- - - -	- - - -	See Note #3
Solubility in CLCH:CCL2, %	- -	- -	97.5 - -	97 - -	97.5 - -	97.5 - -	T 44
Ductility @ 77 °F {25 °C}, cm	- -	- -	- - - -	- - - -	60 - -	40 - -	T 51
Ash, % by Mass	- -	- -	- - - -	- - 2.0	- - - -	- - - -	T 111
Specific Gravity, 77 °F/ 77 °F {25 °C/25 °C}	- -	- -	- - - -	1.0 - -	- - - -	- - - -	T 228
Penetration 77 °F {25 °C}, 100 g. 5s	- -	- -	- - - -	- - - -	70 100	60 110	T 49

* All CRS-2p, CRS-2hp and CQS-1hp shall contain a minimum of 3.0% polymer by volume. All polymers shall conform to the requirements given in Section 811.

NOTES TO ASPHALT MATERIALS TABLE NO. 5.

NOTE #l. Stone Coating Test.

Use AASHTO T 59, Coating Test, except the mixture of stone and asphalt emulsion shall be mixed vigorously for five minutes and then immediately drenched with approximately twice its own volume of tap water at room temperature after which the aggregate shall be at least 90 percent coated with an asphalt film.

NOTE #2. Modified Sand Coating Test.

Use AASHTO T 59, Coating Test, except a mixture of air-dry test aggregate and asphalt emulsion shall be mixed thoroughly for five minutes then allowed to stand for five hours, after which the mixture shall be capable of being mixed for an additional five minutes. The mixture shall then be drenched with approximately twice its own volume of tap water at room temperature without showing more than 10 percent loss of bituminous film. The test aggregate for use in this test shall be a combination of 90 percent concrete sand and 10 percent Portland cement. The amount of asphalt emulsion used shall be 10 percent by weight {mass} of the aggregate.

NOTE #3. Float Test.

Use AASHTO T 50, with the exception that the residue shall be allowed to cool to room temperature and re-melted at lowest possible temperature that will bring it to a sufficiently fluid condition for easy pouring. Then pour into the collar for completion of the float test.

NOTE #4. Cement Mixing Test.

The Cement Mixing Test is waived for CSS-1 and CSS-1h.

NOTE #5. Viscosity Test.

If the Viscosity Test begins to drip at 122 °F {50 °C} test temperature, the test shall be repeated at 160 °F {70 °C}. The Viscosity at 160 °F {70 °C} shall not exceed 200 seconds.

ASPHALT MATERIALS TABLE NO. 6 SPECIFICATIONS FOR EMULSIFIED PETROLEUM RESIN				
	RESULTS		TEST METHODS	
TESTS	Minimum	Maximum	ASTM	AASHTO
Particle Charge Test	Positive		D 244	T 59
Residue, % * (Residue contains 5% Asphalt)	60	--	D 244	T 59
Sieve Test, % **	--	0.1	D 244	T 59
Viscosity, @ 77 °F {25 °C}, SFS	14	60	D 244	T 59
Tests on Residue: Flash Point, COC (°F) Viscosity at 77 °F {60 °C} (cST)	 210 190	 --- 450	 D 92 D 2171	 T 48 T 202
* ASTM D 244 Evaporation Test for percent of residue is modified by heating 50 gram sample to 149 °C until foaming ceases, then cooling immediately and calculating results. ** Test procedure identical with ASTM except that distilled water shall be used in place of 2% sodium oleate solution.				

SECTION 805
MINERAL FILLER, HYDRATED LIME, CALCIUM CHLORIDE, BRICK, AND BLOCKS

805.01 Mineral Filler, Hydrated Lime, Calcium Chloride, Brick and Blocks.

These minerals shall meet the following requirements:

Mineral Filler	AASHTO M 17
Hydrated Lime	ASTM C 207, Type N.
Calcium Chloride	AASHTO M 144, Type S or L
Sewer Brick	AASHTO M 91, Grade S.M. or M.M.
Building Brick (Clay or Shale)	AASHTO M 114, Grade S.W. or M.W.
Concrete Brick (Manholes, etc)	ASTM C 55, Type 11, Grade S
Concrete Brick (Buildings)	ASTM C 55, Type 1, Grade N-I or N-II
Concrete Block (Hollow Load Bearing)	ASTM C 90, Grade N, Type I or II

SECTION 806
MINERAL ADMIXTURES

806.01 Mineral Admixtures.

(a) GENERAL.

The Department has established a list of Mineral Admixtures For Use In Portland Cement Concrete. These products can be found on List I-3 of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

(b) FLY ASH.

Fly ash shall consist of the finely divided residue or ash that remains after burning finely pulverized coal at high temperatures and shall meet the requirements of AASHTO M 295, including the optional requirements in Table 2.

(c) MICROSILICA.

Microsilica for use as a mineral admixture in Portland cement concrete shall meet the requirements of AASHTO M 307.

(d) GROUND GRANULATED BLAST FURNACE SLAG.

Ground granulated blast furnace slag for use as a mineral admixture in Portland cement concrete shall meet the requirements of AASHTO M 302, Grade 100 or 120. The total cementitious material (the ground granulated blast furnace slag and the cement) shall meet the total alkali content requirement in Article 815.07. See Item 501.02(c)7. for additional requirements.

If ground granulated blast furnace slag is used as a mineral admixture in soil-cement stabilization, the ground granulated blast furnace slag shall meet the requirements of AASHTO M 302, Grade 100 or 120, and the content shall be 50 % of the weight {mass} of the total cementitious material.

SECTION 807
WATER

807.01 Water for Cement Concrete.

(a) Water used in cement concrete shall be fresh, free from oil, and shall not contain impurities in excess of the following limits:

Acidity or alkalinity calculated in terms of calcium carbonate	500 mg/L AASHTO T 26
Total organic solids	500 mg/L AASHTO T 26
Total inorganic solids	500 mg/L AASHTO T 26
Chloride Ion Concentration	250 mg/L AASHTO T 26
Sulfate Ion Concentration	250 mg/L AASHTO T 26
pH	Min. 6.0, Max. 8.0 ASTM D 1293

(b) A comparison of the given water with distilled water can be obtained by making standard soundness, time of setting, and mortar strength tests with standard Ottawa sand, using the same cement of standard quality with each water. Any indication of unsoundness, marked change in time of setting, or a variation of more than 10 percent in strength from results obtained with mixtures containing the distilled water shall be sufficient cause for rejection of the water under test.

(c) Water from city water supplies may be accepted without being tested.

(d) Water used in curing cement concrete or mortar shall be free from salt or other substance which may be injurious to concrete.

807.02 Water for General Purposes.

This water shall be suitable for the purpose intended and free from substances harmful to the particular work involved.

807.03 Water for Lime Stabilization work.

Water shall be from an approved source, free from any substance which might be harmful to the work, and the total inorganic solids shall not exceed 0.20 percent.

SECTION 808
AIR ENTRAINING ADDITIVES

808.01 Air Entraining Additives.

(a) GENERAL.

Air entraining additives for Portland cement concrete shall comply with AASHTO M 154. These additives shall not contain chloride added during its manufacture.

Air entraining additives already approved for use may not be required to meet performance tests; however, new agents not already approved, if deemed necessary, will be required to meet the comparative strength and non-bleeding provisions of AASHTO M 154 modified to require only 3, 7, and 28 day flexural and compressive tests.

(b) ACCEPTANCE OF MATERIAL FOR USE.

The Department has established a list of Chemical Admixtures For Use In Portland Cement Concrete. These products can be found on List II-1 of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

SECTION 809
CHEMICAL ADMIXTURES FOR CONCRETE

809.01 Chemical Admixtures For Concrete.

(a) GENERAL.

Chemical admixtures for concrete shall comply with the requirements of AASHTO M 194 within the following limitations:

These admixtures shall not contain calcium chloride or sugars added during its manufacture. The dosage of each type additive will be included in the concrete design mix issued from the Bureau of Materials and Tests.

When an air entraining additive is used with a water reducer and/or retarder, both additives must be manufactured by the same producer.

(b) ADMIXTURE TYPES.

Type A	Water-reducing admixtures
Type B	Retarding admixtures
Type C	Accelerating admixtures
Type D	Water-reducing and retarding admixtures
Type E	Water-reducing and accelerating admixtures
Type F	Water-reducing, high range admixtures
Type G	Water-reducing, high range, and retarding admixtures

(c) ACCEPTANCE OF MATERIAL FOR USE.

The Department has established a list of Chemical Admixtures For Use In Portland Cement Concrete. These products can be found on List II-1 of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

SECTION 810
GEOTEXTILES

810.01 Geotextile Filters.

Geotextile filters shall meet the appropriate chemical and physical requirements of AASHTO M 288 for the application for which the material is to be used. The Department has established a list of acceptable Geotextiles. Only the materials on this list shall be furnished for use. This list, List II-3, is given in the "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355.

Geotextile rolls shall be furnished with a suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement. Each roll shall be labeled or tagged to provide product identification sufficient for inventory and quality control purposes. Rolls shall be stored in a manner which protects them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof cover.

The geotextile shall be formed in widths of not less than 6 feet {2 m}. Sheets of geotextile may be sewn together with thread of a material meeting the chemical requirements given for the plastic yarn to form filter widths as required. The sheets of geotextile shall be sewn together at the point of manufacture or another approved location.

SECTION 811
POLYMER ADDITIVES FOR ASPHALT MATERIALS

811.01 General.

Any polymer not specifically addressed in this Section shall not be used. Variations in composition of polymers listed in this Section will also be considered, if requested in writing to the Materials and Tests Engineer.

The use of any polymer shall require the submittal of a written certification to the Materials and Tests Engineer from the manufacturer showing test results for physical properties of the material including, as a minimum, polymer types, polymer percentages, percentage of any cross linking agent and specific gravity. The manufacturer shall also submit a procedure for incorporating the polymer into the asphalt material for actual production and laboratory blending, which would include blending procedures, desired temperatures, duration of blending, etc. A sample of the bituminous material along with an infrared trace using ALDOT 408 procedure or AASHTO T 302 for emulsions showing the styrene and butadiene peaks and percentage of polymer shall also be submitted by the refinery to the Department for laboratory evaluation prior to use. This submittal shall be made annually or upon request by the Department or if the manufacturer changes polymer sources. Field blends of emulsions shall not require an FTIR trace.

811.02 Styrene Butadiene Rubber (SBR) Latex for Hot Mix Asphalt.

The latex to be used shall be unvulcanized styrene butadiene rubber in liquid latex form. A sample of the asphalt binder at the appropriate polymer loading along with an infrared trace showing the styrene and butadiene peaks shall be submitted to the Department for laboratory evaluation semi-annually or if the manufacturer changes polymer sources. The manufacturer of the SBR latex shall provide a written certification showing test results for total rubber solids, percent styrene and butadiene monomer, ash content, and viscosity. The test results shall comply with the following minimum requirements:

Total Solids, % by weight {mass} (min.)	67
Monomer Ratio Butadiene/Styrene, %	75/25 ± 3
Brookfield, Viscosity, RVT #3 Spindle, 20 rpm	500-2000
Total weight per gallon {mass per liter, kg}	7.7 – 8.0 {3.5 - 3.6}
Total Ash (max.), % of Total Rubber Solids, ASTM D 297	3.5

811.03 SBR Latex for Asphalt Surface Treatments.

The SBR latex to be used shall be an unvulcanized styrene butadiene rubber in liquid latex form. The manufacturer of the SBR latex shall provide a written certification showing test results for total rubber solids, percent styrene and butadiene monomer, ash content, and viscosity. The test results shall comply with the following minimum requirements:

	Cationic CRS-2 Compatible
Total Solids, % by weight {mass} (min.)	60
Monomer Ratio Butadiene/Styrene, %	75/25 ± 3
Brookfield, Viscosity, RVT #3 Spindle, 20 rpm	500-3000
Total Ash (max.), % of Total Rubber Solids, ASTM D 297	3.5

Before beginning the SBR latex rubber surface treatment operation, and as often thereafter as deemed necessary, the Department will check the compatibility of the SBR latex and the asphalt emulsion by using the following procedure:

1. Measure 100 ml of hot asphalt emulsion (160 °F {71 °C}) in beaker.
2. Add 10% of SBR latex to the hot emulsion.
3. Using a stirring rod, mix the contents by hand for a minimum of two minutes. Check for coagulum.
4. Allow to cool to ambient temperature. Note any separation or coagulum.

If the SBR latex-asphalt emulsion is in a smooth liquid state, the materials show compatibility. If the materials coagulate, the Contractor will be required to make any changes necessary, such as lowering the pH of the asphalt emulsion or slightly increasing the surfactant in the asphalt emulsion, to create compatibility of the materials.

The SBR latex-asphalt emulsion shall be used within 24 hours after combining the materials unless special authorization of the Engineer allows otherwise.

811.04 Styrene Butadiene (SB) or Styrene Butadiene Styrene (SBS) for Hot Mix Asphalt.

A sample of the asphalt binder at the appropriate polymer loading, along with an infrared trace using ALDOT 408 showing the styrene and butadiene peaks, along with the percent polymer added shall be submitted to the Department for laboratory evaluation.

SECTION 812
MASONRY STONE

812.01 Masonry Stone.

(a) TYPE I MASONRY STONE.

Stone for coursed and uncoursed rubble masonry shall be of approved quality, sound, durable, and free from segregations, seams, cracks, and other structural defects or imperfections tending to destroy its resistance to stresses and the weather. It shall be free from rounded, worn, or weathered surfaces. All weathered stone shall be rejected. It shall be kept free from dirt, oil, or any other injurious material which may prevent the proper adhesion of the mortar. Unless otherwise provided or shown on the plans, individual stones shall have a thickness of not less than 6 inches {150 mm}. No stone having a horizontal dimension less than 12 inches {300 mm} or less than its thickness shall be used except for filling the interior of the wall.

(b) TYPE II MASONRY STONE.

This stone shall meet the requirements of Type I Masonry Stone above, except that the dimensions of the individual stones shall be 4 to 6 inches {100 to 150 mm} in depth and shall have a reasonably flat top surface of a width not less than 2 inches {50 mm} and length not less than the depth. All stones shall be inspected before and after laying and all rejected material shall be removed immediately from the work.

(c) TYPE III MASONRY STONE.

Stone for rustic masonry shall be rough quarried or field stone of varying sizes and shapes, suitable for the purpose intended and with no attempt made toward squaring or dressing.

SECTION 814
RIPRAP MATERIALS

814.01 Stone.

(a) GENERAL.

All stone for riprap shall consist of field stone or rough unhewn quarry stone as nearly rectangular in section as is practicable. When tested as specified in AASHTO T 104, the stone shall show a soundness of not less than 85 percent for 5 cycles, using sodium sulphate, and shall be suitable in all other respects for the purpose intended. It shall have a percentage wear not over 60 percent by the Los Angeles Test, AASHTO T 96, and shall meet the requirements of Article 801.02 for deleterious substances; however, the requirements for deleterious substances may be modified by the Engineer.

Control of the gradation of the various classes of riprap will be by visual inspection either at the source or the project site at the Engineer's option. Any difference of opinion between the Engineer and the Contractor shall be resolved by checking two random truck loads (or equivalent size sample) in accordance with the method provided in ALDOT-239 with all the equipment, labor, and sorting site for this check being provided by the Contractor at his expense.

(b) CLASS 1 RIPRAP.

Stone for this class riprap shall consist of graded stones ranging from 10 to 100 pounds {5 to 50 kg} with not more than 10% having a weight {mass} over 100 pounds {50 kg} and at least 50% having a weight {mass} over 50 pounds {25 kg} and not over 10% having a weight {mass} under 10 pounds {5 kg}.

(c) CLASS 2 RIPRAP.

Stone for this class riprap shall consist of graded stones ranging from 10 to 200 pounds {5 kg to 100 kg} with not over 10% having a weight {mass} over 200 pounds {100 kg} and at least 50% having a weight {mass} over 80 pounds {40 kg} and not over 10% having a weight {mass} under 10 pounds {5 kg}.

(d) CLASS 3 RIPRAP.

Stone for this class riprap shall consist of reasonably well graded stones ranging from 25 pounds to 500 pounds {10 kg to 250 kg} with not over 10% having a weight {mass} over 500 pounds {250 kg}, at least 50% having a weight {mass} over 200 pounds {100 kg} and not more than 15% having a weight {mass} under 25 pounds {10 kg}.

(e) CLASS 4 RIPRAP.

Stone for this class riprap shall consist of reasonably well graded stones ranging from 50 to 1000 pounds {25 kg to 450 kg} with not over 25% having a weight {mass} over 1000 pounds {450 kg}, at least 50% having a weight {mass} over 500 pounds {250 kg} and not more than 25% having a weight {mass} under 50 pounds {25 kg}.

(f) CLASS 5 RIPRAP.

Stone for this class riprap shall consist of reasonably well graded stones ranging from 2000 pounds {900 kg} and down with not over 10% having a weight {mass} over 2000 pounds {900 kg}, at least 50% having a weight {mass} over 1000 pounds {450 kg} and not more than 25% having a weight {mass} under 200 pounds {100 kg}.

814.02 Concrete Sacked Riprap.

(a) SACKS.

Sacks shall be new, unused, manufactured from jute, cotton, burlap, reinforced paper, or other approved materials capable of holding the cement mixture without significant leakage when handled. The sacks shall be of uniform size and dimension with a capacity of approximately 0.75 cubic feet {0.025m^3}.

(b) AGGREGATE.

Local sand, gravel, or other designated aggregates shall be from sources approved by the Engineer suitable for the purpose intended.

(c) CEMENT.

Cement shall meet the requirements of Section 815.

(d) WATER.

Water shall meet the requirements of Section 807.

(e) MIXING.

The aggregate and cement shall be formulated by volumetric measure in the proportions of one part cement to four parts sand and five parts gravel or nine parts of bank run gravel, or to designated proportions of other materials, then damp mixed in a concrete mixer using sufficient water to provide for a crumbly consistency.

(f) PREPACKAGED CONCRETE SACKED RIPRAP.

Prepackaged sack riprap which utilizes approved bagging material and a dry mixture of predried sand-cement material may be substituted for the concrete sacked riprap noted in this Article provided (1) the source or prepackaging operation has been approved by the Materials and Tests Engineer, (2) the packing material is permeable and absorptive enough to permit passage of sufficient water to provide for hydration of the cement, (3) the sand and cement materials are from sources acceptable to the Materials and Tests Engineer, (4) the sand and cement are dry mixed in the proportions of 5 cubic feet {0.14 m^3} of sand to one bag of cement until uniform in color, (6) packaging, handling, and storage shall be such as to prevent damage to the prepackaged material, especially from collecting excess moisture until placed.

814.03 Filter Blanket.

(a) GENERAL.

Filter blanket material shall consist of a blanket of aggregate or geotextile blanket placed under a riprap material.

(b) AGGREGATE BLANKET.

An aggregate blanket may be either gravel or crushed stone ALDOT Size No. 467 aggregate, unless otherwise shown on the plans, reasonably free from flat or elongated pieces and from organic or soft friable particles in objectionable quantities.

(c) GEOTEXTILE BLANKET.

The geotextile shall meet the requirements of AASHTO M 288 for Permanent Erosion Control Geotextile and Section 810 of these specifications.

SECTION 815
CEMENT

815.01 Type I Portland Cement.

Type I Portland Cement shall meet the requirements of AASHTO M 85 and the additional requirements shown below.

815.02 Type II Portland Cement.

Type II Portland Cement shall meet the requirements of AASHTO M 85 and the additional requirements shown below.

815.03 Type III Portland Cement (High Early Strength).

Type III Portland Cement shall meet the requirements of AASHTO M 85 and the additional requirements shown below.

815.04 Type IS Portland Blast Furnace Slag Cement.

Type IS Portland blast furnace slag cement (for use in soil-cement stabilization) shall meet the requirements of AASHTO M 240, *Blended Hydraulic Cement*.

815.05 Type IP Portland - Pozzolan Cement.

Type IP Portland - Pozzolan Cement shall meet the requirements of ASTM C 595 with the following modifications:

1. The fly ash content shall be limited to a maximum of 20% by weight {mass}.
2. The Pozzolan shall be limited to fly ash meeting the requirements of Section 806, Mineral Admixtures.
3. Attention is directed to the fact that the final blend of the IP Cement must comply with Article 815.07.

815.06 Masonry Cement.

Masonry cement shall meet the requirements of ASTM C 91.

815.07 Chemical Properties.

The Specifications for all cements as covered by Articles 815.01 to 815.06, inclusive, are amended to the effect that the total alkali content of any cement used, calculated as the percentage of sodium oxide (Na_2O) plus the product of 0.658 times the percentage of potassium oxide (K_2O), shall not exceed 0.60 percent.

In addition to the above, for Type II cement covered by Article 815.02, the standard chemical requirement shown in Table 1 of AASHTO M 85 for Tricalcium Silicate (C_3S) is hereby waived.

815.08 Testing of Cement.

All cement furnished for use shall be tested before use or be from an approved producer meeting the requirements of ALDOT-227, Quality Control of Portland and Blended Hydraulic Cements, and listed on List I-2, PRODUCERS OF PORTLAND AND BLENDED CEMENT, of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

815.09 Flash Set And False Set.

Flash set and false set, as determined by ASTM C 451, shall be cause for rejection of the cement.

815.10 Unusual Appearance.

Unusual appearance as to color, etc. shall be sufficient grounds for rejection of the cement.

815.11 Use, Care, And Handling.

(a) USE.

1. Bulk cement will be permitted provided the bulk cement is handled as follows:

a. Portland cement shall be measured by weight {mass}, considering that one bag of cement is equivalent to 94 pounds {42 kg} net of cement.

b. Handling equipment and the equipment used for weight {mass} determination shall be inspected by the Engineer prior to use. Cement shall be fully protected from contamination or damage during handling.

c. Bulk cement shall be batched by weight {mass}, and scales may be of either the beam or springless dial type and shall be the product of a reputable manufacturer. Scales shall be accurate to within a tolerance of 5 pounds per 1000 pounds {2 kg per 455 kg} net load in the hopper. The value of the minimum gradation of any scale shall not be greater than 0.1 percent of the scale capacity.

d. Provisions shall be made to indicate to the operator that the required load in the hopper or container is being approached, such as a springless dial indicator or tare beam. Such device shall indicate at least the last 50 pounds {22 kg} of load.

e. After the required weight {mass} of the cement is batched, it shall be protected from loss in handling or in transit.

2. Only cement of the same "Type" shall be used in the construction of any structure or unit (substructure or superstructure) except as permitted in writing. All cement in any container having lumps of cement or caked cement, or cement which for any reason has become damaged or partially set, shall be rejected. Cement salvaged from discarded or used bags shall not be used. Cement shall not be used while its temperature is more than 150 °F {65 °C}.

NOTE: Brands of cement are interchangeable but cement types are not.

3. The Contractor shall keep accurate records of the deliveries of cement and its use in the work including that from ready-mix plants. Copies of these records shall be furnished the Engineer at the close of each day's work or 8 hour run, in such form as he may require, showing the quantity used during the day or run at each part of the work.

(b) CARE AND HANDLING.

1. The Contractor shall provide suitable means for storing and protecting the cement against dampness. Cement not for immediate use shall be stored in suitable weather proof buildings. Buildings shall be placed in approved locations. Provisions for storage shall be ample and the shipment of cement as received shall be separately stored in such a manner as to provide easy access for identification and inspection of each shipment. On small structures, storage in the open may be permitted by authorization, in which case a raised platform and ample waterproof covering shall be provided. Stored cement shall meet the test requirements at any time after storage when a retest is ordered.

2. Cement of different types, even if tested and approved, shall be stored separately and shall not be mixed.

SECTION 816
TIMBER PRESERVATIVES

816.01 General.

Preservatives shall meet the respective requirements of AASHTO M 133 for the various types permitted for the uses designated in this Section.

816.02 Bridge Construction.

Piling	Creosote Oil or, except for marine use, Chromated Copper Arsenate (CCA).
General Bridge Construction	Creosote Oil, Pentachlorophenol Petroleum Oil, or Chromated Copper Arsenate (CCA).
Posts	Creosote Oil, Pentachlorophenol Petroleum Oil, Fluor Chrome Arsenate Phenol (FCAP), or Chromated Copper Arsenate (CCA).
Lumber to be Painted or Dry Use	Pentachlorophenol Petroleum Oil, Fluor Chrome Arsenate Phenol (FCAP), or Chromated Copper Arsenate (CCA).

816.03 General Construction.

Buildings and Lumber to be Painted or Dry Use	Pentacholorophenol Petroleum oil solution, Fluor Chrome Arsenate Phenol (FCAP), Ammoniacal Copper Arsenate (ACA), or Chromated Copper Arsenate (CCA), Type A, B, or C.

816.04 Fence And Guardrail Construction.

Round and Sawn Posts	Creosote Oil, Creosote Oil and Pentachlorophenol Solution, or Chromated Copper Arsenate (CCA).

SECTION 817
LIME FOR ROADBED AND BASE STABILIZATION

817.01 Hydrated Lime.

Hydrated lime shall be high calcium (Type 1) and shall conform to AASHTO M 216 when tested in accordance with AASHTO T 219.

Hydrated lime shall be stored and handled in water-proof containers until immediately before distribution to the road. If storage bins are used, they shall be completely enclosed. Hydrated lime in bags shall be stored in weatherproof buildings with adequate protection from ground dampness.

817.02 Quicklime.

Quicklime shall meet the requirements of AASHTO M 216 after hydration in the laboratory.

When quicklime is to be applied directly to the roadbed, the following additional requirements shall apply:

Sieve	% Passing by Weight {Mass}
3/4 inch {19.0 mm}	100
1/2 inch {12.5 mm}	30 - 80
No. 4 {4.75 mm}	0 - 10

Quicklime shall be handled and stored in waterproof containers until used. Accidental contact with water shall be avoided.

SECTION 820
SELECTED MATERIALS FOR BASES

820.01 Description.

Selected materials for the purpose of these specifications shall be of the kind and general character of sand-clay, chert, clay-gravel, sand, local stone, stone screenings, etc., or combinations thereof, with or without commercial aggregate meeting the requirements noted in this Section.

820.02 General Requirements.

(a) GENERAL.

The material shall meet the general requirements for the respective material noted in this Article and the special and specific requirements noted in Article 820.03.

The following terms are defined for general use.

Artificial Mixture. The term "Artificial Mixture" is defined as a mixture, resulting from combining as indicated on the plans or as directed, of two or more base course materials, including binder soils suitable for the purpose intended and sands of the same or different kind generally from separate sources.

Coarse Aggregate and Binder Soil (Binder). The coarse aggregate for base courses shall be all material retained on the No. 8 {2.36 mm} sieve; binder shall be all materials passing the No. 8 {2.36 mm} sieve.

Blends. Blends shall be an artificial mixture of (1) two or more materials of the kind and/or character described in this Section or similar materials; (2) one or more soils plus stabilizer aggregate or either local stone, commercial coarse aggregate meeting the provisions of Section 801 with size number designated on the plans, or processed reef shell meeting provisions of Section 827.

(b) SAND CLAY.

Sand clay shall be a natural material or artificial mixture, consisting largely of a mixture of sand and clay in proper proportions, that occurs in natural deposits of varying depths or a blended mixture of sand and clay.

(c) CHERT.

Chert shall be a metamorphic, fragmentary, flint or silica formation interspersed with varying quantity and quality of clay binder. Chert in its natural formation may require blasting to facilitate loading and manipulation.

(d) CLAY GRAVEL.

Clay gravel shall be composed of gravel and sand with clay binder. The coarse aggregate (gravel) shall be clean, hard, tough, durable, and reasonably free from thin, elongated, soft, or laminated pieces. The binder, consisting of material passing the No. 8 {2.36 mm} sieve, shall be a good grade of sand clay or other approved material. Clay gravel in its natural formation may require blasting to facilitate loading and manipulation.

(e) LOCAL SAND.

Local sand shall consist of grains of hard, sound material, predominantly quartz or other hard, durable rock, including friable, loosely bound deposits of sandstone conglomerate normally found in natural deposits in the project vicinity.

(f) LOCAL SAND-GRAVEL.

Local sand-gravel shall be hard, sound, durable rock, including friable, loosely bound sand-stone conglomerate, with varying amounts of coarse aggregate and sand normally found in natural deposits in the project vicinity. The coarse aggregate and the sand shall be free from a coating of injurious material, lumps of clay, loam, organic matter, or other foreign material. If necessary, gradation and/or other requirements will be provided in the plans and/or proposal form.

(g) LOCAL STONE.

Approved local source-run stone shall consist of tough, durable fragments and sand, clay, or other binder type materials. If necessary, gradation and/or other requirements will be provided in the plans or proposal.

(h) COMMERCIAL AGGREGATES.

Commercial aggregates shall meet the appropriate requirements of Sections 801 and 802.

(i) STONE SCREENINGS.

Stone screenings shall consist of crushed stone fragments, all passing the No. 4 {4.75 mm} sieve with the fines down to and including dust, but not more than 30 percent by weight {mass}, passing the No. 100 {150 μm} sieve. The stone shall meet the general requirements of Section 801.

(j) POND ASH.

Pond ash shall consist of a combination of bottom ash and fly ash produced as a by-product of burning coal.

820.03 Specific Requirements.

GENERAL COMPOSITION					
Sieve Requirements	Percentage Passing By Weight {Mass}				
	TYPE				
	A	A-1	B	B-1	C*
3 inch {75 mm}	100	100	100	100	100
No. 8 {2.36 mm}	60-100	42-100	22-75	20-70	20-50
No. 200 {75 µm}	7-45	5-45	3-38	3-46	3-35
Liquid Limit (LL)	28 Max.	35 Max.	28 Max.	35 Max.	45 Max.
Plasticity Index (PI)	8 Max.	15 Max.	8 Max.	15 Max.	20 Max.
* CBR of 40 + with swell of less than 5%					

Material placed on the road found not meeting the above requirements may in lieu of removal and replacement be stabilized with approved materials in such proportions that the finished layer will meet the above specified requirements.

SECTION 821
GRANULAR SOIL MATERIALS.

821.01 Description.

Granular Soil for the purpose of these Specifications shall be of the kind and general character of sand-clay, topsoil, sand, soft sand rock, etc., or combinations thereof meeting the requirements noted in this Section.

821.02 General Requirements.

(a) GENERAL.

The material shall meet the general requirements for the respective material noted in this Article and the specific requirements noted in Article 821.03.

Reference is made to Subarticle 820.02(a) for definition of terms for coarse aggregate, binder, artificial mixture, and blends.

(b) SAND CLAY.

See Subarticle 820.02(b).

(c) TOPSOIL BASE MATERIAL.

Topsoil base material shall consist of a natural material or artificial mixture, sometimes pebbly in character, that occurs in surface deposits of limited depth and in general on elevated areas.

(d) FOUNDRY SAND.

Foundry sand shall be a waste material consisting of burned sand with or without slag fragments. In general, this material is waste or by-product material from foundry operations.

(e) SOFT SAND ROCK.

Soft sand rock shall be a friable natural material, generally sandy in character and occurring as a partially disintegrated sandstone with occasional hard strata, in sub surface formations of varying thickness and in general on elevated areas.

Blasting is usually required to facilitate loading with power shovels. Pulverizing by use of rollers, tractors, or other equipment is usually necessary.

(f) LOCAL SAND.

See Subarticle 820.02(e).

821.03 Specific Requirements.

GENERAL COMPOSITION			
Sieve Requirements	Percentage Passing By Weight {Mass}		
	TYPE		
	A	B	C
2 inch {50 mm}	100	100	100
No. 8 {2.36 mm}	20-100	20-100	20-100
No. 10 {2.00 mm}	19-100	18-99	18-95
No. 40 {425 µm}	10-100	8-95	6-65
No. 200 {75 µm}	2-45	2-40	2-35
Clay	2-18	1-18	1-16
Liquid Limit (LL)	25 Max.	25 Max.	25 Max.
Plasticity Index (PI)	6 Max.	6 Max.	6 Max.

Material placed on the road found not meeting the above requirements may, in lieu of removal and replacement, be stabilized with approved materials in such proportions that the finished layer will meet the above specified requirements.

SECTION 822
DRAINAGE PLANE MATERIALS

822.01 General.

Drainage plane material shall, unless otherwise specified by plan details, be restricted to ALDOT Sizes 57, 67, 68 or 78 conforming to the requirements of Section 801 modified to require a minimum permeability of 50 mm/sec. as determined by the Constant Head Permeameter Test.

Each material source will be pretested for permeability before shipments of material to the project are begun, and after approval no further permeability tests will be required provided there are no significant changes in the characteristics of the material noted; however, continuing gradation tests of the material will be made.

SECTION 823
SOIL AGGREGATE MATERIALS

823.01 Description.

Soil Aggregate for the purpose of these Specifications is classified according to the several kinds and general characteristics set forth in this Section.

823.02 General Requirements.

(a) GENERAL.

The material shall meet the general requirements noted in this Article and the specific requirements noted in Article 823.03.

Reference is made to Subarticle 820.02(a) for definitions of terms, coarse aggregate, binder, artificial mixture and blends.

(b) CLAY GRAVEL.

See Subarticle 820.02(d).

(c) CLAY GRAVEL-SAND.

Clay gravel-sand shall meet the general requirements provided in Subarticle 823.02(b) for clay gravel, except that it is an artificial mixture composed of clay gravel and sand.

(d) CHERT.

See Subarticle 820.02(c).

(e) CHERT-SAND MIXTURE.

Chert-sand shall meet the same general requirements provided in the Subarticle 820.02(c) for chert, except that it is an artificial mixture composed of chert and sand.

(f) FLOAT GRAVEL.

Float gravel shall be a varying stream deposit of worn and weathered coarse aggregate containing varying amounts of sand and soil. Oversized rock and boulders are frequently encountered and require reduction in size if used or elimination from the desired material. If provided by the plans, sand or binder soil shall be combined to provide for an artificial mixture.

(g) INDUSTRIAL WASTE.

Industrial waste shall be a mixture of foundry sand and fragments of slag or other materials of a durable nature. This is a waste material occurring as a result of processing iron and steel, and due to chemical actions therein, the stockpile must be approved by the Materials and Tests Engineer before it may be used.

(h) RED DOG-SAND.

Red Dog-sand is an artificial mixture of red dog and sand. Red dog (or red ash) is a burned waste material from mining or industrial operations, and in general is a fragmentary, tile-like material with varying amounts of binder and fines which will not be permitted unless specified on the plans or in the proposal.

(i) SOFT SAND ROCK - ANY AGGREGATE.

Soft sand rock - any aggregate shall be an artificial mixture consisting of soft sand rock as defined by Subarticle 821.02(e) combined with (1) any aggregate or (2) other base materials which in general is predominantly coarse aggregate.

(j) STONE, GRAVEL AND SLAG AGGREGATE.

Stone, gravel, and slag aggregate shall meet the general requirements provided by Articles 801.03, 801.04, and 801.05 respectively. This classification is an artificial mixture of stone, gravel, or slag aggregate and (1) binder soil, or (2) clay gravel, chert, float gravel, or other natural soil-aggregate material.

823.03 Specific Requirements.

GENERAL COMPOSITION			
Sieve Requirements	Percentage Passing By Weight {Mass}		
	TYPE		
	A	B	C
2.5 inches {63 mm}		100	100
2 inches {50 mm}	100	85-100	85-100
1 inch {25.0 mm}	85-100	50-100	50-100
3/4 inch {19.0 mm}			35-95
No. 4 {4.75 mm}	50-85	30-75	25-58*
No. 8 {2.36 mm}	35-75	25-70	22-50
No. 10 {2.00 mm}	30-74	22-69	20-49
No 40 {425 µm}	12-68	6-67	6-48
No. 200 {75 µm}	4-28	3-29	3-23
Clay	2-15	2-14	2-12
Liquid Limit (LL)	26 Max.	26 Max.	26 Max.
Plasticity Index (PI)	6 Max.	6 Max.	6 Max.
* Retained portion must contain a minimum of 25% crushed particles.			

Material placed on the road found not meeting the above requirements, may in lieu of removal and replacement, be stabilized with approved materials in such proportions that the finished base will meet the above requirements.

SECTION 824
PROCESSED REEF SHELL BASE MATERIALS

824.01 Description.

Processed Reef Shell Base for the purpose of these Specifications is classified as a composite base course material which contains a large percentage of Processed Reef Shell blended with portions of Selected Soil, Granular Soil, Soil Aggregate, or other approved materials.

824.02 General Requirements.

Processed Reef Shell furnished for use shall comply with the requirements of Article 827.02 and, when combined with other material, shall produce the material complying with the designated type noted in the specific requirements provided in Article 824.03.

Gradation may be obtained by the proper blending of local or other commercial materials and approximately 40% of reef shell by weight {mass} for Type A and approximately 60% reef shell by weight {mass} for Type B.

Special note is made of the fact that, should the gradation run on the extreme fine or coarse side, difficulty can be expected in obtaining the modified proctor density.

824.03 Specific Requirements.

GENERAL COMPOSITION		
Sieve Requirements	Percentage Passing By Weight {Mass}	
	TYPE	
	A	B
2.5 inches {63 mm}		100
2 inches {50 mm}	100	85-100
1 inch {25.0 mm}	70-100	50-100
3/4 inch {19.0 mm}		40-95
No. 4 {4.75 mm}		25-65*
No. 8 {2.36 mm}	40-70*	20-55
No. 10 {2.00 mm}	38-66	18-53
No 40 {425 µm}		5-52
No. 200 {75 µm}	4-28	2-22
Clay		10 Max.
Liquid Limit (LL)	30 Max.	26 Max.
Plasticity Index (PI)	10 Max.	6 Max.
* NOTE: Retained portion must contain at least 75% shell particles.		

SECTION 825
CRUSHED AGGREGATE BASE MATERIALS

825.01 Description.

Crushed Aggregate Base for the purpose of these Specifications shall consist of 100 percent crushed stone conforming to the requirements noted in this Section.

825.02 General Requirements.

The crushed stone furnished for use shall conform to the general requirements of Section 801 and the specific requirements noted in Article 825.03. Gradation analysis will be performed in accordance with AASHTO T 27.

Gradation may be obtained by the proper mixing of certain regular ALDOT size aggregates as noted below; however, no specific gradation will be required prior to mixing operations.

Type A - Approximately 75% ALDOT No. 610 with Approximately 25% ALDOT No. 8910.
Type B - Approximately 50% ALDOT No. 410 with Approximately 50% ALDOT No. 810.

825.03 Specific Requirements.

GENERAL COMPOSITION		
Sieve Requirements	Percentage Passing By Weight {Mass}	
	TYPE	
	A *	B **
2 inches {50 mm}		100
1.5 inches {37.5 mm}		90-100
1 inch {25.0 mm}	100	75-98
3/4 inch {19.0 mm}	86-100	- - -
1/2 inch {12.5 mm}	- - -	60-85
No. 4 {4.75 mm}	26-55	40-70
No. 8 {2.36 mm}	15-41	28-54
No. 16 {1.18 mm}	- - -	19-42
No. 50 {300 µm}	3-18	9-32
No. 200 {75 µm}	0-10	4-18
* The fraction passing the No. 40 {425 µm} sieve shall not have a liquid limit in excess of 25. ** The fraction passing the No. 40 {425 µm} sieve shall not have a P.I. in excess of 6 nor a L.L. in excess of 25, and contain not more than 2/3 by weight {mass} passing the No. 200 {75 µm} sieve.		

SECTION 826
LOCAL SAND AND SAND-GRAVEL FOR MISCELLANEOUS CONSTRUCTION USE

826.01 Description.

Local materials, for the purpose of these Specifications, shall be of the kind and character of local sand and local sand-gravel or blends thereof.

826.02 General Requirements.

(a) GENERAL.

The kind of material shall meet the general requirements for the respective classification of material as noted in this Article.

Blends shall consist of any combinations of local sand or sands, or local sand-gravel, or sand-gravels. All blends shall be of the material proportions or ratio provided by the plans and/or proposal.

When used in bituminous pavements, local source material shall be non-plastic.

(b) LOCAL SAND.

Local sand shall be pit-run sand suitable for the purpose intended. In general, all local sand shall consist of grains of hard, sound material, predominantly quartz or other hard, durable rock, including friable, loosely bound deposits of sandstone conglomerate. The sand shall be free from a coating of injurious material, lumps of clay, loam, organic matter, or other foreign material.

If necessary, gradation and/or other requirements will be provided in the plans and/or proposal form.

(c) LOCAL SAND-GRAVEL.

Local sand-gravel shall be pit-run sand-gravel, suitable for the purpose intended. In general, the sand-gravel shall be hard, sound durable rock, including friable, loosely bound sandstone conglomerate, with varying amounts of coarse aggregate and sand. The coarse aggregate and the sand shall be free from a coating of injurious material, lumps of clay, loam, organic matter, or other foreign material. If necessary, gradation and/or other requirements will be provided in the plans and/or proposal form.

SECTION 827
PROCESSED REEF SHELL

827.01 Description.

Processed Reef Shell shall consist of dead reef shells (oyster, clam, or other dead shell as encountered in the reef) but not cannery or live shell. Processing shall consist of washing the shell by the use of a screen washer, the mesh of which shall not be smaller than 1/4 of an inch {7 mm}.

The processed shell shall be classified as a commercial aggregate.

827.02 Processed Shell For Soil Or Aggregate Base Courses.

Processed shell used in base courses shall, after processing, not contain foreign matter in excess of three percent when washed over a No. 200 {75 µm} sieve of the dry weight {mass} of the shell.

827.03 Processed Shell For Bituminous Bases and Pavements.

Processed shell used in bituminous work shall in addition to the requirements noted in Articles 827.01 and 827.02 require the oversize fraction to be crushed in a mechanical crusher and rescreened.

SECTION 830
CONCRETE CURING MATERIALS

830.01 Burlap Cloth and Waterproof Covering Material.

(a) GENERAL.

Burlap cloth and waterproof covering material shall be of sufficient length and width to extend beyond the edge of the concrete a distance of at least twice the thickness of the slab. Sections of covering material shall be lapped at least 18 inches {450 mm}. The surface and both sides of a concrete slab shall be completely covered. The covering shall be so placed and secured as to cause it to remain in intimate contact with the exposed surface. Burlap cloth shall be saturated with water before being placed and shall be kept wet while in position. The covering shall remain in position for six days after the concrete has been placed unless otherwise specified or directed.

(b) TYPES OF COVERING MATERIAL.

1. Burlap cloth shall conform to the requirements of AASHTO M 182 for Class 4 burlap.
2. White Waterproof Paper shall conform to the requirements of AASHTO M 171.
3. Polyethylene sheeting (film) shall be white opaque conforming to the requirements of AASHTO M 171 modified to omit the elongation requirements when the sheeting is internally reinforced with a cord net having a cord spacing of 1/4 to 1/2 of an inch {6 to 13 mm}. (Net may be nylon or other approved material.)
4. White Burlap Polyethylene sheet shall conform to the requirements of AASHTO M 171.

830.02 Impervious Membrane.

Impervious membrane compounds shall meet the requirements of AASHTO M 148, Class A. Type 2, white pigmented, shall be used on concrete pavement and bridge decks. Other types may be used on other concrete.

Membrane liquid shall be applied under pressure with spray nozzles in such a manner as to cover the area being treated with a uniform film. For concrete pavement the rate of application shall be 1 gallon {4 L} to not more than 135 square feet {13 m^2}, applied in two applications. For concrete bridge wearing surfaces and sidewalks, the rate of application shall be 1 gallon {4 L} to not more than 200 square feet {19 m^2}.

830.03 Wetted Earth Or Sand.

When this type of curing is used, the pavement shall be cured initially with burlap cloth, polyethylene sheets, or waterproof paper, as specified in Article 830.01, until after final set of the concrete or, in any case, for 12 hours after placing the concrete. As soon as the covering material is removed, the surfaces and sides of the pavement shall be covered with a blanket of earth or sand not less than 2 inches {50 mm} thick. If the earth or sand covering becomes displaced during the curing period, it shall be replaced to the original depth and saturated with water for three days and thoroughly wetted down during the morning of the fourth day; the cover shall remain in place until the

concrete has attained the required strength. When permission is given to open the pavement to traffic, the covering material shall be removed and the pavement cleaned and swept.

Earth or sand used in this method of curing shall be free of sticks, stones, or other matter which might injure the surface of the concrete. The material shall contain no ingredients which would be detrimental to the concrete or discolor the surface finish.

830.04 Straw.

Straw used as a supplement to the curing materials noted in Article 830.01 and 830.02 for cold weather protection shall be suitable for the purpose intended and approved each time it is used.

SECTION 831
PRECAST CONCRETE PRODUCTS

831.01 Description.

All products furnished for use shall be from an approved producer who is participating in and meeting the requirements of ALDOT-364, Quality Control Program For The Production and Inspection of Concrete Pipe, Precast Manholes, Precast Box Culverts, and Miscellaneous Precast Concrete Products, and listed on List I-8, PRODUCERS OF PRE-CAST CONCRETE PRODUCTS, of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

SECTION 832
CONCRETE JOINT FILLERS, SEALERS AND WATERSTOP MATERIALS

832.01 Preformed Joint Filler.

(a) GENERAL.

Preformed joint filler units shall be furnished in one piece of the length, thickness, and depth shown on the plans for a complete joint, unless otherwise authorized by the Engineer. When the use of more than one piece is authorized, the abutting ends shall be fastened securely and held accurately in place to correct shape by stapling or other satisfactory means.

When a preformed filler is used with dowels or other protruding items which must pass through the filler, clean-cut holes, accurately spaced and not more than 1/8 of an inch {3 mm} larger than the protruding item shall be provided.

Damaged filler units shall be rejected.

Joint fillers used in conjunction with expansion joints will require the use of a joint sealer in order to provide a functional joint. Sealers shall be one of the appropriate types specified in Article 832.02 or Subarticle 832.03(a), unless a specific type is specified by the plans.

(b) FILLER FOR CONSTRUCTION JOINTS IN BRIDGE, CULVERT, AND DRAINAGE STRUCTURES.

Preformed bituminous joint filler for general use in bridge, culvert, and drainage structure work shall meet the requirements for one of the following "Types" unless a specific "Type" is required by the detailed plans:

Type 1 - AASHTO M 33
Type 2 - AASHTO M 213, modified to allow a maximum of 25% water absorption.

(c) EXPANSION JOINT FILLER.

Expansion joint filler for concrete pavement, curb, gutter, combination curb and gutter, flumes, slope paving, and other miscellaneous concrete structures shall be one of the materials provided by AASHTO M 153 or AASHTO M 213 with the latter being modified to allow a maximum of 25% water absorption.

832.02 Poured Joint Sealers.

(a) GENERAL.

Poured sealers may be used for sealing both expansion joints and construction joints in concrete units other than bridges within the following limitations:

Type 1 and Type 3 poured sealers may be used in all joints located in all concrete units unless a specific type is specified by plan details.

Type 2 and Type 3 poured sealers may be used for sealing joints in concrete units not under normal traffic usage, such as curbs, gutters, combination curb and gutter, flumes, slope paving, etc.

Vertical joints in concrete units such as curbs, etc. will require the use of a non-sag compound.

Construction joints 1/4 of an inch {6 mm} or less in width will not require sealing unless specified by plan details.

The shape factor of joint sealer is most important. The joint configuration shown by the plan details may require the use of a backer rod or strip to insure proper shape. When a backer rod or strip is necessary, it shall be compatible with the sealant and shall have no bond or reaction between the sealant and the backer rod or strip. A bond breaking tape may be used to insure no bond occurs between the two materials.

Requirements for poured sealers are noted in the following Subarticles; however, the Contractor may substitute an approved preformed elastomeric seal meeting the requirements of Subarticle 832.03(a) in lieu of a poured sealer provided such is furnished at no additional cost to the Department.

A certified test report showing actual test results shall be furnished with each lot of joint sealer furnished to each project. Each lot of sealant shall be delivered in containers plainly marked with manufacturer's name or trade mark, type of sealant, lot number, and date of manufacture. The Department may run any or all tests deemed necessary.

(b) TYPE 1 - HOT-POURED JOINT SEALER.

This type sealer shall conform to the requirements of AASHTO M 173, modified as follows:

The joint sealant shall be free from all foreign matter. When heated the material shall be free of lumps. The composition of the material shall be a mixture of virgin synthetic rubber, reclaimed rubber, or a combination of the two with asphalt, plasticizers, and tacifiers. Under no circumstances shall ground cured rubber scrap be used in place of virgin or reclaimed rubber.

Flow test at 140 °F {60 °C} shall not exceed 10 mm.

Ductility test at 77 °F {25 °C} (ASTM D 113) 400 mm minimum.

(c) TYPE 3 - LOW MODULUS SILICONE COLD-POURED JOINT SEALANT.

This type sealer shall be a resilient adhesive compound capable of effectively sealing joints from infiltration of incompressible materials and water throughout repeated contraction and expansion cycles.

The sealant, when delivered, shall be capable of being used on the job site and may be placed by machine, pressure gun, or by hand. The compound, when used in other than horizontal joints, shall be capable of conforming to the slope face without sagging.

The Department has established a Qualified Materials list for low modulus silicone joint sealers. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

The sealant shall be a homogeneous blend of materials, which may or may not require a primer, and shall meet the following requirements:

JOINT SEALANT SPECIFICATIONS		
TEST	REQUIREMENT	TEST METHOD
Flow	0.3 inches {8 mm} maximum	ASTM C 639
Tack free time @ 77 °F ± 3 °F {25 °C ± 2 °C} and 45-50% R.H.	100% @ 75 minutes	ASTM C 679
Durometer hardness cured 7 days @ 77 °F ± 3 °F {25 °C ± 2 °C} and 45-55% R.H.	10-25	ASTM D 2240 Shore A
Tensile stress @ 150% elongation, 7-day cure @ 77 °F ± 3 °F {25 °C ± 2 °C} and 45-50% R.H.	75 psi {515 kPa} maximum	ASTM D 412 Die C
Elongation, 7-day cure @ 77 °F ± 3 °F {25 °C ± 2 °C} and 45-55% R.H.	500% minimum	ASTM D 412 Die C
Bond (using mortar blocks)	1/4 inch {6 mm} Max/ as per Item 4.3 of ASTM D 1850	ASTM D 1851
Accelerated weathering test	No chalking, cracking or bond loss after 5000 hour minimum	ASTM C 793

PRIMER SPECIFICATIONS (when required by silicone manufacturer and must be approved by manufacturer)	
PROPERTY	SPECIFICATION
% Solids	46 - 50%
Viscosity @ 23 °C	60 - 100 CPS
Specific Gravity	1.035 - 1.085

832.03 Preformed Elastomeric Joint Seals.

(a) COMPRESSION SEALS.

1. GENERAL.

Compression type elastomeric seals shall consist of an approved seal shape formed from elastomeric material, designed to be installed and function in a compressed state. Installation of this type seal requires the use of a lubricant adhesive. This type seal when used on bridge decks will not require the use of a joint filler material unless such is specified by plan details.

2. MATERIALS.

a. Materials used in fabricating the preformed elastomeric seals shall conform to the requirements of ASTM D 2628 for Concrete Pavement and ASTM D 3542 for Bridges and be of the basic shape, dimension, etc. shown by the plan details. No factory or field splicing of seals in transverse joints 50 feet {15 m} or shorter in length will be allowed. On transverse joints over 50 feet {15 m} in length, one field splice will be considered for approval by the Engineer pending written request from the Contractor. This request shall specify the materials and details of performing the splice. Since the intent is to have one continuous seal meeting the above requirements, absolutely no patching of torn or damaged spots in the seal shall be permitted.

In addition to the above, seals for bridge joints (including the joint between the bridge end and the bridge end slab) shall comply with the following:

Provide a depth to width ratio of not less than 1 ($D/W \geq 1$).

b. The lubricant adhesive used in installing the compression seals in joints shall meet the requirements of ASTM D 2835 for concrete pavement and ASTM D 4070 for bridge joints.

3. CONSTRUCTION METHOD.

The installation of the seal shall be in accordance with the manufacturer's recommendation, plan details, approved shop drawings, and the following:

a. Sand blast and clean all surfaces of the joint with steel areas cleaned to a "Near White" classification.

b. Prepare joint lubricant adhesive compound and apply to joint.

c. Place sealer without stretching beyond a maximum of five percent elongation.

(b) DIAPHRAGM TYPE SEALS

1. FLEXIBLE, UNREINFORCED ELASTOMERIC TYPE SEAL.

a. General.

This type seal shall consist of an approved seal shape formed from elastomeric material without metal reinforcement, anchored by mechanical or other acceptable methods to anchor plates cast into or affixed to the joint edges.

b. Materials.

The elastomeric material shall conform to the requirements of ASTM D 2628 modified to omit the recovery tests, with or without fiber or other types of acceptable non-metallic reinforcement. The seal shall be of the basic shape and dimensions shown by plan details unless otherwise authorized in writing by the Bridge Engineer.

Metal anchor plates shall conform to the requirements of ASTM A 36 or equivalent.

Any sealant or lubricant shall conform to the requirements for lubricant adhesive noted in Subarticle 832.03(a) or an approved equivalent.

c. Construction Methods.

The installation of the seal shall be in accordance with the manufacturer's recommendations, the plan details, and the approved shop drawings.

2. FLEXIBLE, REINFORCED ELASTOMERIC TYPE SEAL.

a. General.

This type seal shall consist of an approved shape formed from elastomeric material reinforced internally with metal strips with the seal affixed to the bridge deck by the method indicated in the plan details.

b. Materials.

The elastomeric material used in the seal shall conform to the following:

ELASTOMERIC SEAL SPECIFICATIONS		
TEST	REQUIREMENT	TEST METHOD
Hardness, Durometer A	45 ± 5	ASTM D 2240
Tensile Strength	1800 psi {12.5 Mpa}, Min.	ASTM D 412
Elongation @ break	400% Min.	
Compression Set, 22 hrs. @ 158 °F {70 °C}	20% Max.	ASTM D 395 Method B
Low Temperature	Not Brittle @-40 °C	ASTM D 746
Ozone Resistance, Exposure to 100 ppm {100 mg/l} Ozone for 70 hrs. @ 100 °F {38 °C} Sample under 20% Strain	No Cracks	ASTM D 1149
Oil Deterioration Volume increase after immersion in ASTM Oil #3 for 70 hrs. @ 212 °F {100 °C}	120% Max.	ASTM D 471
Flame Resistance	Will Not propagate flame	ASTM C 542
Reinforcement		ASTM A 36 or equivalent

Sealant shall conform to lubricant adhesive in Subarticle (a) or an approved equivalent.

c. Construction Method.

Installation of the seal shall be in accordance with the manufacturer's recommendations in the plan details and the approved shop drawings.

832.04 Blank.

832.05 Waterstop Materials.

(a) DESCRIPTION.

Waterstops shall be of the size and shape shown by the plan details. The material may be either neoprene or polyvinylchloride meeting the requirements noted in this Section.

(b) NEOPRENE.

Physical Requirements.

1. Tensile Strength – 1800 psi {12.5 MPa} Min., ASTM D 412.
2. Elongation - 300% Min., ASTM D 412.
3. Type A Shore Durometer Hardness - 70 ± 5, ASTM D 2240.
4. Change in Type A Durometer Hardness, 70 hrs. heat aged @ 212 °F {100 °C} + 15 points Max.

5. Ozone aging when subjected to an exposure of 100 hours at anatmosphere containing 100 parts per 100,000,000 {1 mg/L} of ozone in an ozone chamber - Show no checking or cracking.

(c) POLYVINYLCHLORIDE.

Physical Requirements.

1. Tensile Strength – 1800 psi {12.5 MPa} Min., ASTM D 412.
2. Elongation - 300% Min., ASTM D 412.
3. Type A Shore Durometer Hardness 70 ± 5 ASTM D 2240.
4. Change in Type A Durometer Hardness, 70 hrs. heat aged @ 212 °F {100 °C} + 15 points Max.
5. Ozone aging when subjected to an exposure of 100 hours at an atmosphere containing 100 parts per 100,000,000 {1 mg/L} of ozone in an ozone chamber - Show no checking or cracking.
6. Specific Gravity, 1.38 Max., ASTM D 792.

832.06 Drainage Trough Material for Open Type Expansion Dam Units.

Drainage trough material furnished for use shall be a high grade neoprene reinforced with at least two layers of flexible polyester or nylon cord fabric acceptable to the Engineer meeting the following requirements.

1. Fabric reinforcement shall be a close woven material providing equal strength in both warp and fill directions.
2. The finished product shall be of the shape, size, and thickness shown by the plan details meeting the following test:

Oil Deterioration - Maximum weight {mass} change of 55% after immersion in IRM Oil 903 for 70 hours at 212 °F {100 °C} - ASTM D 471.

3. Only minimum splicing across the width of the required material will be allowed. Any splice allowed must be performed using materials and in a manner recommended by the producer of the material so as to provide a waterproof, full strength (same as original material) joint through the splice.

Samples (12 inch x 12 inch {300 mm x 300 mm} minimum) of the material along with the material data sheet of the producer of the material shall be submitted to the Central Laboratory for approval.

832.07 Blank.

SECTION 833
LUMBER AND TIMBER - UNTREATED AND TREATED

833.01 Structural Lumber and Timber.

Structural lumber and timber shall be Southern Yellow Pine, unless otherwise noted on the plans or in the proposal, meeting the requirements of AASHTO M 168. The grade of structural wood shall be as shown on the plans.

833.02 Preservative Treatment.

Treated wood shall meet the requirements of AASHTO M 133. Preservative materials shall meet current EPA regulations.

SECTION 834
PILING - TIMBER, CONCRETE, AND STEEL

834.01 Timber Piling.

(a) SPECIES OF WOOD.

1. Timber test piles and piling which will be permanently below water level may be of any species of wood that will satisfactorily withstand driving.
2. In untreated piling for use in exposed work, the diameter of the heartwood shall not be less than 8/10 of the required diameter of the pile. Treated piling shall be Southern Yellow Pine (loblolly excluded) containing by area not less than 30 percent sapwood.

(b) QUALITY.

1. All timber piling shall be cut from sound and solid trees, preferably during the winter season. Piles shall contain no unsound knots and shall be free from rafting or other pins or pinholes. Sound knots will be permitted provided the diameter of the knot does not exceed 4 inches {100 mm} or 1/3 of the diameter of the pile at the point where it occurs. Any defect or combination of defects that will impair the strength of the pile more than the maximum allowable knot will not be permitted. The butts shall be sawed and the tips shall be sawed or tapered to a point not less than 4 inches {100 mm} in diameter as directed.

2. Unless otherwise provided, all piles, including test piles, shall be peeled by removing all of the outer bark and at least 80 percent of the inner bark. No strip of inner bark remaining on the pile shall be over 3/4 of an inch {19 mm} wide or over 8 inches {200 mm} long, and there shall be at least 1 inch {25 mm} of clean wood surface between any two such strips. Not less than 80 percent of the surface on any circumference shall be clean wood.

3. Piles shall be cut above the ground swell and shall have a gradual taper from the point of butt measurement to the tip. A line drawn from the center of the tip to the center of the butt shall not fall outside of the center of the pile at any point more than three-fourths of one percent of the length of the pile. Piles shall be free from reverse bends. In short bends, the distance from the center of the pile to a line stretched from the center of the pile above the bend to the center of the pile below the bend, shall not exceed four percent of the length of the bend or 2.5 inches {60 mm}. All knots shall be trimmed close to the body of the piles. Piles shall be free from twist exceeding one-half the circumference in any 20 feet {6 m} of length.

(c) DIMENSIONS.

1. Round piles, unless otherwise provided by the plans, shall meet the requirements for Class 1 piles.

2. Round piles shall have a minimum diameter at the tip, measured under the bark, as follows:

Length of Pile	MINIMUM TIP DIAMETER	
	Class 1	Class 2
Less than 40 feet {12 m}	8 inches {200 mm}	7 inches {175 mm}
40 to 60 feet {12 to 18 m}	7 inches {175 mm}	7 inches {175 mm}
Over 60 feet {18 m}	5 inches {125 mm}	5 feet {125 mm}

3. The minimum diameter of piles at a section 4 feet {1200 mm} from the butt, measured under the bark, shall be as follows:

Length of Pile	MINIMUM DIAMETER			
	Southern Yellow Pine or Southern Cypress		All Other Species	
	Class 1	Class 2	Class 1	Class 2
Under 20 feet {6 m}	11 inches {280 mm}	10 inches {255 mm}	11 inches {280 mm}	10 inches {255 mm}
20 thru 29 feet {6 thru 9 m}	12 inches {305 mm}	10 inches {255 mm}	12 inches {305 mm}	10 inches {255 mm}
30 thru 39 feet {9 thru 12 m}	12 inches {305 mm}	10 inches {255 mm}	13 inches {330 mm}	11 inches {280 mm}
40 feet {12 m} and Over	13 inches {330 mm}	10 inches {255 mm}	14 inches {355 mm}	12 inches {305 mm}

4. The diameter of a pile at the butt shall not exceed 20 inches {510 mm}. Square piles shall have the dimensions shown on the plans.

834.02 Untreated Timber Piles.

Untreated trestle piles and untreated foundation piles for trestle bents shall be of Southern Yellow Pine or Southern Cypress, meeting the requirements for timber piling noted in Article 834.01, unless otherwise provided by the plans, and/or proposed form. In general, untreated timber piles shall be used only below permanent ground water level. Untreated timber piles, except untreated foundation piles, shall not be used in water which is infested by marine borers.

834.03 Treated Timber Piles.

(a) PILES.

1. Piles shall be of Southern Yellow Pine conforming to the corresponding requirements for timber piling noted in Article 834.01 treated in accordance with Section 833.

2. Piles shall have preservative in the minimum amounts set out on the plans, unless the oil has been injected to refusal, and shall be so treated as to secure penetration of all the sapwood and as much of the heartwood as practicable.

(b) AMOUNT OF PRESERVATIVE.

Unless otherwise provided by plan details, the preservative treatment shall be in accordance with Section 833.

(c) PENETRATION TESTS OF PRESERVATIVES.

Tests for preservation penetration shall be made in accordance with the requirements of Section 833.

834.04 Concrete Piles.

(a) GENERAL.

All concrete materials and their preparation and placing shall be in accordance with the requirements of Section 501 unless otherwise specified in this Article.

Reinforcement shall conform to the requirements of Section 502 and dimensions shall be as shown on the plans.

(b) PRECAST CONCRETE PILES.

The manufacture of precast concrete piles shall conform to the requirements for precast units provided in Subarticle 501.03(m). Concrete shall be Class A unless otherwise specified by plan details or in the proposal.

(c) PRECAST PRETENSION-PRESTRESSED CONCRETE PILING.

1. GENERAL.

The term precast prestressed concrete as used herein shall refer to concrete in which the prestressing strands or wire are tensioned prior to placing the concrete and released after the concrete has gained sufficient strength to retain the prestressing force by bond.

The definition of all other terms pertaining to prestressed concrete shall conform to the latest report of the AASHTO Committee on Bridges and Structures and Prestressed Concrete Institute Joint Committee.

2. MATERIALS.

Materials shall be the same as specified in Article 513.02 for pretensioned-prestressed girders.

3. MANUFACTURE OF UNITS.

The manufacture of pretensioned-prestressed piling shall conform to the requirements of Subarticles 513.03(a) through 513.03(g), and the following:

a. Anchorage of the prestressed concrete pile to the cap shall be in accordance with the plan requirements.

b. No piling shall be transported or driven until 5000 psi {35 MPa} concrete is obtained and verified by test cylinders.

c. Any pile damaged during driving shall be repaired as approved by the Engineer or removed and replaced, all at the expense of the Contractor.

d. The outside of all pile shall receive an ordinary surface finish as specified in Subarticle 501.03(1). All exposed surfaces of the pile shall receive a Class I or a coated finish, with the finish the same as used on the bridge structure. In the case of a Class I finish, the first rub shall be applied at the fabrication yard and the second after installation. For a coated finish the coating shall be applied after installation.

(d) CAST IN PLACE CONCRETE PILES.

1. SHELL.

a. Cast in place concrete piles shall be reinforced and cast in strong metal shells which shall remain permanently in place. However, other types of cast in place concrete piles, plain or

reinforced, cased or uncased, may be used if, in the opinion of the Engineer, the soil conditions permit their use and if the method of placing is approved.

b. The metal shell shall be of sufficient thickness and shall be reinforced so that it will hold its original form and show no signs of distortion after the core has been withdrawn. The design of the shell shall be approved before any driving is done, but it shall be Contractor's responsibility to select an adequate shell thickness that will permit driving without damage. Pipe steel shell meeting requirements of ASTM A 252 may be driven without use of a driving core or mandrel.

c. After the shell has been driven and the core withdrawn, the shell shall be inspected and approved before any concrete is placed. Any improperly driven, broken, or otherwise defective shell shall be removed and replaced.

2. CONCRETE.

a. Class A concrete with 1 inch {25 mm} maximum size aggregate shall be used.

b. No concrete shall be placed until all driving within a radius of 15 feet {5 m} has been completed, nor until all the shells for any one bent have been completely driven. If this cannot be done, all driving within the above limits shall be discontinued until the concrete in the last pile cast has set at least seven days.

c. Concrete shall be placed as provided in Subarticle 501.03(m), except that the forms shall not be vibrated. Accumulations of water in the shells shall be removed before the concrete is placed.

3. REINFORCEMENT.

Reinforcement for cast in place piles shall be of the unit type, (fastened together rigidly) and shall be lowered into the shell before concrete is placed. No loose bars will be permitted. The reinforcement shall be secured in such a manner as to insure its proper location in the finished pile.

834.05 Blank.

834.06 Blank.

834.07 Steel Pile Point Protectors.

The pile points shall be fabricated from cast steel meeting or exceeding the requirements of AASHTO M 103M. The pile points shall be properly identified as to the heat from which they were fabricated, either by this number being cast into the point or by being legibly stenciled on each point. Certified mill test reports shall be submitted for the pile points in accordance with the requirements given for the submittal of certified mill test reports for Structural Steel.

834.08 Steel Bearing Piles.

The material in rolled steel piles and splices shall conform to the requirements of AASHTO M 183 {AASHTO M 183M}, unless otherwise specified by plan details. All piles shall be rolled steel sections of the section number, size, and weight per foot {mass per meter} indicated on the plans and shall be fabricated in conformity with the requirements of AASHTO M 160 {AASHTO M 160M}.

834.09 Timber Sheet Piles.

(a) UNTREATED TIMBER.

1. Untreated timber sheet piles may, unless otherwise provided, consist of any species that will satisfactorily stand driving. They shall be sawed and dressed on four sides (S4S) and shall be free from worm holes, loose knots, wind shakes, decayed or unsound portions, or other defects which might impair their strength or tightness.

2. The piles shall be of thickness and width specified and shall have tongues and grooves of ample proportions, either cut from the solid material or made by building up the piles of three planks securely fastened together. They shall be drift sharpened at the lower end so that adjacent piles will be wedged tightly together.

(b) TREATED TIMBER.

Treated timber sheet piles shall conform to the requirements of Articles 834.03 and Item 834.09(a)2.

834.10 Steel Sheet Piles.

Permanent steel sheet piling shall be of the type called for on the plans and shall conform to the requirements of AASHTO M 202 {AASHTO M 202M} and its supplementary requirement, S1.

Temporary steel sheet piling shall conform to the requirements of AASHTO M 202 {AASHTO M 202M} and its supplementary requirement, S1 and may be either new piling or used piling, acceptable to the Engineer for the intended function. The temporary steel sheet piling shall be interlocking type piles having a 3/8 inch {9.4 mm} minimum web thickness.

834.11 Storage And Handling.

(a) TIMBER PILES.

The method of storing and handling shall be such as to avoid injury to the piles. Special care shall be taken to avoid breaking the surface of the treated piles. Cantdogs, peaveys, hooks, pile poles, or other pointed tools shall not be used except on that part of the ends of the pile which will either be cut off or located permanently below water level. Holes shall not be bored or spikes driven in piles to support scaffolding or temporary bracing.

(b) PRECAST, AND PRECAST PRESTRESSED CONCRETE PILES.

The method of storing and handling shall be such as to eliminate the possibility of undue bending stresses, cracking, spalling, or other injury in curing or transporting the piles from the forms and into the leads. Concrete piles shall be lifted by means of a suitable bridle or sling attached to the pile at pickup points designated on the plans. Piles cracked or otherwise injured during handling or driving will be rejected and shall be immediately removed and replaced at no cost to the Department.

(c) STEEL PILING.

When placed in the leads, the pile shall conform to camber and sweep permitted by allowable mill tolerance. The method of storing and handling shall be such as to avoid undue bending stresses or other injury. Piles bent, cracked, or otherwise injured will be rejected.

(d) PILES FOR SEA WATER.

In handling piles for use in sea water, special care shall be exercised to avoid injury to the surface of the pile.

SECTION 835
STEEL REINFORCEMENT

835.01 General.

All reinforcing steel shall be Grade 40 or Grade 60 {Grade 300 or Grade 420} billet steel, unless otherwise stipulated in these Specifications or specifically designated by plan details.

All reinforcing bars over 1/4 of an inch {6 mm} in diameter shall have deformations as prescribed in AASHTO M 31.

Rail steel concrete reinforcement bars in sizes not greater than No. 6 {Size 19} will be permitted for all culverts and other concrete structures except bridges. In bridges their use shall be limited to curbs and handrail and to floor slabs with a clear span of less than 10 feet {3 m} measured parallel to the main bar reinforcement.

835.02 Reinforcing Bars.

(a) BILLET STEEL REINFORCEMENT BARS.

Billet steel reinforcement bars 1/4 of an inch {6 mm} or less in diameter shall meet the requirements of AASHTO M 32.

Billet steel reinforcement bars over 1/4 of an inch {6 mm} in diameter shall meet the requirements of AASHTO M 31.

(b) RAIL STEEL REINFORCEMENT BARS.

Rail steel shall not be used for tie bars that are to be bent and restraightened. See restrictions noted in Article 835.01. All rail steel reinforcement bars shall be Grade 50 or Grade 60 {Grade 350 or Grade 420} meeting the requirements of AASHTO M 42.

835.03 Reinforcing Mesh or Mats.

WIRE FOR MESH REINFORCEMENT. - Plain wire for mesh reinforcement shall meet the requirements of AASHTO M 32 . Deformed wire for mesh reinforcement shall meet the requirements of AASHTO M 225 .

WELDED WIRE REINFORCEMENT. - Welded plain wire reinforcement mesh shall meet the requirements of AASHTO M 55. Welded deformed wire reinforcement mesh shall meet the requirements of AASHTO M 221 .

FABRICATED BAR OR ROD MAT. - Fabricated bar or rod mat shall meet the requirements of AASHTO M 54.

835.04 Spiral Reinforcement.

Spiral reinforcement may be plain or deformed bars or may be cold drawn wire. Plain reinforcing bars shall conform (except for deformations) to AASHTO M 31, Grade 40 {300} or Grade 60 {420}. Deformed bars shall conform to Article 835.02. Cold drawn wire shall conform to AASHTO M 32 .

835.05 Dowel and Tie Bars for Concrete Pavement.

(a) DOWEL BARS.

Dowel bars shall be smooth round bars of the size shown by plan details. The bars shall be fabricated from steel conforming to AASHTO M 31, M 42, M 53, or M 227 of a grade which will provide a tensile strength of 70,000 psi {480 MPa} or higher. The bars shall have a corrosion resistant coating conforming to the requirements of AASHTO M 254 for a Type A or Type B coating. One end of each dowel used in an expansion assembly shall be provided with an approved tight fitting non-collapsible expansion cap.

(b) TIE BARS.

Standard tie bars shall be of the size shown by plan details, fabricated from deformed bars meeting the requirements of AASHTO M 31, M 42, or M 53, Grade 40, 50, or 60 {Grade 300, 350 or 420} steel, unless a specific grade is designated by plan requirements, except that rail steel (M 42) or axle steel (M 53) shall not be used for bars which are required to be bent and restraightened.

Sectional tie bars shall be of the size shown by plan details fabricated from deformed bars meeting the requirements of AASHTO M 31, M 42, or M 53 for Grade 60 {Grade 420} steel. Connectors shall be of a type approved by the Engineer.

835.06 Prestressing Steel.

(a) STRESSING CABLE.

Unless otherwise shown by plan details, stressing cables shall meet the requirements of AASHTO M 203 for the appropriate design strength.

(b) STRESSING BARS.

Stressing bars, when allowed by plan details, shall meet the requirements of ASTM A 722 for Type 1 with supplemental requirements S2 and S4, unless other requirements are provided by the plans or proposal.

835.07 Use, Care, And Handling.

All reinforcement received on the project shall be placed in approved storage and shall be maintained clean, intact, and free from distortion. Reinforcement shall be free from loose or thick rust, which would impair bond of the steel with the concrete. Rust that produces only discoloration without reducing the cross section of the steel will not be considered objectionable. Only such reinforcement shall be distributed along the construction as needed for immediate use.

SECTION 836
STRUCTURAL STEEL, FASTENERS AND MISCELLANEOUS METALS

836.01 General.

(a) MARKING OF STEELS.

Steels, when received from the mill shall be identified in accordance with AASHTO M 160 {160M}. On steel piling the heat number and section size shall be legibly marked on each piece by stamp, paint, tag, sticker or other industry accepted method. Any piece that can not be properly identified at time of use will be rejected.

Certified mill test reports or certified reports of tests made by other agencies which are approved by the ALDOT, and an ALDOT Fabricator's affidavit form shall be furnished for each heat of steel verifying that the material meets the requirements of the type and grade specified. The

Department reserves the right to make its own test of any material, and the material may be rejected if these tests prove the material does not meet the requirements.

For identification purposes, the fabricator shall stamp the mill heat numbers of the flanges and webs in the webs of welded members and in the webs of rolled members. The heat numbers shall be legible and located adjacent to piece marks.

All steel which is required to have a yield point greater than 36,000 psi {250 MPa} shall, at all times in the fabricator's plant, be color marked to identify its AASHTO, ASTM, or special specification.

(b) GENERAL REQUIREMENTS.

1. Structural steel shall conform to the requirements of AASHTO M 270 Grade 36 {Grade 250} unless otherwise noted hereinafter in this Section or shown on the plans.

AASHTO material specifications shall govern in lieu of ASTM material specifications where an AASHTO equivalent specification exists for all references within any referenced specification.

With the approval of the Engineer, materials (other than web and flange material and web splice and flange splice material) for members may be taken from stock, provided the fabricator provides all documentation which shows the material conforms to the required specifications, prior to use of such material.

The term "main member", as used hereinafter in this section or shown on the contract plans, is defined as any member requiring CVN testing.

Special attention is directed to the following mandatory material requirements for member components when designated by the contract drawings. Structural steel members requiring Charpy V-notch testing shall include, but not be limited to, the following:

All rolled beams in the superstructure and steel pier caps.

All flanges and webs of steel plate girders and steel pier caps.

All cover plates for beams and girders.

All flange and web splice plates for beams, girders, and floorbeams or stringer beams.

All connection plates welded to rolled beams, steel plate girders, and steel pier caps.

All diaphragms or cross frames for curved beams and girders, including their gusset and connection plates.

All stringer beams (floorbeams) and any connection plates welded thereto.

All floorbeam trusses (cross frames) which support stringer beams (floorbeams), including their gusset and connection plates.

The material supplied shall meet the longitudinal Charpy V-notch test noted below. Sampling and testing shall be in accordance with AASHTO T 243 with the (H) frequency of heat testing used. Test reports are required and shall be furnished in the same number of copies as mill test reports. All members requiring CVN testing shall have heat numbers legibly marked during fabrication.

Steel Grade	Thickness	Test Requirements	
M 270 Grade 36	Up to 4"	15 ft. lb. @ 70°F.	(Min. Ser. Temp. 0°F. and above)
M 270 Grade 50 & Grade 50W	Up to 4" Mech. Fastened Up to 2" Welded Over 2" to 4" Welded	15 ft. lb. @ 40°F. 15 ft. lb. @ 40°F. 20 ft. lb. @ 40°F.	(Min. Ser. Temp. -1°F. to -30°F.)
{250}	{Up to 102 mm}	{20 J @ 21 °C}	{Min. Ser. Temp. -18 °C and above}
{345 & 345W}	{Up to 102 mm Mech. Fastened} {Up to 51 mm Welded} {Over 51 mm to 102 mm Welded}	{20 J @ 4 °C} {20 J @ 4 °C} {27 J @ 4 °C}	{Min. Ser. Temp. -18 °C to -34°C}
If the yield point of the material exceeds 65 ksi {450 MPa}, the temperature of the CVN value for acceptability shall be reduced by 15 °F {8 °C} for each increment of 10 ksi {70 MPa} above 65 ksi {450 MPa}.			

When designated on the plans, the Contractor (Fabricator) shall furnish one main load carrying member 18 inches {460 mm} overlength in order to provide an 18 inch {460 mm} sample for Departmental testing.

Unless otherwise shown on the plans, steel plates for main members shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile and/or compressive stresses.

2. Fasteners, pins and rollers shall conform to the requirements of Articles 836.32, 836.33 and 836.42.

Threads for all bolts and pins for structural steel construction shall conform to the American National Standard for Unified Screw Threads, ANSI B1.1, Class 2A for external threads and Class 2B for internal threads, except that pin ends having a diameter of 1.375 inches {35 mm} or more shall be threaded six threads to the inch {25 mm}.

All bolt heads and nuts shall be hexagonal shaped with dimensions conforming to the requirements for Hexagon Structural Bolts and Heavy Semi-Finished Hexagon Nuts of ANSI Standard B18.2.1 and B18.2.2.

3. All cast and built-up bearings shall be shop assembled, checked for fit, securely packaged and shipped as a unit unless otherwise approved by the Engineer. The method of securing the bearing unit for shipment shall be as shown by the plan details or a method acceptable to the Engineer.

The diameter of pins used in cast and built-up bearing shall be within 1/16 inch {1.6 mm} of the diameter specified by the plans with pin holes not in excess of the pin diameter by more than 1/16 inch {1.6 mm}.

4. Copper bearing structural steel, used for structural steel piling, shall conform to the requirements of Article 836.01, except that it shall contain not less than 0.20 percent of copper. Copper bearing steels for other structural uses shall be as specified.

5. High strength and alloy steel shall be in accordance with the following.

a. Special alloy steels to meet definite corrosion requirements shall be as specified on the plans.

b. High strength structural steel for bolted and welded construction shall conform to AASHTO M 270 of the Grade as shown on the contract plans (Grade 50 * or Grade 50W).

* AASHTO M 270 Grade 50 {Grade 345} steel shall be limited to structural shapes in groups 1, 2 and 3 in AASHTO M 160 and to plates and bars in thicknesses through 4 inches {102 mm}. Plates and bars over 3/4 inch {19 mm} through 4 inches {102 mm} in thickness shall be "killed-fine grain practice."

6. Corrosion-resistant iron chromium and iron chromium-nickel castings for general application shall conform to the requirements of ASTM A 296 of the grade specified on the plans.

7. Anchor bolt assemblies (anchor bolts, nuts, and washers) shall be in accordance with AASHTO M 314 (maximum tensile strength is waived). Galvanization of the anchor bolt from 3 inches {75 mm} below the top of the concrete to the top of the anchor bolt shall be required. The remaining length of the anchor bolt will not be required to be galvanized.

(c) FULL SIZE TESTING OF MEMBERS.

When full size tests of structural members are required the methods and procedures shall be provided in the plans and specifications.

836.02 Steel Forging.

Carbon steel forgings shall, unless otherwise specified by plan details, conform to the requirements of AASHTO M 102 for Class C material. All forgings shall be annealed prior to being machined to form finished parts. A record of the annealing charges shall be furnished the Engineer by the manufacturer showing the forgings in each charge, the melt or melts from which they were secured, and the treatment they received.

836.03 Blank.

836.04 Steel Castings.

Steel castings shall conform to the requirements of AASHTO M 103, Grade 70-36, unless otherwise specified, and the following:

(a) The dimensions of fillets shall not be less than the thickness of the thinnest adjoining section or member nor less than 1/2 inch {13 mm}.

(b) All steel castings shall be annealed, unless otherwise provided, in accordance with AASHTO M 103 {M 103M}. Certification of annealing process shall be furnished by the manufacturer.

(c) Steel castings shall be true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. No finished casting shall have visible blow holes so located that a straight line laid in any direction will cut a total length of cavity greater than 1 inch {25 mm} in any 1 foot {300 mm}, nor shall any single blow hole exceed 1 inch {25 mm} in any dimension or have an area greater than 1/2 square inch {13 mm^2}. Blow holes shall not have a depth injuriously affecting the strength of the casting. Minor defects which do not impair the strength may, if approved, be welded by the electric

process. The defects shall be removed to solid metal by chipping, drilling or other satisfactory methods and, after welding, the castings shall be annealed, if required. No cracks, flaws or other defects shall appear after such treatment. No sharp unfilleted angles or corners will be allowed. Castings that have been welded without the Engineer's permission shall be rejected.

(d) All castings shall be blast cleaned of scale and sand so as to present a smooth, clean and uniform surface.

(e) Castings shall be checked for soundness by comparing computed weight {mass} against actual weight {mass} (actual weight {mass} less than 95% of computed weight {mass} shall be cause for rejection of casting) and/or by suspending the casting and hammering it all over, comparing soundness of the ring.

836.05 Gray Iron Castings.

(a) GENERAL.

Gray iron castings shall be boldly filleted at angles and the arrises shall be sharp and perfect. They shall be true to pattern in form and dimensions.

Castings will be classified under one of the following grades:

1. GRADE "A".

Grade "A" Castings shall conform to the requirements of Class No. 30 A for Gray Iron Castings, AASHTO M 105.

2. GRADE "B".

Grade "B" Castings shall conform to the requirements of Class No. 20 A for Gray Iron Castings, AASHTO M 105.

All castings shall be of the Grade "A" classification unless otherwise noted.

(b) CLEANING.

All castings shall be blast cleaned of scale and sand so as to present a smooth, clean and uniform surface.

(c) WEIGHTS {MASSES}.

Any casting weighing less than 95% of the weight {mass} computed from its dimensions shall be rejected.

836.06 Malleable Iron Castings.

Malleable iron castings shall conform to the requirements of ASTM A 47, Grade No. 35018. Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect. The dimensions of fillets shall not be less than provided in Article 836.04. The surfaces shall have a workmanlike finish. Malleable castings shall be true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. Cleaning shall be as provided in Subarticle 836.05(b). Soundness shall be checked as provided in Subarticle 836.04(e).

836.07 Ductile Iron Castings.

Ductile iron castings shall conform to the requirements of ASTM A 536, Grade 60-40-18. Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect. The dimensions of fillets shall not be less than provided in Article 836.04. The surfaces shall have a workmanlike finish. Malleable castings shall be true to pattern in form and dimension, free from pouring faults, sponginess, cracks, blow holes and other defects in positions affecting their strength and value for the service intended. Cleaning shall be as provided in Subarticle 836.04(d). Soundness shall be checked as provided in Subarticle 836.04(e).

836.08 Self-Lubricating Bronze Or PTFE Bearing Plates.

(a) SELF-LUBRICATING BRONZE BEARING PLATES.

These bearing plates shall be an article of standard production by an established manufacturer of such equipment. They shall be provided with trepanned or drilled recesses (not grooves) which shall be filled with a lubricating compound capable of withstanding the atmospheric elements and consisting of graphite and metallic substances with a lubricating binder. Such compound shall be pressed into the recesses by hydraulic presses so as to form dense non-plastic lubricating inserts. The lubricating area shall comprise not less than 25 percent of the total area. The manufacturer shall furnish additional lubrication and just prior to assembling, the entire sliding surfaces of members in contact with plates shall be thoroughly lubricated with the approved lubricant.

The bearing plates shall be made of bronze conforming to the requirements for Bronze Castings for Bridges and Turntables, AASHTO M 107, Alloy D, Copper Alloy 905, except that a maximum of 2-1/2 percent lead will be permitted. This will modify minimum on copper to 84.5 percent, minimum on tin to 8.5 percent and maximum on zinc to 3.75 percent.

The coefficient of friction shall not exceed one-tenth.

(b) PTFE BEARING PLATES.

The structural steel portion of the bearing plate shall meet the requirements of AASHTO M 270 GRADE 36 {M 270M GRADE 250} unless shown otherwise on the plans.

The material, fabrication and installation requirements for Polytetrafluoroethylene (PTFE) polymer shall be those given in SECTION 837.

The coefficient of friction shall not exceed one-tenth.

836.09 Grounding Materials For Steel Bridges.

Standard stranded copper grounding conductor shall be bare annealed Class B stranded electric conductor.

Extra flexible grounding conductor shall be Class G bare annealed stranded electric conductor.

Grounding rods shall be 5/8 inch x 8 feet {16 mm x 2.5 m}, minimum size, copperclad steel grounding rods as manufactured by A.B. Chance, McGraw-Edison, Joslyn Manufacturing and Supply Company, or approved equal.

Exothermic welding shall be by the Cadwell process or an approved equivalent method. All materials shall conform to the National Electrical Manufacturers' Association (NEMA) or the Underwriter's Laboratories, Inc. standards.

836.10 Lead Plates, Etc.

Lead used for plates, pipes, etc., shall conform to the requirements of ASTM B 29 for common desilverized lead.

836.11 Hardware For Timber Bridges.

Machine bolts, nuts, washers, drift bolts, lag bolts and screws, dowels, nails, spikes, shear rings and plates and other miscellaneous hardware shall be common stock hardware items, either plain or galvanized. Galvanization when specified shall be in accordance with AASHTO M 232.

836.12 and 836.13 Blank.

836.14 Shop And Working Drawings.

The plans furnished the Contractor by the Department are not intended for use as shop or working drawings. Shop drawings and working drawings will be required as specified in Article 105.02.

All applicable ALDOT specifications shall be referenced on the first shop drawing sheet by specification number and title.

Shop drawings shall include camber and sweep diagrams covering steel portions of all structures.

Fabricators shall furnish verification certificates of the actual measurements of the camber placed in each beam, girder or truss.

836.15 Mill Orders And Shipping Statements.

The Contractor shall furnish the Engineer with as many copies of mill orders and shipping statements as may be directed. The weights {masses} of the individual members shall be shown.

836.16 Notice And Facilities For Inspection.

After the Bridge Engineer has received the fabricator notification required by 508.03(b), but prior to actual fabrication, copies of the mill test reports, purchase orders, and fabricators material information, for materials which require CVN testing, shall be supplied to the ALDOT Bridge Engineer or his representative for initial review of such items.

No materials or members will be accepted by the ALDOT Bridge Engineer's representative or partial payments made on structural steel until the Department's form BBF-1 (available from the Bridge Engineer) and the supporting mill test reports for the materials have been furnished and approved by the Department. A complete package of this information shall be given to the ALDOT representative at the fabricator's plant, to be followed by a submittal to the ALDOT Materials & Tests' Certification office. The BBF-1 form shall be signed by a company official and shall be notarized. The acceptance of members as fabricated may be noted by the affixing of the ALDOT stamp on the member by the Bridge Engineer's representative.

The Contractor shall provide adequate, suitable facilities and equipment when required for the inspection of materials and workmanship in the mill and fabrication shop. This office shall be located conveniently near the fabricating plant or work site, shall be private and not shared with the fabricator or any other agency, and shall be equipped so that it may be locked. It shall be roofed, insulated and weather tight with suitable operational air-conditioning and heating facilities for year round use. The furniture shall include chairs, a desk, filing cabinet and a table. A telephone and telephone line shall also be furnished. The telephone line shall be dedicated for inspection office use only and shall be suitable for communications by modem.

Inspectors shall be allowed free access to the necessary parts of the work. Refer to articles 105.09, 105.10, and 105.11 concerning the duties of the Inspector(s) and inspection of work.

Unless otherwise provided, the Contractor shall furnish, without extra compensation, test specimens as provided herein.

Fabrication shops shall have a master tape calibrated by the National Institute of Standards and Technology. All tapes used in fabrication measurements shall be calibrated with the master tape before being used on the project. Any master tape found damaged or with a certification over two years old shall be replaced or recalibrated.

The quality control program for any fabrication work performed will be subject to the review of the Bridge Engineer. A written current copy of the fabricator's Quality Control Manual and current copies of all nondestructive testing and Quality Control Inspection personnel certifications associated with fabrication work shall be on file with the Bridge Engineer prior to the beginning of work. Current copies of eye examinations are also required. Eye examinations administered by a qualified ASNT NDT Level III are acceptable.

Any bridge fabrication facility that is required to have an AISC Certification of Major Steel Bridge (Mbr) shall have a Certified Welding Inspector (CWI) employed by, or retained by, and preferably working with the fabricator's quality control office. A CWI shall be present on all shifts and shall be available at any location that fabrication and welding are to take place.

Quality Control guidelines and requirements shall conform to ANSI/AASHTO/AWS D1.5 Section 6. If the Bridge Engineer finds the fabricator's quality control office is not providing sufficient inspection on the work in progress, he may suspend all or any portion of the work in progress (reference is made to Article 105.01 and Subarticle 108.07(a)). Work may resume only after necessary adjustments to the Quality Control Program are instituted which will assure conformance to the contract requirements.

All nondestructive testing personnel shall meet the requirements set forth in the "ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel (ANSI/ASNT CP-189-1991)".

836.17 Handling, Storage And Transporting Of Materials.

The loading, unloading, handling and storing of materials shall be so conducted that the metal will not be injured or damaged. Structural material delivered at the bridge shop receiving yard shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected from corrosion. It shall be kept free from accumulations of dirt, grease or foreign matter.

During and after fabrication, proper lifting equipment with the capacity to handle members carefully at all times so that no member or part thereof will be bent, excessively stressed, deformed or otherwise damaged shall be used. Handling of members shall require the use of suitable clamps, plate hooks or other approved devices. Chains or chokers will not be allowed without the use of a protective shield between the chain and the member. Members longer than 50 feet {15 m} shall utilize a two or more point pickup method. Members shall be transported in such a manner that they will not be excessively stressed, deformed or otherwise damaged. Unless otherwise authorized for exceptionally deep girders, girders and beams shall be stored and transported in a "workway position" as used in the structure with appropriate shoring and blocking methods approved by the Engineer. Chain tie downs shall be provided with protection shields. Multiple stacking of beams and girders may only be done in a manner acceptable to the Engineer. Any suspected damage from handling, storage or hauling shall be cause for the Engineer to order verification of design camber and/or repair of the beam or girder.

All structural materials shall be examined by shop personnel and/or quality control, at the earliest possible time for evidence of any defects. If pitting or other defects are plainly visible during early stages of fabrication prior to any required surface preparation (sand or shot blasting), evaluation shall be required. Information regarding actual material thickness, amount of area affected and end use of material being evaluated will be submitted to the Engineer for acceptability. Any required conditioning will be allowed only when in compliance with AASHTO M 160.

The above shall also apply to pitting of fabricated material stored prior to shipment and to material delivered to the bridge site. Attention is called to Subarticle 106.05(b).

Preparation and shipment of fabricated pieces shall conform to the following:

Loose Members.

1. Parts not completely assembled in the shop shall be secured, insofar as practicable, to prevent damage in shipping or handling.

2. Projecting parts likely to be damaged during shipment shall be blocked with wood or otherwise protected. Members weighing {with mass} more than 3 tons {2700 kg} shall have the weight {mass} marked thereon.

Packages.

1. Pins, small parts and small packages of bolts, rivets, washers, and nuts shall be shipped in boxes, crates, kegs, or barrels. A list and description of the contained material shall be plainly marked on the outside of each shipped container.

2. Anchor bolts, washers, and other anchorage or grillage materials, shall be shipped in time to suit the requirements of the masonry construction.

Loading diagrams shall be provided to the Bridge Engineer for his review when Structural Steel items are to shipped by barge or railcar.

836.18 Straightening Material.

Rolled material, before it is marked, laid out, or otherwise worked in the shop must be straight or cambered as shown on the plans. Material with sharp kinks or bends may be rejected. If straightening is necessary it shall be done by methods that will not injure the metal and must be approved by the Engineer. Heat straightening will be permitted provided the metal is not heated above 1100°F {590 °C}. (controlled by the use of heat crayons furnished by the Fabricator or other approved means). After heating, the metal shall not be artificially cooled until after naturally cooling to 600 °F {315 °C} or less. The method of artificial cooling is subject to the approval of the Engineer. Water or water spray misting shall not be used as a means of artificial cooling. After straightening, the surface of the metal shall be carefully inspected for evidence of fracture.

836.19 Workmanship And Finish.

(a) GENERAL.

Workmanship and finish shall be first class in every respect. Materials at the shop shall be kept clean and protected from the weather insofar as practical. Shearing, burning, chipping and grinding shall be neatly and accurately done in a workmanlike manner.

Damage incurred to members or the surfaces of members for any reason shall be cause for the Engineer to order the damage repaired or to reject the member in accordance with the following:

1. Except as noted in paragraph 2 below, damage to surfaces of plates that does not reduce the plate thickness below the permissible minimum thickness allowed by AASHTO M 160 {M 160 M} or the thickness of structural shapes in excess of 1/32 inch {0.8 mm} for material less than 3/8 inch {9.5 mm} in thickness, 1/16 inch {3.2 mm} for materials 3/8 inch to 2 inches {9.5 mm to 50 mm} inclusive in thickness or 1/8 {3.2 mm} in for material over 2 inches {50 mm} thick are considered repairable. Damage in excess of the limits noted will be evaluated by the Engineer as to whether to reject or allow repair of member.

2. Surface indentation of members caused by lifting devices shall be evaluated by the Engineer to determine if the damage is repairable and if repairable, the repairs necessary for acceptance. Continued use of lifting devices that cause damage, especially that which reduces the specified thickness by more than 1/16 inch {1.6 mm}, will be cause for the rejection of all such members so damaged.

3. In general, when allowed, repair work will consist of welding and/or grinding of the surfaces; however, when evaluation of base metal defects becomes necessary, such evaluation shall be done in the presence of the Bridge Engineer’s representative. The type of evaluation shall be determined by the fabricators quality control personnel subject to the approval of the Bridge Engineer's Representative.

After evaluation of such defects and where welding is necessary on rolled surfaces, stringer beads shall be placed parallel to the direction of stress. All welding shall be performed by competent welders using low hydrogen welding electrodes or consumables which are listed in the ALDOT "Materials, Sources, and Devices with Special Acceptance Requirements” manual. The Engineer

shall be the sole judge as to the acceptability of the repair work, and unacceptable work shall be cause for rejection of a member.

4. A form of buffer and/or shield shall be utilized during fitting operations to protect base materials from damage caused by fitting tools or devices. If evidence of base metal damage appears due to misuse of such devices, the material may be deemed unacceptable.

(b) DETAILS.

1. Bends and crimps shall conform to wood or metal templates. All bending or crimping shall be done to the bend lines shown on the plans by a mechanically operated press without avoidable or unnecessary decrease in section.

2. All material shall be bent cold when practical. Cold bending of rolled steel plates shall conform to the following:

a. They shall be so taken from the stock plates that the bending line will be at right angles to the direction of rolling.

b. The radii of bends, measured to the concave face of the metal, shall not be less, and preferably shall be greater, than shown in the following table.

Plate Thickness "t"	Bend Radii For All Grades of Steel
t ≤ 1/2 in {t ≤ 12 mm}	2t
1/2 in. < t ≤ 1 in. {12 mm < t ≤ 25 mm}	2.5t
1 in. < t ≤ 1.5 in. {25 mm < t ≤ 38 mm}	3t
1.5 in. < t ≤ 2.5 in. {38 mm < t ≤ 60 mm}	3.5t
2.5 in. < t ≤ 4 in. {60 mm < t ≤ 100 mm}	4t

If a shorter radius is essential, the plates shall be bent hot. Hot-bent plates shall conform to requirement Item 1 above.

c. Before bending, the corners of the plate shall be rounded to a radius of 1/16 inch {1.6 mm} throughout that portion of the plate at which the bending is to occur.

3. When hot bending is necessary, the metal shall be carefully heated to a temperature not to exceed 1100 °F {590 °C}. as evidenced by heat crayons or other approved means. Material that has been heated shall be slowly cooled after the bending has been completed.

4. Material that is overheated, fractured, or otherwise injured or damaged shall be rejected.

(c) CAMBER OR CURVING OF BEAMS AND GIRDERS.

Camber in rolled beams shall be accomplished by the heat up-set method utilizing the lowest possible temperature not to exceed 1100 °F {590 °C}, as evidenced by heat crayons (furnished by the Fabricator). The application of heat shall be carefully supervised using a method acceptable to the Engineer.

Camber for built-up girders shall be accomplished by cutting the web to the prescribed camber with suitable allowance for shrinkage due to cutting and welding. However, moderate variation from the prescribed camber tolerance may be corrected by a carefully supervised application of heat not to exceed 1100 °F {590 °C}. as evidenced by heat crayons (furnished by the Fabricator) utilizing a method acceptable to the Engineer.

Horizontal curving of rolled beams shall be accomplished by the heat up-set method which will require a written procedure approved by the Engineer. Said procedure shall utilize the lowest temperature possible but not in excess of 1100 °F {590 °C} as evidenced by heat crayons (furnished by the Fabricator).

Horizontal curving of built-up girders shall be accomplished by cutting flange plates to the radii shown by the plan details from wider plates, unless the heat up-set method is allowed by the plans or proposal. When the heat up-set method is allowed, such will require a written procedure approved by the Engineer. Said procedure shall utilize minimum temperatures not to exceed 1100°F {590 °C} as evidenced by heat crayons (furnished by the Fabricator).

After heating of metals as noted, the metal shall not be artificially cooled until after naturally cooling to 600°F {315 °C}. or less. The method of artificial cooling must be acceptable to the Engineer. Water or water spray misting shall not be used as a means of artificial cooling. Any material that is heated above the temperature limit noted will be rejected until tests and investigations reveal the material is suitable for use. The Fabricator shall be solely responsible for providing any test data or

other information deemed necessary by the Engineer to evaluate the acceptability of the material at no cost to the Department.

The fabricator's Quality Control Inspector shall furnish verification certificates of the actual measurements of the camber, overall length and horizontal sweep placed in each beam or girder. Actual measurements shall be verified and recorded by the Fabricator's Quality Control Inspector.

836.20 Thermal Cutting.

Steel may be thermal cut, provided a smooth surface is secured by the use of a mechanical guide. Thermal cutting by hand shall be done only when approved, and the surface shall be made smooth by planing, chipping or grinding. Re-entrant cuts shall be filleted to a radius of not less than 3/4 inch {19 mm}.

Defects in cut edges shall not be repaired by welding except with approval of the Engineer for occasional notches or gouges less than 7/16 inch {11 mm} deep for material up to 4 inches {100 mm} thick and less than 5/8 inch {16 mm} for material over 4 inches {100 mm} thick. Such weld repairs shall be made by suitably preparing the defect, welding with low hydrogen electrodes not exceeding 5/32 inch {4 mm} in diameter, observing the applicable requirements of Departmental welding requirements and grinding the completed weld smooth and flush with the adjacent surface to produce a workmanlike finish.

Other methods of cutting steel may be approved for use provided the method will produce cut surfaces within the required tolerances for thermal cut surfaces.

836.21 Substitutions.

Substitutions of sections having different dimensions than those shown on the plans shall be made only when approved in writing.

836.22 Fastener Holes.

(a) GENERAL.

Holes for connections in material forming a part of the section for main members shall be (1) subdrilled and while assembled, reamed or drilled to full size, or (2) shall be drilled full size from the solid while assembled onto a steel template with hardened steel bushings in holes accurately dimensioned from the centerlines of the connection. Refer to Section 836.01 for the definition of main member material.

All holes for floorbeam end connections, crossframes, jacking frames, longitudinal, and sway bracing end connections shall be subpunched and reamed to a steel template (not less than one inch in thickness) or reamed while assembled and match-marked. Templates used for connections on like parts or members shall be so accurately located that the parts or members are duplicates and require no match-marking. Numerically controlled drilling or punching equipment may be used in lieu of the hardened steel bushing template when approved by the Engineer. Holes produced using numerically controlled equipment shall meet the accuracy requirements of Subarticle 836.22(d).

All other holes may be punched with a die full size provided each thickness of material is not greater than the nominal diameter of the fastener nor greater than 3/4 inch {20 mm} for carbon steel, 5/8 inch {16 mm} for high strength steel, 1/2 inch {13 mm} for quenched and tempered alloy steel. The diameter of the die shall not exceed the diameter of the punch by more than 1/16 inch {1.6 mm}. Holes shall be clean cut and without torn or ragged edges. If the thickness of the material is greater than the nominal diameter of the fastener or greater than the thickness shown above, the holes shall either be subdrilled and reamed or drilled full size.

The tolerance for standard, slotted, or oversize holes shall be as follows:

All holes in a connection may be oversize or slotted by 1/32 inch {0.8 mm}.

In any connection, 10% of the holes may be oversized or slotted by 1/16 inch {1.6 mm}.

Any further deviation in the hole size will be referred to the Engineer or his representative for approval.

Plug welding of any mis-located or mis-sized hole is not allowed. Any evidence of plug welding will be cause for the rejection of the material

Completed holes, whether drilled or punched, shall be 1/16 inch larger than the nominal diameter of the fastener. Burrs on the metal surfaces shall be removed. Members drilled while assembled shall be securely held in correct position while being drilled.

(b) ACCURACY OF PUNCHED HOLES.

1. If the Engineer finds that the punched work does not comply with requirements hereinafter provided, it may be required that any or all holes be (1) subpunched (or subdrilled) and either reamed or drilled to full size or (2) drilled full size from the solid. All subpunched holes shall be 3/16 inch {4.8 mm} smaller than the nominal diameter of the fastener.

2. The punched holes shall be so accurately punched that after assembling (before any reaming is done) a cylindrical pin 1/8 inch {3 mm} smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same surface or in like proportion for any group of holes. If this requirement is not fulfilled, the badly punched pieces will be rejected. If any hole will not pass a pin 3/16 inch {4.8 mm} smaller in diameter than the nominal size of the punched hole, this will be cause for rejection.

(c) SHOP ASSEMBLY.

Bolted trusses, arches, continuous beam spans and plate girders shall be assembled in the shop either in an upright position or on their side. After the members have been adjusted to line and fit with proper camber and rigidly fastened (i.e., drift pinned) together, the holes for field connections shall be reamed or drilled.

Filler plates for bolted beam and girder splices have been based on theoretical dimensions. The thickness of the plates shall be adjusted in the shop to take care of any difference greater than 1/16 inch {1.6 mm} between the theoretical and actual dimensions. Splices in members of the same theoretical size will require filler plates if the actual dimensions vary more than 1/16 inch {1.6 mm}.

After assembling, sub-punched or sub-drilled holes shall be reamed to a diameter 1/16 inch {1.6 mm} larger than the nominal diameter of the fastener. Reaming shall be done after all the pieces to be connected are assembled and firmly fastened together. Reaming of fastener holes shall be done with twist drills or with short taper reamers. Where practicable, reamers shall be directed by mechanical means. Burrs resulting from reaming or drilling shall be removed.

(d) ACCURACY OF REAMED OR DRILLED HOLES.

Reamed or drilled holes shall be cylindrical and perpendicular to the member and their accuracy shall be the same as provided for punched holes (Subarticle 836.22(b)) except that, after reaming or drilling, 85 percent of the contiguous holes in the same surface, or in like proportion for any group of holes, shall not show an offset greater than 1/32 inch {0.8 mm} between adjacent thickness of metal. There shall be no drifting in the shop or field to enlarge mismatched holes. If any holes must be enlarged to admit the fastener, they shall be reamed.

(e) EDGE DISTANCE OF FASTENERS.

1. The minimum distance from the center of any fastener to a sheared or flame cut edge shall be:

1" Fastener: 1-3/4" {45 mm}; 7/8" Fastener: 1-1/2" {38 mm}; 3/4" Fastener: 1-1/4" {32 mm}; 5/8" Fastener: 1-1/8" {29 mm}.

The minimum distance from the center of any fastener to a rolled or planed edge, except in flanges of beams and channels, shall be:

1" Fastener: 1-1/2" {38 mm}; 7/8" Fastener: 1-1/4" {32 mm}; 3/4" Fastener: 1-1/8" {29 mm}; 5/8" Fastener: 1" {25 mm}.

In the flanges of beams and channels the minimum distance from the center of the fastener to a edge shall be:

1" Fastener: 1-1/4" {32 mm}; 7/8" Fastener: 1-1/8" {29 mm}; 3/4" Fastener: 1" {25 mm}; 5/8" Fastener: 7/8" {22 mm}.

2. When enlarged or slotted holes are used the distance between edges of adjacent holes shall not be less than three times the diameter of the fastener minus the nominal diameter of the hole. The distance to an edge shall not be less than the amount shown in Item 836.22(e)1. minus 1/2 the nominal diameter of the hole.

836.23 Through 836.26 Blank.

836.27 Shop Assembling.

(a) GENERAL.

All surfaces of metal that will be in contact when assembled shall be cleaned before assembly but shall not be painted unless otherwise specified by plan details.

No temporary welds for fitting aids or for other purposes will be allowed unless shown on the approved drawings.

All welding (including stiffeners) shall be completed on beams or girders before they are put into laydown and/or assembled.

(b) ASSEMBLING.

1. Before the reaming or drilling of any holes in a splice for continuous beam spans, continuous plate girder spans and stringer beams, is done, a "laydown", consisting of at least three contiguous shop sections or all members in at least three contiguous panels but not less than the number of panels associated with three contiguous chord lengths (lengths between field splices) and not less than 150 feet {46 m} in the case of structures longer than 150 feet {46 m}, shall be required. All individual members (girders and beams) which require horizontal curvature shall be processed in the laydown with the required curvature. Shop assembly may proceed so long as one section of the minimum size "lay down" has been satisfactorily assembled in a preceding "lay down."

All trusses shall be assembled in the shop.

All expansion dams (finger joints) shall be assembled in the shop. Expansion dams shall be shipped assembled, including troughs, unless otherwise shown on the plans.

For structures having curved girders, girders with integral steel caps, extreme skews in combination with severe grade or camber, or other complex characteristics, the plans may direct that the entire structure, including the floor system, be assembled in the shop. The assembly, including camber, alignment, accuracy and fit of joints, shall be approved by the fabricator's Quality Control Inspector before reaming or drilling is commenced.

2. The parts of a member shall be assembled, properly aligned with drift pins, and firmly drawn together with bolts before reaming or shop fastening is commenced. Assembled pieces shall be taken apart for the removal of burrs and shavings produced by reaming or drilling operation. The member shall be free from twists, bends and other deformations.

3. Preparatory to the shop fastening of full-sized punched material, the fastener holes, if necessary, shall be spear-reamed for the admission of the fastener. The reamed or drilled holes shall not be more than 1/16 inch {1.6 mm} larger than the nominal diameter of the fastener.

4. Abutting joints in compression members, where so specified on the drawings, shall be faced and brought to an even bearing. No milling shall be done until members are completely shop assembled, unless otherwise provided on the plans. Where joints are not faced, the opening shall not exceed 3/8 inch {9.5 mm}.

5. Field splice plates and filler plates shall be bolted to girders and/or beams, at the locations shown on the approved shop drawings, in the fabrication shop after cleaning (blasting) and coating (painting) of both pieces to be joined.

836.28 Blank.

836.29 Match-Marking.

Connecting parts assembled in the shop for the purpose of reaming or drilling holes in field connections shall be match-marked with a steel die using figures and letters at least 3/8 inch {10 mm} high, and a diagram showing such marks shall be furnished to the Engineer. Reamed parts shall not be interchanged.

836.30 Rivets.

In removing rivets, care shall be taken not to injure the adjacent metal, and, if necessary, they shall be drilled out.

836.31 Blank.

836.32 Bolts, And Bolted Connections.

(a) GENERAL.

1. This Article does not pertain to the use of high strength bolts.

2. Unfinished and turned bolts and nuts shall conform to the requirements for Grade "A" bolts of ASTM A 307 unless otherwise specified.

3. The holes shall be truly cylindrical. Holes shall be at right angles to the surface of the metal so that both head and nut will bear squarely-against the metal.

4. The heads and nuts shall be drawn tight against the work with a suitable wrench. Where bolts are to be used in beveled surfaces, beveled washers shall be provided to give full bearing to the head or nut. All bolts shall have cut threads neatly and accurately finished.

5. Permanent unfinished or turned bolts shall have single self-locking nuts or double nuts, unless otherwise shown on the plans.

(b) UNFINISHED BOLTS.

Bolts transmitting shear shall be threaded to such a length that not more than one thread will be within the grip of the metal. The bolts shall be of such length that they will extend entirely through their nuts, but not more than 1/4 inch {6 mm} beyond them.

(c) TURNED BOLTS.

1. Holes for turned bolts shall be carefully reamed and the bolts turned to a light driving fit with the threads entirely outside of the holes and under the washer, and a washer shall be used. The heads and nuts shall be hexagonal.

2. The surface of the body of turned bolts shall meet the ANSI roughness rating value of 125 {3.2 μm}

3. Bolts shall be driven accurately into the holes without damaging the thread. A snap shall be used to prevent damaging the threads.

836.33 High Strength Fasteners.

The components of high strength bolt assemblies shall meet the requirements of the following:

AASHTO M 164 {M 164M} - Bolts & Nuts
AASHTO M 292 {M 292M} - Nuts
AASHTO M 291 {M 291M} - Nuts
AASHTO M 293 {M 293M} - Washers
ASTM F 959 - Direct Tension Indicators

Unless otherwise noted by plan details, or approved by the Engineer, Type 1 bolts shall be used for standard construction and Type 3 bolts shall be used with weathering steel.

Galvanization, where required shall be in accordance with the provisions of AASHTO M 298 Class 50. When an Inorganic Zinc Paint Primer is specified on the contract plans, all bolts shall be galvanized.

The producer, supplier and distributor shall submit the documentation required to certify that the bolt assembly components are in compliance with these specifications.

These requirements shall be modified or supplemented as follows:

(a) QUALITY ASSURANCE.

Acceptance of bolts, nuts, washers and direct tension indicator washers shall be based on the "Production Lot Method" of identification and quality assurance. A production lot is a group of bolts, nuts, washers or load indicator washers that are the same nominal size, are produced from the same heat of steel and are processed together through all operations to the shipping container. The manufacturer shall identify and maintain the integrity of each production lot from raw-material selection through all processing operations and treatments to final packing and shipment.

(b) MANUFACTURING.

1. BOLTS.

Bolts shall meet the hardness requirements given in ASTM A 325 {A 325M}.

2. NUTS.

Nuts to be galvanized shall be heat treated grade 2H, DH, or DH3.

Plain (ungalvanized) nuts shall be grades 2, C, D or C3 with a minimum Rockwell hardness of 89 HRB (or Brinell hardness 180 HB), or heat treated grades 2H, DH, or DH3. (The hardness requirements for grades 2, C, D and C3 exceed the current AASHTO/ASTM requirements).

Nuts that are to be galvanized shall be tapped oversize the minimum amount required for proper assembly. The amount of overtap in the nut shall be such that the nut will turn freely on the bolt in the coated condition. Galvanized nuts shall meet the mechanical requirements of AASHTO M 291 and the rotational-capacity test herein (the overtapping requirements of AASHTO M 291 paragraph 7.4 shall be considered maximum values instead of minimum, as currently shown).

3. MARKING.

All bolts, nuts and washers shall be marked in accordance with the appropriate AASHTO/ASTM Specifications.

(c) TESTING.

1. BOLTS.

Proof load tests (ASTM F 606 Method 1) are required. Minimum frequency of tests shall be as specified in AASHTO M 164 paragraph 9.2.4.

Wedge tests on full size bolts (ASTM F 606 paragraph 3.5) are required. If bolts are to be galvanized, tests shall be performed after galvanizing. Minimum frequency of tests shall be as specified in AASHTO M 164 paragraph 9.2.4.

If galvanized bolts are supplied, the thickness of the zinc coating shall be measured. Measurements shall be taken on the wrench flats or top of bolt head.

2. NUTS.

Proof load tests (ASTM F 606 paragraph 4.2) are required. Minimum frequency of tests shall be as specified in AASHTO M 291 paragraph 9.3 or AASHTO M 292 paragraph 7.1.2.1. If nuts are to be galvanized, tests shall be performed after galvanizing, overtapping and lubricating.

If galvanized nuts are supplied, the thickness of the zinc coating shall be measured. Measurements shall be taken on the wrench flats.

3. WASHERS.

If galvanized washers are supplied, hardness testing shall be performed after galvanizing. (Coating shall be removed prior to taking hardness measurements).

The thickness of the zinc coating shall be measured.

4. ASSEMBLIES.

Rotational-capacity tests are required and shall be performed on all plain and galvanized (after galvanizing) bolt, nut and washer assemblies by the manufacturer or distributor prior to shipping. Washers are required as part of the test.

The following shall apply:

a. Except as modified herein, the rotational-capacity test shall be performed in accordance with the requirements of AASHTO M 164.

b. Each combination of bolt production lot, nut lot and washer lot shall be tested as an assembly. Where washers are not required by the installation procedures, they need not be included in the lot identification. A production lot change of either the bolt, nut, or washer shall require the testing of additional assemblies.

c. A rotational-capacity lot number shall be assigned to each combination of lots tested.

d. The minimum frequency of testing shall be two assemblies per rotational-capacity lot.

e. The bolt, nut and washer assembly shall be assembled in a Skidmore-Wilhelm Calibrator or an acceptable equivalent device (note - this requirement supersedes the current AASHTO M 164 requirement that the test be performed in a steel joint). For short bolts which are too short to be assembled in the Skidmore-Wilhelm Calibrator, See Subitem 836.33(c)4.i.

f. The minimum rotation, from a snug tight condition (10% of the specified proof load), shall be:

240° (2/3 turn) for bolt lengths < 4 diameters
360° (1 turn) for bolt lengths > 4 diameters and < 8 diameters
480° (1 1/3 turn) for bolt lengths > 8 diameters
(Note: These values differ from the AASHTO M 164 Table 8).

g. The tension reached at the above rotation shall be equal to or greater than 1.15 times the required installation tension. The installation tension and the tension for the turn test are shown below:

Diameter (In.)	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
Req. Installation Tension (kips)	12	19	28	39	51	56	71	85	103
Turn Test Tension (kips)	14	22	32	45	59	64	82	98	118

Diameter {mm}	16	20	22	24	27	30	36
Req. Installation Tension {kN}	94.2	147	182	212	275	337	490
Turn Test Tension {kN}	108.3	169.1	209.3	243.8	316.3	387.6	563.5

h. After the required installation tension listed above has been exceeded, one reading of tension and torque shall be taken and recorded. The torque value shall conform to the following:

$$\text{Torque} \leq 0.25\ PD$$

Where: Torque = measured torque (foot-pounds); P = measured bolt tension (pounds) and D = bolt diameter (feet).

i. Bolts that are too short to test in a Skidmore-Wilhelm Calibrator may be tested in a steel joint. The tension requirement of Subitem 836.33(c)4.g. need not apply. The maximum torque requirement of Subitem 836.33(c)4.h. shall be computed using a value of P equal to the turn test tension shown in the table in Subitem 836.33(c)4.g.

5. REPORTING.

The results of all tests (including zinc coating thickness) required herein and in the appropriate AASHTO specifications shall be recorded.

The location where tests are performed and the date of tests shall be recorded.

(d) DOCUMENTATION.

1. MILL TEST REPORT(S) (MTR).

An MTR shall be furnished for all mill steel used in the manufacture of the bolts, nuts, and washers.

The place where the material was melted and manufactured shall be shown on the MTR.

2. MANUFACTURER CERTIFIED TEST REPORT(S) (MCTR).

The manufacturer of the bolts, nuts and washers shall furnish test reports (MCTR) for the item furnished.

Each MCTR shall show the relevant information required in accordance with Item 836.33(c)5.

The manufacturer performing the rotational-capacity test shall include on the MCTR:

a. The lot number of each of the items tested.
b. The rotational-capacity lot number as required in Subitem 836.33(c)4.c.
c. The results of the tests required in Item 836.33(c)4.
d. The pertinent information required in Item 836.33(c)5.
e. A statement that MCTR for the items are in conformance to this specification and the appropriate AASHTO specifications.
f. The location where the bolt assembly components were manufactured.

3. DISTRIBUTOR CERTIFIED TEST REPORT(S) (DCTR).

The DCTR shall include MCTR above for the various bolt assembly components.

The rotational-capacity test may be performed by a distributor (in lieu of a manufacturer) and reported on the DCTR.

The results of the tests required in Item 836.33(c)4. shall be shown on the DCTR.

The pertinent information required in Item 836.33(c)5. shall be shown on the DCTR.

The rotational-capacity lot number as required in Subitem 836.33(c)4.c. shall be shown on the DCTR.

The DCTR shall contain a statement that the MCTR are in conformance to this specification and the appropriate AASHTO specifications.

(e) SHIPPING.

Bolts, nuts and washers from each rotational-capacity lot shall be shipped in the same container. If there is only one production lot number for each size of nut and washer, the nuts and

washers may be shipped in separate containers. Each container shall be permanently marked with the rotational- capacity lot number such that identification will be possible at any stage prior to installation.

836.34 Sheared Edges.

Sheared edges of plates more than 5/8 inch {16 mm} in thickness shall be planed to a depth of 1/4 inch {6 mm}. Plates 5/8 inch {16 mm} and less in thickness shall be ground to remove sharp corners and burrs.

Re-entrants corners shall be filleted to a minimum radius of 3/4 inch {19 mm} before cutting.

836.35 Facing Of Bearing Surfaces.

The top and bottom surfaces of steel slabs and base plates and cap plates of columns and pedestals shall be planed, or else the plates or slabs hot-straightened. Parts of members in contact with them shall be faced and shall have full contact when assembled.

For fit-up of sole plates or bearing seats of beams or girders see Article 836.46. Sole plate and masonry plate corrections may be made by planing or hot-straightening. In planing the surface of expansion bearings, the cut of the tool shall be in the direction of expansion.

Cast pedestals shall be planed on surfaces to be in contact with steel, and the surface to be in contact with masonry rough finished.

The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall meet the ANSI surface roughness requirements as defined in ANSI B46.1, Surface Roughness, Waviness and Lay, Part I unless otherwise specified,

Steel slab in contact with Masonry	ANSI 2000 {50 μm}
Steel slabs	ANSI 2000 {50 μm}
Heavy plates in contact in shoes to be welded	ANSI 1000 {25 μm}
Milled ends of compression members, milled or ground ends of stiffeners and fillers	ANSI 500 {12.5 μm}
Bridge rollers and rockers	ANSI 250 {6.3 μm}
Pins and pin holes	ANSI 125 {3.2 μm}
Sliding bearings	ANSI 125 {3.2 μm}

Surfaces of bronze bearing plates intended for sliding contact shall be carefully milled and polish finished.

836.36 Blank.

836.37 Blank.

836.38 Finished Members.

These shall be true to line and free from twists, bends, and other defects.

836.39 Blank.

836.40 Blank.

836.41 Stress Relieving.

Members such as bridge shoes or pedestals which are built-up by welding sections of plates together shall be stress relieved in accordance with the provisions of paragraph 4.4 of ANSI/AASHTO/AWS-D1.5-95 unless an alternate method has the written approval of the Bridge Engineer.

836.42 Pins And Rollers.

(a) GENERAL.

Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth, and free from flaws. Pins and rollers more than 9 inches {228 mm}in diameter shall be forged and annealed, pins and rollers 9 inches {228 mm}or less in diameter may be either forged and annealed or cold finished carbon steel shafting. Pins and roller material shall conform to one of the following unless a specific Grade or Class is specified by plan details:

4" { 100 mm} in Diameter or less.....AASHTO M 169*, Grade 1016 to 1030, Inclusive
0" to 20" { 0 mm to 508 mm} in diameter.....AASHTO M 102, Class C, Class D or Class G**
0" to 10" { 0 mm to 254 mm} in diameter.....AASHTO M 102, Class F

* This material shall provide the following minimum values:
Yield - 36,000 psi {250 MPa}
Stress in extreme Fiber - 29,000 psi {200 MPa}
Shear - 14,000 psi {97 {MPa}
Bearing on Pins not subject to rotation 29,000 psi {200 MPa}
Bearing on Pins subject to rotation 14,000 psi {97 MPa}

** Rolled material with the same properties may be substituted for this class.

In pins larger than 9 inches {228 mm} in diameter, a hole not less than 2 inches {50 mm} in diameter shall be bored full length along the axis after the forging has been allowed to cool to a temperature below the critical range under suitable conditions to prevent injury by too rapid cooling, and before being annealed.

Two pilot nuts and two driving nuts shall be furnished for each size pin, unless otherwise provided by plans or directed.

The diameter of pins and rollers shall not exceed 1/16 inch {1.6 mm} plus or minus from the diameter specified by the plans or ordered by the Engineer.

(b) BORING PIN HOLES.

Pin holes shall be bored true to gage, smooth and straight, at right angles with the axis of the member and parallel with each other unless otherwise shown on the plans. Pins shall be parallel to each other unless otherwise shown on the plans. The final surface shall be obtained by a finishing cut. Boring of holes in built up members shall be done during the final lay down operation.

(c) PIN CLEARANCE.

The diameter of the pin holes except as noted in Item 836.01(b)3 shall not exceed that of the pin by more than 1/50 inch {0.50 mm} for pins 5 inches {127 mm} or less in diameter or 1/32 inch {0.80 mm} for larger pins.

836.43 through 836.45 Blank.

836.46 Welds.

(a) GENERAL.

Welding of Structural Steel shall not be done unless required or permitted by the plans, proposal, or the Specifications. The Contractor shall examine this provision and documents referenced thereto, and any provisions which are not clearly understood shall be referred to the Department for interpretation prior to bidding.

Shop welding shall be performed by Submerged Arc Welding (SAW) in accordance with the specification noted herein. In the event the above method can not be used, approved manual welding or other approved and qualified automatic or semi-automatic methods may be authorized. The use of electroslag or electrogas welding on a member will not be permitted; the use of such shall cause rejection of the member.

Field Welding shall be performed by manual Shielded Metal Arc Welding (SMAW) using approved electrodes and procedures in accordance with the specifications noted herein.

If a minimum of 3 inches (75 mm} of excess material beyond the theoretical end cuts does not exist, extension bars or run-off tabs shall be used at girder ends to insure sound welds on web to flange welds. Extension bars or run-off tabs shall also be used at the ends of all full-penetration weld butt-splicing operations.

All welding shall be subject to the inspection and approval of the Engineer or his representative. During inspection of the work any workman, including welders and inspection technicians, who, in the opinion of the Engineer, produces inferior work, may under the provision of Article 108.06 be disqualified from performing Departmental work.

All welding shall be in accordance with the American National Standards Institute, American Association of State Highway and Transportation Officials, American Welding Society (ANSI/AASHTO/AWS) Bridge Welding Code D1.5-95, as modified by the following:

Paragraph 1.3.6. shall be amended by the deletion of bearings and expansion dams from the list of ancillary products.

Article 3.1. A new sentence shall be added to paragraph 3.1.3 as follows:

"Shop welding, except for minor secondary members and minor repair welding, shall be done under a cover of a permanent structure and/or building capable of protecting the actual welding operation from inclement weather. Any standing water that would be dangerous to the welder or operator or to the integrity of the weld itself shall be cause for the welding to stop until such time as the situation is corrected."

Article 3.1 shall be further amended by the addition of a new Paragraph 3.1.6 given below.

"Paragraph 3.1.6. Intersecting welds will not be allowed unless shown by plan details or approved by the Engineer."

Paragraph 3.2.1. A new sentence shall be added to Paragraph 3.2.1 as follows:

"On web plates and flange plates of plate girders, surfaces of fusion areas of web to flange fillet welds shall be ground to bright metal to remove all scale, rust or foreign matter."

Paragraph 3.2.3.5. This paragraph shall be deleted and the following substituted in lieu thereof:

"Paragraph 3.2.3.5. Edges of base metal shall be inspected, and required repairs shall be completed as early as feasible in the fabrication sequence (prior to assembly) so as to allow maximum opportunity for the fabricator to incorporate repaired plates in the least critical areas."

Paragraph 3.2.9. This paragraph shall be deleted and the following substituted in lieu thereof:

"Paragraph 3.2.9. All corners of thermal cut or sheared edges, including edges of flanges of beams and girders along with splice material and other sharp edges deemed undesirable by the Engineer on structural members designated to be coated shall be slightly rounded. Said rounding shall be accomplished by light grinding to produce a satisfactory surface for painting (approximately 1/16 inch {1.6 mm} radius). The grinding shall be performed in such a manner as to produce a neat workmanship like product without nicks or notches in the metal."

Paragraph 3.3.7.3. This paragraph shall be deleted and the following substituted in lieu thereof:

"Paragraph 3.3.7.3 "Tack welds not incorporated into the final weld shall not be used. Tack welds which have cracked shall be removed to the satisfaction of the ALDOT inspector. After removal of the cracked tack weld, the area shall be examined by the use of MT or PT to assure the crack was totally removed."

A new paragraph 3.3.11 shall be added as follows:

"Paragraph 3.3.11. Cover plates on beams and built-up girders shall have their side fillets welded simultaneously."

Paragraph 3.5.1.2. This paragraph shall be deleted and the following substituted in lieu thereof:

"Permissible variations in straightness of welded beams or girders, regardless of cross section, where there is no specified camber or sweep, shall not exceed:

$$1/8 \text{ inch} \quad X \quad \frac{\text{Number of Feet From Nearest End}}{10}$$

{1 mm X Number of Meters From Nearest End}

Paragraph 3.5.1.3. This paragraph and Tables 3.2 and 3.3 shall be deleted and the following substituted in lieu thereof:

"Paragraph 3.5.1.3. Permissible variation in specified camber of beams or girders, regardless of cross section, shall not exceed:

$$- 0, + 1/8 \text{ inch} \quad X \quad \frac{\text{Number of Feet From Nearest End}}{10}$$

{-0, 1 mm X Number of Meters From Nearest End}

Note: 3.5.1.3 applies to fabricated pieces before erection.

Paragraph 3.5.1.4. This paragraph shall be deleted and the following substituted in lieu thereof:

"Permissible variation in specified sweep for horizontally curved welded beams or girders is:

$$\pm 1/8 \text{ inch} \quad X \quad \frac{\text{Number of Feet From Nearest End}}{10}$$

{±1 mm X Number of Meters From Nearest End}

provided the member has sufficient lateral flexibility to permit the attachment of diaphragms, cross-frames, lateral bracing, etc., without damaging the structural member or its attachments. The permissible difference in the horizontal curvature between the top and bottom flanges at any point along a member shall not exceed 3/8 inch {9.5 mm}."

Paragraph 3.5.1.9. This paragraph shall be deleted and the following substituted in lieu thereof:

"Paragraph 3.5.1.9.1. The bearing ends of bearing stiffeners (grind to bear or mill to bear) shall be flush and square with the web. At least 75% of the end area of the bearing stiffeners shall be in contact with the inner surfaces of the flanges.

Paragraph 3.5.1.9.2 The angle between the web and flange shall not exceed 90° in the bearing length.

Paragraph 3.5.1.9.3. Gaps shall not exceed 0.040 inches {1.0 mm) between the contact surfaces at the bottom flanges of beams or girders and steel bearing plates. There shall be no gap for at least 75% of this contact area."

Paragraph 3.7.2. A new paragraph 3.7.2.5 shall be added as follows:

"Paragraph 3.7.2.5. Number of Repairs to Same Area of a Weld. The number of repairs to the same area of a weld shall be limited to two (2) after which a new written weld repair procedure will be required before additional repairs will be permitted."

Paragraph 3.7.7. This paragraph shall be deleted and the following substituted in lieu thereof:

"Paragraph 3.7.7. Mislocated holes shall be brought to the attention of the Bridge Engineer or his representative for a determination of the need for a repair or corrective procedure. Any repair or corrective procedure shall be submitted to the Bridge Engineer for his approval prior to the work being performed.

Paragraph 3.11.1 A new sentence shall be added to Paragraph 3.11.1 as follows:

"Carbon-arc or thermal cut boundaries and back gouged surfaces for groove welds shall be ground to a smooth, bright surface before welding. Butt welds shall be finished flush in the direction of stress unless otherwise allowed by the plans."

Paragraph 3.13.5. This paragraph shall be deleted and the following substituted in lieu thereof:

"Paragraph 3.13.5. Groove and fillet welds may be backed by flux, glass tape, iron powder or similar materials to provide an appropriate back-bead shape or to prevent melting through. Roots of welds may also be sealed by means of root passes deposited with SMAW low-hydrogen electrodes or by other approved arc WPSs.

Welds made against backing other than base metal or approved low-hydrogen weld metal shall be subject to WPS qualification testing under the provisions of 5.13 and approval by the Engineer.

Note: In SAW, flux that fills gaps not exceeding 3/16 in. between adjacent parts is not considered to be backing and shall not require WPS qualification testing."

Paragraph 4.5.2. The following additional sentences shall be added to Paragraph 4.5.2:

"Drying and storage ovens shall be electric and of sufficient size to accommodate a days supply of electrodes. Drying ovens shall be equipped with a recording thermometer; holding ovens shall have a visible thermometer."

A New Paragraph including 4.9.5, 4.10.7, and 4.11.7 shall be added as follows:

"Paragraph 4.9.5. (SAW – single electrode), 4.10.7 (SAW – parallel electrodes), 4.11.7 (SAW – multiple electrodes). A properly operated heating torch shall run immediately ahead (about 12 inches {300 mm}, and on the same side, in advance of the point of welding) of the submerged arc welding head to remove moisture from the steel in the vicinity of the weld when making web to flange fillet welds of plate girders. Gases which produce moisture in burning will not be permitted unless it can be shown that the resultant temperature of the metal is sufficient to vaporize any moisture that might be present."

A New Paragraph 4.27.3 shall be added as follows:

"Paragraph 4.27.3. Amperage and wire feed speeds shall be shown on the WPS."

A New Paragraph 5.21.1 shall be added as follows:

"Paragraph 5.21.1. It is the Departmental policy to observe the welding and testing of the specimens; hence, the fabricator shall qualify its welders in the presence of an ALDOT representative. However, in certain cases, at the discretion of the Engineer, fabricating shops may be allowed to prequalify its welders, welding operators and tackers in accordance with these Specifications and certify to the Engineer that the welder, welding operator or tacker has been

prequalified. The certificate shall state that the welder, welding operator or tacker has been doing satisfactory welding of the required type within the six month period previous to the subject work. A certification shall be submitted for each welder, welding operator or tacker stating the name of the welder, welding operator or tacker, the name and title of the person who conducted the examination, the kind of specimens, the position of welds, the results of the tests and the date of the examination. Certifications shall also contain signatures bearing evidence of third party witness and or testing of test specimens. (For example: Independent testing agency and/or representative of another State DOT). Such a certification of prequalification may also be accepted as proof that a welder, welding operator and tacker on field welding is qualified, if the Contractor who submits it is properly staffed and equipped to conduct such an examination or if the examining and testing is done by a recognized agency which is staffed and equipped for such purpose. The fabricator shall provide a listing of all current ALDOT qualified welders in their organization to the Bridge Engineer's representative."

A New Paragraph 5.21.2 shall be added as follows:

"Paragraph 5.21.2. It is the Departmental policy to observe and test all field welders; hence, a Departmental representative shall be present to witness the welding of the test plates and the testing of the specimens, if tested by other than Departmental personnel, unless otherwise authorized in writing by the Engineer."

A New Paragraph 6.3.3 shall be added as follows:

"Paragraph 6.3.3. Each welding machine shall have its approved welding procedure specification (WPS) posted on the machine."

Paragraph 6.7.1, 6.7.1.1, and 6.7.1.2 shall be deleted in its entirety and the following substituted in lieu thereof:

"Paragraph 6.7.1 - Groove welds shall be tested by radiographic testing (or ultrasonic testing with approval of the engineer) in accordance with the following:

"6.7.1.1 - Shop Welds.

100% of all butt weld splices in the following: all flanges (tension and compression) of beams and girders, all flanges of floorbeams, all members of floorbeam trusses which support stringer beams, all flanges of steel bent caps; and all chords, diagonals and verticals of trusses.

50% of all vertical butt weld splices in webs of beams, girders, floorbeams, and steel bent caps. This requirement shall consist of 25% of the web depth beginning at the top of the web plate and 25% of the web depth beginning at the bottom of the web plate. If rejectable discontinuities are found in the vertical butt welded splices, the remainder of the weld shall be tested.

15% of each longitudinal butt weld splice in the webs of beams, girders, floorbeams, and steel bent caps, and in truss members. This requirement shall consist of 5% of weld length at each end of each plate and 5% of the weld length at the center of the plate (each plate is defined as that portion of web between vertical splices either welded or bolted).If rejectable discontinuities are found in a partially radiographed longitudinal joint, additional radiographs of that joint shall be made as required by the Engineer.

100% of all full-penetration welds used at the ends of longitudinal stiffeners welded to girder webs and the full-penetration welds used to splice the longitudinal stiffeners.

All repairs of radiographed joints shall be reradiographed in the area of the repair.

6.7.1.2. - Field Welds.

100% of all butt welds in beams, girders, floorbeams, steel bent caps; and chords, diagonals, and verticals of trusses.

All repairs of radiographed joints shall be reradiographed in the repair area."

Paragraph 6.7.2.3. This paragraph shall be deleted and the following substituted in lieu thereof:

"Paragraph 6.7.2.3. Magnetic-particle inspection of fillet welds in all main member material is required. The definition of main member materials is given in Item 836.01(b)1. The amount of required testing is given in AWS 6.7.2.1."

A New Paragraph 6.7.2.4. shall be added as follows:

"Paragraph 6.7.2.4. Magnetic particle examination of all fillet welds and/or reinforcement welds used in bearing assembly fabrication and a minimum of 10% of all fillet welds in expansion dams is required. If defects are found which require repair they shall be re-examined with magnetic particle testing after the repairs are made. Magnetic particle examination shall follow the procedures and requirements as outlined in AWS Subsection 6.7.

A New Paragraph 6.7.5.1. shall be added as follows:

"Paragraph 6.7.5.1 Ultrasonic testing may be used in lieu of radiographic testing as required in Paragraph 6.7.1 if requested in writing provided 1) all of the requirements for tests, etc. of Paragraph 6.7.1 are complied with utilizing the U.T. Method in lieu of the R.T. Method, 2) all U.T. Testing shall be performed by qualified personnel. The Engineer shall review the U.T. technicians qualification with the option to verify said qualifications by retest or other approved means. U.T. technicians responsible for performing required testing shall complete ALDOT forms BBF-7 (Report of Ultrasonic Examination of Welds) and BBF-6 (Ultrasonic Joint Diagram) which document such testing. This documentation shall be given to the ALDOT representative within three working days, as welded joints which require such testing are completed."

A New Paragraph 6.7.7.1. shall be added as follows:

"Paragraph 6.7.7.1. Dye penetrant (PT) examination of all edges of complete joint penetration groove welds in main members is required. This examination shall be performed prior to and in addition to the required radiographic testing (RT) or ultrasonic testing (UT). If defects are found which require repair these areas shall be re-examined with PT after repairs are made. Written documentation of the PT examination shall be submitted to the ALDOT representative within three working days, as joints which require such testing are completed and tested."

A New Paragraph 6.10.11.3. shall be added as follows:

"Paragraph 6.10.11.3. The density in any single radiograph showing a continuous area of constant thickness shall not vary in this area by more than 0.5" {13 mm}.

A New Paragraph 6.10.14. shall be added as follows:

"Paragraph 6.10.14. "Edge blocks shall be used when radiographing butt welds greater than 1/2 in. {13 mm} thickness. The edge blocks shall have a length sufficient to extend beyond each side of the weld centerline for a minimum distance equal to the weld thickness, but no less than 2 inches {50 mm}, and shall have a thickness equal to or greater than the thickness of the weld. The minimum width of the edge blocks shall be equal to half the weld thickness, but not less than 1 in {25 mm}. The edge blocks shall be centered on the weld with a snug fit against the plate being radiographed, allowing no more than 1/16 inch {1.6 mm} gap. Edge blocks shall be made of radiographically clean steel and the surface shall have a finish of ANSI 125 μinches {3.2 μm} or smoother.

Paragraph 7.4.3. Paragraph 7.2.3 as written shall be deleted and the following substituted in lieu thereof:

"The fusion areas on the member to which studs are to be welded, as well as the fusion area of the studs shall be cleaned to bright metal by an acceptable method."

Paragraph 9.21.1.5. A new sentence shall be added to paragraph 9.21.1.5 as follows:

"Undercut in the web of beams and girders shall not exceed 0.01 inches {0.25 mm}."

(Note: The above tolerance shall be applied to any other built up member utilizing a web and flanges).

(b) QUALIFICATION OF WELDERS.

Field welders shall be prequalified according to the standard qualification procedure of the applicable AWS Specifications and amendments thereto as noted in Subarticle 836.46(a). A welder that passes the required test procedure without requiring a retest will then be qualified for the next three years with no test required provided his performance is satisfactory. During this three year period a new card will be issued for one-year periods when the welder presents evidence that he has been welding during the previous six (6) month period. Welders that require a retest to become qualified must take and pass the test each year. Field welders must have a current qualification card on his person at all times that he is doing field welding.

Shop welders must have a valid qualification card or test report on file at each fabrication shop where he works. Shop welders, welding operators and tackers shall be prequalified in accordance with applicable ANSI/AASHTO/AWS Specifications and amendments thereto as noted in Subarticle 836.46(a).

(c) SHOP WELDING.

1. The Contractor or his representative shall furnish to the Department a written report that shall cover the welding procedure specification (WPS) for each process and joint used in shop welding. This report shall be submitted in duplicate on a format approved by the Department.

2. All shop welds shall be properly identified so that it can be determined by the Engineer which welder performed the work.

3. The AWS joint designation shall appear in the tail of the weld symbol on the shop drawing.

4. Each full penetration weld that is to be tested by ultrasonic or radiographic testing shall be assigned a unique number by the preparer of the shop drawing. This number shall serve to identify that particular weld and shall also appear on all nondestructive test reports and x-ray film.

(d) FIELD WELDING.

Only authorized welding shall be done in the field. Unauthorized indiscriminate welding shall not be done to attach temporary construction details to beams, girders, or other main members without approval of the Construction Bureau.

(e) NON DESTRUCTIVE TESTING.

All non-destructive testing required by these Specifications shall be performed by the Contractor at his expense.

836.47 & 836.48 Blank.

836.49 Painting.

Shop coating shall meet applicable requirements of Section 521.

836.50 Protection Of Machine Finished Surfaces.

Machine-finished surfaces in general shall be shop painted except for the following:

Driven pins and pin holes; surfaces in sliding contact; bronze, and steel surfaces opposing bronze in sliding contact; other surfaces as noted on the plans. Machine surfaces of steel not requiring paint should receive a heavy shop coat of Petrolatum meeting the requirements of ASTM D 217, NLGI Grade 2 or 3 or Military Specification C-16173D, Grade 1. Other approved coating may be used. Surfaces opposing bronze in sliding contact, if shipped assembled with bronze, shall be coated and assembled with the lubricant supplied by the bronze manufacturer. If not shipped assembled with bronze, such surfaces shall receive a shop coating, which shall be removed before field assembly. The lubricant furnished by the bronze manufacturer shall then be applied.

No paint or protective coating shall be applied to bronze.

SECTION 837
ELASTOMERIC BEARING MATERIALS

837.01 Description.

Elastomeric bearings shall be classified by Type in accordance with the following:

BEARING TYPE	Plain Elastomer	Layers of Elastomer With Internal Steel Laminate Plates	Bearing Plate Vulcanized to the Elastomer	PTFE Surfacing Bonded to the Bearing Plate on the Elastomer. Stainless Steel Surfacing Attached to a Second Bearing Plate.
Type 1	X			
Type 2		X		
Type 3	X		X	
Type 4		X	X	
Type 5		X	X	X

837.02 Required Physical Properties.

(a) GENERAL.

The materials for the elastomeric bearings shall meet the requirements given in AASHTO M 251 as modified by the requirements given in this Section.

Physical property tests shall be performed in accordance with applicable AASHTO, ASTM, and ALDOT procedures.

(b) ELASTOMER.

The elastomer, unless otherwise specified, shall be 100% virgin polychloroprene (neoprene). Natural rubber, vulcanized rubber (natural or synthetic) or other synthetic rubber-like materials will not be accepted.

The elastomer for Type 1 and Type 3 bearings (bearings without internal laminate plates) shall be 60 Durometer hardness.

The elastomer for Type 2, Type 4, and Type 5 bearings (bearings with internal laminate plates) shall be 50 Durometer hardness.

Where bearing plates are required, the elastomeric portion of the pad shall be hot bonded to the bearing plate during the vulcanization of the pad. This process shall form a bond such that removal of the elastomeric portion of the pad from the bearing plate will result in elastomer failure before bond failure.

(c) INTERNAL STEEL LAMINATE PLATES FOR TYPE 2, 4 AND 5 BEARINGS.

Internal steel laminate plates, unless shown otherwise on the plans, shall have a nominal thickness of not less than 12 gage.

(d) STEEL BEARING PLATES FOR TYPE 3, 4 AND 5 BEARINGS.

Steel bearing plates shall be hot dipped galvanized coated in accordance with the requirements given in ASTM A 123.

The surfaces of the plates that will be bonded to the elastomer shall be cleaned to SSPC 10 "near white metal finish" after galvanization and immediately prior to bonding. The cleaned bonding surface shall be protected from rust that will be detrimental to the strength of the bond.

A portion of the galvanization shall be removed from the bearing plates to allow the field welding for the installation of the bearings. For each weld, a 2 inch {50 mm} wide strip of galvanization shall be removed. This strip of bare metal shall extend across the entire width of the bearing plate.

(e) PTFE FOR TYPE 5 BEARINGS.

The PTFE shall be composed of 100 percent virgin (unfilled) polytetraflouroethylene polymer. The PTFE resin shall be 100 percent pure new material and shall comply with ASTM D 4894. No reclaimed material shall be used.

The PTFE shall meet the following requirements:

PHYSICAL PROPERTIES OF PTFE		
PHYSICAL PROPERTY	ASTM TEST METHOD	SHEET (UNFILLED)
Specific Gravity	D 792	2.16 ± 0.03
Melting Point ºF {ºC}	D 4894	623 ± 2 {328±1}
Tensile Strength psi {MPa}	D 4894	2800 {19.3}
Elongation at Break (%)	D 4894	200

The thickness of the PTFE shall be at least 1/16 inch {1.58 mm} after compression.

The PTFE shall be attached to the bearing plate by adhesive bonding using an adhesive that is approved by the Engineer, in accordance with the instructions of the adhesive's manufacturer. Prior to bonding, the surface shall be etched by an approved manufacturer using the sodium naphthalene or sodium ammonia process. The peel strength of the bond shall be not less than 20 pounds per inch {3.5 kN/m}, when tested in accordance with ASTM D 429 Method B.

If shown on the plans, the PTFE shall be confined in a recess in the bearing plate for one half of the PTFE thickness. PTFE confined in a recess shall be at least 3/16 inch {4.76 mm} thick when the maximum dimension of the PTFE is less than or equal to 24.0 inches {610 mm}, and 1/4 inch {6.35 mm} when the maximum dimension of the PTFE is greater than 24.0 inches {610 mm}, unless shown otherwise on the plans.

The finished surface of the PTFE shall be smooth, free from bubbles and shall conform to the tolerances shown.

(f) STAINLESS STEEL SURFACING FOR TYPE 5 BEARINGS.

The required thickness of the stainless steel sheet may be shown on the plans. If not shown, the thickness shall be at least 1/16 inch {1.58 mm} when the maximum dimension of the surface is less than or equal to 12.0 inches {305mm} and 1/8 inch {3.18 mm} when the maximum dimension is larger than 12.0 inches {305 mm}.

The stainless steel surfacing shall meet the requirements of ASTM A 240, Type #304 and the requirements of ASTM A 480 and shall have a No. 8 Finish (mirror finish) on the side in contact with the PTFE layer. Unless otherwise shown on the plans, the coefficient of friction between the bearing element (bearing plate with PTFE) and the stainless steel shall not be more than 0.06 at 800 psi {5.5 MPa} compressive loading. The stainless steel component shall be furnished as one piece of steel if it is shown on the plans to be a single piece.

After removal of the galvanization on the bearing plate in the footprint of the stainless steel sheet, each sheet shall be attached to the bearing plate by seal welding around the entire perimeter so as to prevent entry of moisture between the stainless steel sheet and the bearing plate. After welding, the bead and any damaged galvanized area shall be repaired as per the sprayed zinc (metallizing) requirements of ASTM A 780. Welds shall conform to the American Welding Society requirements for stainless steel. After welding, the stainless steel sheet shall be flat, free from wrinkles and in continuous contact with its sole plate.

(g) MANUFACTURING REQUIREMENTS.

Types 1, 2, 3, and 4 pads shall be fabricated in accordance with AASHTO M 251. Type 5 pads shall be fabricated in accordance with the manufacturer's recommendations.

(h) TOLERANCES.

Pads shall be manufactured in accordance with plan details and shop drawings with applied tolerances as established in AASHTO M 251. Type 5 bearing pads shall in addition to AASHTO M 251 meet the following tolerances:

FLAT PTFE SLIDING BEARING TOLERANCES			
ITEM	THICKNESS	DIMENSION	FLATNESS OR OUT-OF-ROUND
PTFE	-0.000" , +0.0063" {-0.00mm, +0.160mm}	-0.000", +0.030" {-0.00mm, +0.76mm}	0.001 X Nominal Thickness
Stainless Steel	-0.000" , +0.0063" {-0.00mm, +0.160mm}	-0.000", +0.125" {-0.00mm, +3.18mm}	0.001 X Nominal Thickness

837.03 Marking, Sampling, and Testing.

Bearings shall be divided into lots and marked in accordance with AASHTO M 251 as modified in ALDOT-368 to allow pads of the same type but different sizes to be grouped together in a lot. Bearings less than 3 inches {75 mm} in thickness may have markings placed on the top surface in lieu of the side. Lots may contain up to 3 additional pads for sampling purposes.

Sampling, for Departmental verification testing, shall be in accordance with ALDOT 368 and the ALDOT Testing Manual.

In addition to ALDOT testing, manufacturers shall, as a minimum, test all lots to Level 1 of AASHTO M 251. Manufacturers shall furnish certified test reports showing actual test results for all parameters found in Table 1 of AASHTO M 251. In addition, steel reinforced pads shall have test results covering the peel strength test and certification that all pads have been proof loaded and passed the requirements for Level 1 criteria, as well as a mill test report for the steel laminates showing the actual physical and chemical analysis for the heat of steel.

Mill test reports shall also be submitted for all bearing plates.

The manufacturer shall furnish certification that the Type 5 bearing assembly meets the requirement for the maximum allowable coefficient of friction between the PTFE and the stainless steel sheet.

SECTION 841
STRUCTURAL PLATE FOR PIPE, PIPE-ARCHES AND ARCHES

841.01 Description.

(a) GENERAL.

Corrugated metal structural plate pipe, pipe-arches, and arches shall meet requirements noted in this Section and the details shown on the plans.

Acceptance of material will be based on job site inspection for workmanship and compliance with fabrication requirements.

A certificate of compliance for each shipment as per AASHTO requirements will not be required; however, a copy of the manufacturer's analysis of the sheets used in the manufacture of the pipe shall be furnished.

For correlation of specified plate thickness and allowable fill heights, see plan details.

(b) FORMING AND PUNCHING OF PLATES FOR PIPE.

Plates shall be formed to provide lap joints. The bolt holes shall be so punched that all plates having like dimensions, curvature, and the same number of bolts per meter of seam shall be

interchangeable. Each plate shall be curved to the proper radius so that the cross-sectional dimensions of the finished structure will be as indicated on the plans.

Plates for forming skewed or sloped ends shall be cut to give the angle of skew or slope specified. Burned edges shall be free from oxide and burrs, and shall present a workmanlike finish.

Elongation of structural plate pipe may be accomplished by forming plates so that the finished pipe is elliptical in shape with the vertical diameter approximately five percent greater than the nominal diameter of the pipe.

Plates for a pipe arch shall form a cross section made up of four circular arcs tangent to each other at their junctions and symmetrical about the vertical axis. The top shall be an arc of not more than 180 degrees nor less than 155 degrees. The bottom shall be an arc of not more than 50 degrees nor less than 10 degrees. The top shall be joined at each end to the bottom by an arc having a radius between 16 and 32 inches {400 and 800 mm} and of not more than 87½ degrees nor less than 75 degrees.

841.02 Corrugated Steel.

Corrugated steel structural plates, fasteners, etc. shall conform to the requirements of AASHTO M 167, with plates hot-dipped galvanized after fabrication, punching, and cutting.

841.03 Corrugated Aluminum.

Corrugated aluminum structural plates, fasteners, etc. shall conform to the requirements of AASHTO M 219 modified to include the following:

Bolt holes along those edges of the plates that will form longitudinal seams in the finished structure shall be on a double row with center to center dimension 1.75 inches {45 mm}. In all structures the longitudinal joint shall be composed of two bolts in the valley and crest of each corrugation. Bolt holes along those edges of the plates that will form circumferential seams in the finished structure shall provide for a bolt spacing of not more than 9.625 inches {245 mm}. The minimum distance from center of hole to edge of plate shall be not less than 1.75 times the diameter of the bolt.

841.04 Bituminous Coatings and Paved Inverts.

Bituminous coatings shall be in accordance with the provisions of Subarticle 850.02(c); however, field coatings may be applied in accordance with the provisions of AASHTO M 243.

Paved inverts shall be in accordance with the provisions of Subarticle 850.02(c); however, field application may be accomplished using the asphalt mastic noted in AASHTO M 243, applied as noted therein to the depth and width required by Subarticle 850.02(c).

841.05 Handling and Storage.

Handling and storage of plates shall be as specified in Subarticle 850.02(f) for pipe. Any spelter damaged in handling shall be painted with two coats of approved galvanizing repair paint, Section 855, or an approved zinc spelter paint.

SECTION 846
PIPE CULVERT JOINT SEALERS

846.01 Rigid Pipes.

(a) GENERAL.

The manufacturer's design and production tolerance for the annular space within the manufactured joint will determine the type of joint which will be required for sealing of the joints. When the annular space within the pipe joints (algebraic difference in diameters measured between the exterior edges of the pipe at the spigot end and the interior faces of the hub at the shoulder of the joint) falls within the following ranges, the type sealer noted thereafter will be used.

Total Annular Space	Type Sealer
1/4 inch {6 mm} or Less	Bituminous Plastic Cement
1/4 inch to 1/2 inch {6 mm to 13 mm}	Mortar or Bituminous Plastic Cement as elected by the Contractor
1/2 inch {13 mm} or More	Mortar

NOTE: When rubber or other approved types of gaskets are used or required, the joints shall conform to the requirements of Subarticle (d) below.

(b) MORTAR.

Mortar, meeting the requirements of Section 611 shall be used on joints whose design or manufacturing process produces an annular space within the limits noted in Subarticle (a) above.

(c) BITUMINOUS PLASTIC CEMENT.

Bituminous Plastic Cement meeting the Specifications noted in this Section, or other kinds of mastic joint sealer that has been approved by the Department, shall be used on joints whose design or manufacturing process produces an annular space within the limits noted in Subarticle (a) above.

This Specification covers a bituminous joint sealing compound which may be applied cold for sealing the joints of bell and spigot or tongue and groove storm or culvert pipe. Material furnished shall be composed of a steam-refined petroleum asphalt dissolved in a suitable solvent and stiffened with a mineral filler .

Properties: The Bituminous Plastic Cement shall be a smooth uniform mixture, not thickened or livered, and it shall show no separation which cannot be easily overcome by stirring. The material shall be of such consistency and properties that it can be readily applied with a trowel, putty knife, or caulking compound gun without pulling or drawing. When applied to the joint surfaces, it shall exhibit good adhesive and cohesive properties. The material shall meet the following requirements:

1. When applied in a layer 1/16 to 1/8 inch {1.5 mm to 3 mm} thick on a tinned metal panel and cured at room temperature for 24 hours, the Bituminous Plastic Cement shall set to a tough, plastic coating, free from blisters.		
	Minimum	Maximum
2. Grease Cone Penetration	175	250
3. Unit Weight {Unit Mass}, pounds per gallon {kilograms per liter}	9.75 {1.17}	-
4. Non-Volatile	70	-
5. Ash, by ignition, by weights {masses}	15	45
Tests: Methods of tests shall be in accordance with the following:		
Grease Cone Penetration	AASHTO T 187	
Non-Volatile	ASTM D 2939	
Ash	ASTM D 128	

(d) RUBBER GASKETS.

Rubber gaskets, meeting the requirements of AASHTO M 198, shall be used only on joints specifically designed for the use with this type gasket. Special conditions, where noted on the plans, may require the use of this type gasket exclusively; under this condition pipe joints shall comply with the requirements of AASHTO M 198 except that for pipe to be used in culvert construction the exfilteration or infilteration test will not be required.

When rubber type gaskets are used, the pipe and/or gasket manufacturer shall furnish the Engineer with a certification showing the physical properties of the gasket and results of hydrostatic tests of the gasket and pipe to be used in the work.

(e) OTHER TYPES OF JOINT SEALERS.

Other types of joint sealers or gaskets with proven satisfactory performance records may be considered by the Department for use on individual contracts on a trial basis.

846.02 Flexible Pipe Sealers.

(a) GENERAL.

Connecting bands complying with the appropriate provisions of the type pipe being used may be considered as a satisfactory sealer provided the installation method provides a water tight joint for the full circumference of the joint, unless otherwise directed. Where a satisfactory joint seal cannot be obtained using only the connecting band, the joint shall be sealed by the use of gaskets designed for this purpose, mastic or other approved material.

The producer of the sealant used in the joints shall furnish the Engineer with a certification showing the physical properties of the material and hydrostatic tests of joints sealed with his material.

(b) SPECIAL JOINTS.

If special joints or sealers are required, such will be designated by plan details.

SECTION 850
ROADWAY PIPE

850.01 Concrete Pipe.

(a) GENERAL.

Concrete pipe shall be reinforced circular or reinforced arch concrete pipe.

Circular concrete pipe shall comply with the requirements of AASHTO M 170, except that elliptical steel reinforcement will not be permitted unless such is permitted for special design pipe by details provided in the plans.

Concrete arch pipe shall comply with the requirements of AASHTO M 206.

(b) SPECIAL DESIGN.

When so permitted by the plans or in the proposal, pipe of designs other than those shown in the standard plans may be permitted; however, such pipe must meet performance and test requirements specified in AASHTO M 170 and shall be installed under the same specifications as circular pipe.

(c) CLASSES OF PIPE.

Circular pipe and arch pipe shall be of the following classes, corresponding to AASHTO M 170 or AASHTO M 206 classes as tabulated herein.

AASHTO CLASS	ALDOT CLASS	ABBREVIATION
Class II	Class 2 Reinf. Conc. Pipe	Cl. 2 R.C. Pipe
Class III	Class 3 Reinf. Conc. Pipe	Cl. 3 R.C. Pipe
Class IV	Class 4 Reinf. Conc. Pipe	Cl. 4 R.C. Pipe
Class V	Class 5 Reinf. Conc. Pipe	Cl. 5 R.C. Pipe
Class II	Class 2 Reinf. Conc. Arch Pipe	Cl. 2 R.C. Arch Pipe
Class III	Class 3 Reinf. Conc. Arch Pipe	Cl. 3 R.C. Arch Pipe
Class IV	Class 4 Reinf. Conc. Arch Pipe	Cl. 4 R.C. Arch Pipe

(d) MATERIALS.

Coarse aggregate, fine aggregate, cement, steel reinforcement, and water shall meet the requirements of AASHTO M 170 or M 206, whichever is applicable, except as modified in applicable Sections of Division 800, Materials.

(e) ACCEPTANCE.

All precast products furnished shall meet the requirements of Section 831.

(f) HANDLING AND STORAGE.

Pipe shall be handled, transported, delivered, and stored in a manner that will not injure or damage the pipe. Pipe shall not be shipped before it has been inspected and approved. Pipe that is damaged during shipment or handling will be rejected even though satisfactory before shipment. Pipe dropped from platforms or vehicles or in the pipe trench will be rejected.

850.02 Corrugated Steel Pipe.

(a) GENERAL.

Corrugated steel pipe used in the construction of roadway culverts shall be either circular or arch pipe meeting the requirements of AASHTO M 36, for Type I, IR, or II culverts, the requirements noted in this Section, and the details shown in the plans.

The pitch and depth of corrugations allowed by the AASHTO Specifications but not covered by plan details must be approved by the Department before use.

Acceptance of pipe will be based on job site inspection for workmanship and compliance with fabrication requirements.

A certificate of compliance for each shipment as per AASHTO M 36 will not be required; however, a copy of the manufacturer's analysis of the sheets used in the manufacture of the pipe will be furnished.

Corrugated steel roadway pipe shall have a protective coating and in most cases requires a paved invert. Certain secondary roads may use plain galvanized steel pipe.

A paved invert will not be required in a Type IR pipe unless needed for abrasion resistance. When such is the case, the requirement for a paved invert in a Type IR pipe will be shown on the plans.

(b) FABRICATION.

All pipes furnished under this Section shall be fabricated with circumferential corrugations and a riveted lap joint, or with helical corrugations and a continuous lock seam or welded seam, or helical ribs projecting outwardly with a continuous lock seam extending from end to end of each length of pipe.

In addition, helical corrugated or helical ribbed pipe shall comply with the following:

1. Lock joints or seams shall produce a continuous water-tight seam parallel to the corrugations or ribs and as near as practical to the neutral axis of the corrugations or mid-point between ribs, for all sizes without perforations. The seam shall be so designed and fabricated as to develop strength and serviceability equal to that of riveted pipe of the same wall thickness.

2. Welded seams shall produce a continuous water-tight seam parallel to the corrugations and as near as practical to the neutral axis of the corrugations. The welding process shall be so controlled that the combined width of the weld and the adjacent spelter coat burned by the welding operation shall not exceed three times the thickness of the metal being joined. If the spelter is damaged outside the above specified width, the weld and the damaged area adjacent to the weld shall be cleaned and treated as required by the appropriate Article of AASHTO M 36. A coating of rust on the base metal portions of the weld is not considered a defect. The welding process shall be such that the welded seam strength shall not be less than 70 percent of the base metal.

The manufacturer of welded seam pipe shall submit a certified test report of his production testing that shows the production will meet the above noted weld strength requirements. One test will be reported for each day's production run with the test performed on the final joint produced for that day.

3. All ends of helical corrugated or helical ribbed pipe which are to be joined to other pipe with coupling bands shall be reformed to provide a minimum of two standard size circumferential corrugations.

(c) PROTECTIVE COATINGS, LININGS, AND PAVED INVERTS.

1. GENERAL.

Protective coating for corrugated metal round and arch pipe shall meet one of the requirements noted in this Article.

Concrete linings for corrugated steel round pipe shall meet the requirements specified in Subarticle (d) of this Article.

Paved inverts shall be formed by the addition of a smooth pavement in the invert of the pipe filling the corrugations for at least 25% of the circumference for a round pipe and 40% for an arch pipe. The pavement shall have a minimum thickness of 1/8 of an inch {3 mm} above the crest of the corrugations, except where the upper edges intersect the corrugations.

In addition the following will be required for the manufacturer of each length of coated pipe shipped to a project:

a. Each length of protective coated corrugated metal pipe shall have one section covered with duct tape for identification. This covered section shall include the heat number and metal thickness.

b. The section of pipe covered with duct tape shall be marked for easy location by project personnel.

c. Pipe that is not properly taped shall not be placed on a project until it has been sampled and tested by the Central Laboratory.

2. COATING.

Bituminous coating shall meet the requirements of AASHTO M 190 for Type "A" Pipe.

Polymeric coatings on precoated metal sheets meeting the requirements of AASHTO M 246 for Type "B" sheets may be used provided the pipe is fabricated so that the heavier coating is located on the inside of the pipe.

3. PAVED INVERTS.

Paved inverts for bituminous coated pipe shall conform to the requirements of AASHTO M 190 for Type "C" Pipe.

Paved inverts for pipe formed from precoated metal sheets shall be compatible with the coating material, capable of providing an acceptable bond with coating material and otherwise meeting the same basic test requirements of Section 5 of AASHTO M 190.

4. CONCRETE LINING.

Concrete lined pipe shall be bituminous coated on the outside as outlined in Item 2 above. Although not required, bituminous coating of the inside of the pipe will be permitted.

Concrete for the lining shall be composed of cement, fine aggregate, and water that are well mixed and of such consistency as to produce a dense, homogeneous, non-segregated lining. The cement shall be Portland cement, Type II, conforming to AASHTO M 85. Aggregate shall conform to the requirements of AASHTO M 6 except the sections on gradation and uniformity of gradation. 100% of the aggregate shall pass the No. 4 {4.75 mm} sieve with not more than 10% passing the No. 200 {75 µm} sieve. The concrete used as lining shall have a minimum 28 day compressive strength of 5000 psi {35 MPa} when tested in accordance with AASHTO T 22.

The concrete lining shall be applied in one or more courses by a machine traveling through the pipe and discharging the concrete over stationary pipe sections. The rate of travel of the machine and the rate of concrete discharge shall be regulated so as to produce a homogeneous, non-segregated lining throughout.

The lining machine shall be equipped with attachments for mechanically troweling the concrete lining. The trowel attachment shall be such that the pressure applied to the lining will be uniform and shall produce a lining that has a uniform thickness and a smooth surface. The concrete lining thickness shall be 3/8 inch ± 1/8 inch {10 mm ± 3 mm} over the inside crests of the corrugations.

The manufacturer shall submit certifications stating the gage of the pipe and that the cement, aggregate, and the lining itself all comply with the above specifications. Random samples of the cement, aggregate, and cylinders made from the lining mixture shall be submitted on request of the Department. If cylinders are required, they shall be made from the last batch mix of the day's operation. Either standard rodded cylinders or cylinders compacted and cured in the same manner as the pipe lining will be acceptable. The minimum average 28 day compressive strength of cylinders tested from any one batch shall be 5000 psi {35 MPa}.

(d) CONNECTING BANDS.

Connecting bands shall be made of material conforming to AASHTO M 218 or to AASHTO M 274 depending on the type of metallic coat on the pipe. All bands shall have a minimum of two circumferential corrugations which shall effectively engage the second, as a minimum, circumferential corrugated valley from the end of each pipe. Connecting bands shall be no more than three nominal sheet thicknesses lighter than the thickness of the pipe to be connected but in no case lighter than 17 gage.

Bolts and nuts for connecting bands, furnished in sufficient sizes and numbers to adequately perform the intended function, shall conform to the requirements of ASTM A 307. Band connection hardware consisting of bolts, nuts, bars, and rivets shall be galvanized in accordance with the requirements of AASHTO M 232 or be coated by the electroplating process as provided in ASTM B 633 Class Fe/Zn 8.

Protective coatings for connecting bands shall be the same as used on the pipes which are being connected and shall meet the appropriate requirements for such noted in Subarticle (c) above.

(e) BLANK.

(f) HANDLING AND STORAGE.

Pipe shall be handled, transported, delivered, and stored by methods that will not damage the pipe or bituminous coating, and with the paved invert at the bottom of the pipe. Any pipe damaged or bent will be rejected even though previously inspected and found satisfactory, and shall be replaced or repaired at the Engineer's option, without additional compensation. Damaged coating or paving shall be repaired in a manner satisfactory to the Engineer using approved materials.

850.03 Corrugated Aluminum Pipe.

(a) GENERAL.

Corrugated aluminum pipes used in the construction of roadway culverts shall be either circular or arch pipe meeting the requirements of AASHTO M 196 except as provided in this Article or shown on the plans.

The pitch and depth of corrugation allowed by the AASHTO Specifications but not covered by plan details must be approved by the Department before use.

Acceptance of pipe will be based on job site inspection for workmanship and compliance with fabrication requirements.

A certificate of compliance for each shipment as per AASHTO M 196 will not be required; however, a copy of the manufacturer's analysis of the sheets used in the manufacture of the pipe shall be furnished.

For correlation of the specified plate thickness of corrugated metal pipe, and aluminum sheet thickness shown in the detailed plans, the following shall apply:

Aluminum Sheet Thickness (Nominal) Table 3 AASHTO M 197	Specified Culvert Sheet Thickness (Nominal) Table 4 AASHTO M 218
0.060 inches {1.5 mm}	0.064 inches {1.6 mm}
0.075 inches {1.9 mm}	0.079 inches {2.0 mm}
0.105 inches {2.7 mm}	0.109 inches {2.8 mm}
0.135 inches {3.4 mm}	0.138 inches {3.5 mm}
0.164 inches {4.2 mm}	0.168 inches {4.3 mm}
NOTE: Minimum acceptable aluminum sheet thickness 0.060 inches {1.5 mm}. Tolerances for aluminum sheet thickness noted in Table 1 AASHTO M 197 shall apply.	

Arch pipe will be accepted on the old sizes as shown by Departmental drawings or the new AASHTO sizes. See Table in Subarticle 850.02(b) for the correlation of sizes.

(b) FABRICATION.

All pipe furnished under this Article shall be fabricated with circumferential corrugations and a riveted lap joint or with helical corrugations and a continuous lock seam or welded seam extending from end to end of each length of pipe provided the seams and ends of the pipe comply with the additional requirements of paragraph 2 of Subarticle 850.02(b).

(c) BITUMINOUS COATING AND PAVED INVERT.

Bituminous coatings and paved inverts shall comply with the requirements of Subarticle 850.02(c).

(d) CONNECTING BANDS.

The width and design of connection bands shall be as noted in AASHTO M 196 with the pitch and depth of corrugations, etc. consistent with the type corrugations of the pipe being used. Bituminous coating for use with bituminous coated pipe and pipe arches shall conform to the appropriate requirements of AASHTO M 190.

(e) HANDLING AND STORAGE.

Handling and storage shall meet the requirements of Subarticle 850.02(f).

SECTION 851
SIDE DRAIN PIPE

851.01 Concrete Pipe.

(a) GENERAL.

Concrete pipe shall be reinforced circular or reinforced arch concrete pipe except that pipe 24 inches {600 mm} or less in diameter, and equivalent size arch pipe, may be plain concrete provided the pipe meets all other requirements of this Article.

(b) SPECIAL DESIGN.

When so permitted by the plans or in the proposal, pipe of designs other than those shown in the standard plans may be permitted; however, such pipe must meet the performance and test

requirements specified, for AASHTO M 170 and shall be installed under the same specifications as circular pipe.

(c) CLASSES OF PIPE.

1. PLAIN CONCRETE PIPE.

Only plain concrete pipe 24 inches {600 mm} or less in diameter (or equivalent area in arch pipe) will be permitted. Circular pipe shall meet the requirements for Class 2 pipe of AASHTO M 86 or for Class II of AASHTO M 170 without steel reinforcement, provided the same strength requirements for the same size pipe provided in AASHTO M 86 for Class II pipe are met. Arch pipe equivalent to a 24 inches {600 mm} diameter round pipe or less shall meet the requirements for Class A-II of AASHTO M 206 without steel reinforcement provided the same strength requirements of the equivalent size circular pipe provided in AASHTO M 86 for Class 2 pipe are met.

2. REINFORCED CONCRETE PIPE.

Circular pipe shall meet the requirements of AASHTO M 170 for the class of pipe designated by the plans.

Arch pipe shall meet the requirements of AASHTO M 206 for the class of pipe designated by the plans.

(d) MATERIALS.

Coarse aggregate, fine aggregate, cement, steel reinforcement, and water shall meet the requirements of AASHTO M 170 or M 206, whichever is applicable except as modified in applicable Sections of Division 800, Materials.

(e) TESTS.

All precast products furnished must meet the requirements of Section 831, Precast Concrete Products.

(f) HANDLING AND STORAGE.

Handling and storage shall meet the requirements of Subarticle 850.01(f).

851.02 Corrugated Steel Pipe.

Corrugated steel pipe used in the construction of side drain culverts shall be either circular or arch pipe meeting the requirements of Article 850.02, except that most side drain pipe may use plain galvanized steel pipe.

851.03 Corrugated Aluminum Pipe.

Corrugated aluminum pipe used in the construction of side drain culverts shall be either circular or arch pipe meeting the requirements of Article 850.03.

851.04 Vitrified Clay Pipe.

(a) GENERAL.

Vitrified clay pipe used in the construction of side drain culverts shall meet the requirements of AASHTO M 65 or ASTM C 700 for Extra Strength pipe.

(b) HANDLING AND STORAGE.

Handling and Storage shall meet the requirements of Subarticle 850.01(f).

851.05 Poly(Vinyl Chloride) (P.V.C.) Pipe.

This pipe shall meet one of the following specifications: ASTM D 2241, F 789, D 1785, D 2665, D 3034, D 2680, F 794, F 949, or F 679.

851.06 Acrylonitrile-Butadiene-Styrene (A.B.S.) Pipe.

This pipe shall meet the requirements of ASTM D 2751 or D 2680.

851.07 Polyethylene (P.E.) Pipe.

This pipe shall meet the requirements of AASHTO M 294, Type C or S.

851.08 Special Requirements.

The Specifications for all pipes, as covered by Articles 851.05, 851.06, and 851.07, are amended to the effect that any of these materials are acceptable in any configuration which will meet the criteria listed below:

1. Pipe shall have a minimum pipe stiffness as shown in AASHTO M 294 (for P.E. pipe), AASHTO M 304 (for P.V.C. pipe), or ASTM D 2751 (for A.B.S. pipe) when tested in accordance with ASTM D 2412.
2. Fill heights will be restricted to 50 feet {15 m} maximum. Pipe cover shall be 12 inches {300 mm} minimum.
3. All joints shall be soil-tight.
4. Pipe ends shall be encased in accordance with Special Dwg. No. HW-614-SP.

SECTION 853
PIPE UNDERDRAIN

853.01 Vitrified Clay Pipe.

This pipe shall meet requirements for standard strength, either plain or perforated pipe of AASHTO M 65 or ASTM C 700.

853.02 Concrete Pipe.

This pipe shall meet the requirements of AASHTO M 86, Class 1 for plain pipe; for perforated pipe AASHTO M 86, Class 1 and AASHTO M 175, Type 1 or 2; for porous concrete pipe, AASHTO M 176, extra strength class, with special attention directed to Section 831, Precast Concrete Products.

853.03 Corrugated Iron or Steel Pipe.

This pipe shall meet the requirements of AASHTO M 36 for Type III, Class I, II, or III Pipe, fabricated from a specified sheet thickness of 0.064 inches {1.6 mm} and may be perforated or non-perforated as required.

853.04 Coated Corrugated Iron or Steel Pipe.

This pipe shall meet the requirements of Article 853.03 coated as specified in Subarticle 850.02(c).

853.05 Corrugated Aluminum Pipe.

This pipe shall meet requirements of AASHTO M 196 for Type III, Class I, II, or III, pipe fabricated from a specified sheet thickness of 0.060 inches {1.5 mm} and may be perforated or non-perforated as required.

853.06 Coated Corrugated Aluminum Pipe.

This pipe shall meet requirements of Article 853.05 coated as specified in Subarticle 850.02(c).

853.07 Poly(Vinyl Chloride) (P.V.C.) Pipe.

This pipe shall meet the requirements of ASTM D 3034. Pipe having a nominal diameter of 4 inches {100 mm} shall have a standard dimension ratio (SDR) of 35; pipe having a nominal diameter of 6 inches {150 mm} or more shall have a standard dimension ratio of either 35 or 41. Perforations, if required, shall be in accordance with the perforation requirements of AASHTO M 175 for either Type 1 or Type 2.

Pipe meeting the requirements of ASTM F 949 or ASTM F 758, Type PS 28 or Type PS 46, may be used in lieu of the above designated pipe.

853.08 Acrylonitrile-Butadiene-Styrene (A.B.S.) Pipe.

This pipe shall meet the requirements of ASTM D 2751 for SDR 42 or SDR 35 pipe. Perforations, if required, shall be in accordance with the perforation requirements of AASHTO M 175 for either Type 1 or Type 2.

853.09 Polyethylene (P.E.) Pipe.

This pipe shall meet the requirements of AASHTO M 252, and in addition have a full circular cross-section, with an outer corrugated pipe wall and a smooth inner liner. Corrugations may be either annular or helical. Pipe may be perforated or non-perforated as required.

853.10 Filter Material.

(a) TYPE A - COARSE FILTER MATERIAL.

The coarse filter material may be slag, gravel, or crushed stone, meeting gradation of ALDOT sizes 67, 7, 78, or 710, at the Contractor's option, provided he gives the Engineer written notice of his choice in advance. Soundness and Los Angeles Abrasion tests will not be required.

(b) TYPE B - FINE FILTER MATERIAL.

Fine filter material shall be reasonably clean, natural sand or manufactured sand produced from the crushing of quartzite gravel, sandstone, or sandstone conglomerates meeting the following requirements:

Permeability - at least 0.5 mm/sec when measured by the constant head method of AASHTO T 215.

Gradation limits when tested in accordance with AASHTO T 27.	
Sieve No.	% Passing
3/8 inch {9.5 mm}	95 - 100
No. 200 {75 µm}	0 - 7

853.11 Handling And Storage.

Pipe shall be handled, transported, delivered, and stored by methods that will not damage the pipe or coating. Any pipe damaged or bent will be rejected, even though previously inspected and found satisfactory, and shall be replaced or repaired at the Engineer's option, without additional compensation. Bituminous coating scratched or damaged shall be repaired in a satisfactory manner with bituminous material.

SECTION 854
SEWER PIPE

854.01 Vitrified Clay (Storm Or Sanitary) Sewer Pipe.

This pipe shall meet the requirements of AASHTO Designation M 65 or ASTM C 700 with standard strength permitted on diameters 15 inches {380 mm} and under, and extra strength required on diameters over 15 inches {380 mm}.

854.02 Concrete (Storm) Sewer Pipe.

(a) PLAIN CONCRETE PIPE.

Only plain concrete pipe 24 inches {610 mm} or less in diameter (or equivalent area in arch pipe) will be permitted. Circular pipe shall meet the requirements for Class 2 pipe of AASHTO M 86 or for Class II of AASHTO M 170 without steel reinforcement, provided the same strength requirements for the same size pipe provided in AASHTO M 86 for Class II pipe are met.

(b) REINFORCED CONCRETE PIPE.

Circular pipe over 24 inches {610 mm} in diameter shall meet the requirements of AASHTO M 170 for Class II unless another class is designated by the plans or proposal.

Arch pipe larger than 18 inch {455 mm} rise by 28.5 inch {725 mm} span shall meet the requirements of AASHTO M 206 for Class A-II unless another class is designated by the plans or proposal.

(c) ACCEPTANCE.

In addition to the above requirements, all precast products furnished must meet the requirements of Section 831, Precast Concrete Products.

854.03 Cast Iron (Sanitary) Sewer Pipe.

This pipe shall meet the requirements of FSS-WW-P-421c and the following unless otherwise specified by plan details:

Grade of Pipe	Grade A
Fittings	Type I, II, or III Class 100
Pressure Class	50 psi {345 kPa} Minimum
Wall Thickness	Wall thickness shall be in accordance with ANSI Standard A-21.1 for 5 feet {1.5 m} of cover unless a greater depth is required for installation, Laying Condition "B".
Pipe Coating	Pipes and fittings shall have an outside coating of bituminous material in accordance with ANSI Standard A-21.1, A-21.8 and A-21.51.

854.04 Ductile Iron (Sanitary) Sewer Pipe.

This pipe shall meet the requirements of FSS-WW-P-421c and the following unless otherwise specified by plan details:

Grade of Pipe	Grade C.
Fittings	Type I, II, or III Class 100
Pressure Class	50 psi {345 kPa} Minimum
Wall Thickness	Wall thickness shall be in accordance with ANSI Standard A-21.1 for 5 feet {1.5 m} of cover unless a greater depth is required for installation, Laying Condition "B".
Pipe Coating	Pipes and fittings shall have an outside coating of bituminous material in accordance with ANSI Standard A-21.1, A-21.8 and A-21.51.

854.05 Coated, Smoothlined Corrugated Metal (Storm) Sewer Pipe (C.S.L.C.M.).

This pipe shall meet the requirements of AASHTO M 36 or AASHTO M 196 for Type 1A pipe and the following:

Coating requirements - the shell and liner shall be precoated on both sides with a 10 mil {0.25 mm} polymeric coating as per AASHTO M 246.

For correlation purposes the following table provides acceptable shell and liner plate thickness which may be used to equate with C.M. Pipe wall thicknesses.

Class of Pipe	Equivalent Single Steel Sheet Wall Thickness	S.L. Wall Thickness	
		Shell	Liner
1	0.064 inches {1.6 mm}	0.052 inches {1.3 mm}	0.04 inches {1.0 mm}
2	0.079 inches {2.0 mm}	0.052 inches {1.3 mm}	0.04 inches {1.0 mm}
3	0.109 inches {2.8 mm}	0.079 inches {2.0 mm}	0.04 inches {1.0 mm}
4	0.138 inches {3.5 mm}	0.109 inches {2.8 mm}	0.04 inches {1.0 mm}
NOTE: For aluminum all thicknesses may be reduced by 0.004 inches {0.10 mm} to compensate for zinc coating.			

Connecting bands shall conform to the appropriate provisions of AASHTO M 36 or M 196 for the type material used and shall have the same type coating as used on the pipe.

Appropriate designed waterproof gaskets shall be used in conjunction with connecting bands to form a watertight joint. Gasket material shall be neoprene or other approved material.

Damage to coatings shall be repaired in accordance with the appropriate provisions of AASHTO M 245 for a polymeric coating.

854.06 Cast Iron Soil (Sanitary) Sewer Pipe And Fittings.

This pipe shall meet the requirements of ASTM A 74 with coating inside and out. This type pipe shall be used only within the limits of a building.

854.07 Coated Smooth Flow Corrugated Metal (Storm) Sewer Pipe (C.S.F.C.M.).

This pipe shall meet the applicable requirements of Article 850.02 or Article 850.03 and the following:

All pipes shall have a protective coating in accordance with the applicable provisions of Subarticle 850.02(c). In addition the inside of the pipe shall have a paved lining for the entire inside periphery which will fill the valleys to the extent that the thickness above the top of the crest of the corrugations will not be less than 1/8 inch {3 mm}. The lining shall be smooth and uniform and its surface shall be parallel to a line projected along the crest parallel to the centerline.

Bituminous coating and pavement lining shall conform to the requirements of AASHTO M 246 for Type B sheets with the pavement lining formed from material compatible with the coating material and otherwise meeting the same basic requirements of Section 5 of AASHTO M 190.

Connecting bands shall meet the requirements of Subarticle 850.02(d) and have appropriate waterproof seals in accordance with Article 846.02.

Damage to coating and pavement linings shall be repaired in accordance with the appropriate provisions of AASHTO M 245 for polymeric material and approved asphalt mastic as noted in AASHTO M 245.

854.08 Concrete Lined Corrugated Metal (Storm) Sewer Pipe (C.L.).

This type pipe shall meet the requirements of Article 850.02 or Article 851.02 with the lining as specified in Item 850.02(c)4.

854.09 Poly(Vinyl Chloride) (P.V.C.) (Storm or Sanitary) Sewer Pipe And Fittings.

Pipe and fittings for pressure flow applications shall meet the requirements of ASTM D 2241.

Pipe and fittings for gravity flow applications shall meet the requirements of ASTM D 2665, ASTM D 3034, SDR 35, ASTM F 794, ASTM F 949, or ASTM F 789.

854.10 Acrylonitrile-Butadiene-Styrene (A.B.S.) and Poly(Vinyl Chloride) (P.V.C.) Composite (Sanitary) Sewer Pipe and Fittings.

This pipe shall meet the requirements of ASTM D 2680.

854.11 Polyethylene (P.E.) (Storm) Sewer Pipe.

This pipe shall meet the requirements of AASHTO M 294, Type S.

854.12 Handling And Storage.

Pipe shall be handled, transported, delivered, and stored by methods that will not damage the pipe, coatings, or linings. Any pipe damaged or bent will be rejected even though previously inspected and found satisfactory, and shall be replaced or repaired at the Engineer's option, without additional compensation. Coating or linings scratched shall be repaired in a satisfactory manner with appropriate material.

854.13 Joint Materials.

Joint material shall provide a suitable waterproof joint capable of withstanding internal pressure of the system involved and be of an approved type. Basic requirements are as follows; however, other types may be considered if appropriate backup data, etc. is submitted in writing to the Central Office for evaluation.

STORM SEWERS

Joint material for storm sewers shall be the same as specified in Section 530 for Roadway Pipe, or those specified for Sanitary Sewers in Section 645.

SANITARY SEWERS

PVC or ABS pipe shall use a jointing system specified in the ASTM for the type pipe involved. Cast Iron pipe shall use rubber type gaskets in accordance with ANSI A-21.11. V.C. pipe may be bell and spigot using rubber gaskets meeting AASHTO M 198 or plain ends using couplings specified in ASTM C 425. Wiped joints for bell and spigot pipe shall consist of jute, oakum, or hemp packing with lead or metallic joint compound as per FSS-QQ-C40.

SECTION 855
COATINGS, PAINTS, ENAMELS, AND VARNISHES FOR METAL AND WOOD STRUCTURES

855.01 General Information.

This Section covers the specifications of the above mentioned materials and their components. Unless otherwise specified, all materials shall be delivered to the job completely mixed and ready for use without the addition of oils or thinners. All materials shall be well ground, shall not settle or cake badly in the container, and shall be readily broken up to a smooth, uniform material. When brushed or sprayed on a smooth, vertical surface, the material shall dry hard and elastic without running, streaking, sagging, or spotting.

No materials shall exceed the maximum volatile organic solvent content (V.O.C.) allowed by the current Federal and State laws governing their use in the State of Alabama.

855.02 Storage.

(a) All materials and their components shall be amply protected from all forms of damage at all times. All materials shall be stored in tightly covered unopened containers at a temperature range recommended by the manufacturer of the product.

(b) Storage space for all materials shall be acceptable to the Engineer. Improper storage conditions may cause the rejection of the material stored therein.

855.03 Identification and Certification.

(a) Each container shall bear a label on which shall be complete written instructions and precautions for use, the date of manufacture, the batch and/or lot number, the designation of the product, and recommended coating thickness.

(b) Each shipment of these materials shall be accompanied by written certification from the manufacturer stating that the material furnished complies with the applicable specifications. The certification shall show the designation of the product, the batch and/or lot number, and the project number.

(c) Each system of inorganic zinc primer used on bolted connection surfaces (faying) shall be qualified annually by test in accordance with "Testing Method To Determine The Slip Coefficient For Coatings Used In Bolted Joints" as adopted by the Research Council On Structural Connections. See Appendix A of Allowable Stress Design Specification For Structural Joints Using AASHTO M 164M or AASHTO M 253M Bolts published by the Research Council On Structural Connections. All inorganic zinc primers shall have a minimum slip coefficient of 0.33 unless shown otherwise on the bridge plans.

855.04 Resampling and Retesting.

(a) Coating systems for structural steel will be approved on the basis of field testing as outlined in List III-1 of the Department's manual "Materials, Sources, and Devices with Special Acceptance Requirements". Components of each batch will be sampled at the project level or fabrication plant for selective verification testing of those parameters listed in the Procedure for List III-1.

(b) The right is reserved to inspect, resample, and retest any previously approved material at any time when it is deemed expedient by the Engineer.

(c) Materials stored in accordance with the recommendations of the manufacturer may be used at any time up to the expiration date printed on the material container. Materials not used prior to the expiration date must be retested and reapproved before their use will be allowed.

855.05 Coating Systems For Structural Steel.

The Department has established several types of coating systems according to the anticipated environmental conditions as well as the required surface preparation. The list is divided into various coating systems which have been approved for each of these types through actual field use or field and/or laboratory tests conducted by approved Governmental Agencies. These are multiple coat systems of production run materials from various coating manufacturers. This list is found in the Department's "Materials, Sources, and Devices with Special Acceptance Requirements" manual, List III-1. The requirements for the use of products from this list are found in its accompanying procedure. A copy of the list and its accompanying procedure are available from the Bureau of Materials and Tests.

The following will apply when the condition exists where a coating system, produced by a manufacturer not initially listed on List III-1, is proposed for use:

(a) The manufacturer of the coating shall request that the Department approve the coating system according to the procedure referred to above.

(b) In lieu of the completed field test, the manufacturer shall be required to demonstrate to the Department that the system can be sucessfully applied.

(c) Upon demonstration of a successful application, the Department may give temporary approval to the coating system until time allows for the system to complete a performance field test.

(d) Upon successful completion of the field test, the coating system will be added to List III-1.

(e) The Department will monitor the applied coating system during this interim period (until field testing is complete) for any cracking, peeling, blistering, or loss of adhesion between the substrate or any layer which will be cause for revocation of the temporary approval.

The required type of system will be specified on the contract plans for individual projects. Contractors may select any system listed from the specified type of system. Only systems on this list shall be furnished for use. Systems are comprised of multiple products representing the various coats required. Products must be used with their counterparts in that system only. Mixing of products from

different systems will not be allowed. The number of coats is specified on the list. Coating thickness shall be as recommended by the producer of the material with conformance checked in accordance with standard SSPC-PA2. All coatings shall be applied in accordance with the manufacturer's recommendations using spray equipment suitable for the coating unless otherwise specified.

To allow ease of visual inspection, the prime coat shall be a color to contrast the cleaned steel surface and each coat in the system shall be of a color which will contrast the other layers in contact with it. The topcoat shall be a green color matching Federal Standard 595 Chip 24272 unless otherwise specified. High solids aluminum mastic coatings will not be required to be colored, unless otherwise specified.

855.06 Timber and Wood Paints.

The following primer, second, and third coat paints shall meet the production specification indicated below. Unpainted work and old painted surfaces in poor condition shall be painted with one coat of primer FSS TT-P-25. These paints have different uses according to the area in which they are used and whether they are to be tested or not.

855.07 Primer (Wood).

FSS TT-P-25.

855.08 Outside White.

AASHTO M 70, Type 2.

855.09 Outside Black.

FSS TT-E-489.

Intended for the top or finish coat on previously primed wood or metal.

855.10 Paint For Concrete and Masonry.

FSS TT-P-24.

Type I - White only.

Type II - Tint-base-white for tinting. Primarily intended to be used as a primer and finish coat on outside surfaces. It can be used inside over suitable primed concrete, brick, stucco, and similar surfaces except floors. The dried coat is an eggshell color.

855.11 Paint For Masonry.

FSS TT-P-19.

Acrylic Emulsion Type, for exterior use.

855.12 Olive-Drab (Exterior).

FSS TT-P-81.

855.13 Green Exterior Paint.

FSS TT-E-489.

855.14 Enamel (Exterior).

FSS TT-E-489.

Class A - Air-drying.

Class B - Baking.

This enamel gives a high-gloss finish to be used over previously primed smooth wood or metal surfaces. Color selection is wide. It is suitable for signs and automotive equipment.

855.15 Galvanizing Repair Paint.

FSS Mil-P-21035 or TT-P-641G Type II.

855.16 Asphalt Varnish.

FSS-TT-V-51.

855.17 Shellac Varnish.

FSS TT-S-300.

855.18 Spar Varnish.

FSS TT-V-121.

SECTION 856
TRAFFIC MARKING MATERIALS

856.01 General.

This Section shall cover the materials used for traffic markings. These materials will be divided into Classes, with Class 1 designating paint, Class 2 designating standard thermoplastic material, Class 2T designating thin film spray applied thermoplastic material, Class 3 designating tape, and Class 3W designating warranted profiled tape.

These Classes will be further designated as to reflectorization or non-reflectorization with Type A designating reflectorized and Type B designating non-reflectorized.

Reflectorization (Type A) shall be accomplished by the use of glass spheres (beads) premixed into the base compounds (paint or thermoplastic) and/or the application of beads or additional beads by a separate operation but at the same time to produce instant reflectivity along with bead exposure when the base material wears down.

856.02 Paints.

(a) GENERAL.

1. PERMANENT TRAFFIC PAINT.

The Department has established a list of products approved for use through field tests. These products can be found on List V-3, Temporary Traffic Marking Materials and List V-4, Permanent Traffic Marking Materials. Information concerning these lists is given in Subarticle 106.01(f) and ALDOT-355. The Contractor may choose from any of these products, unless otherwise noted. Although the product durability has been approved, acceptance of the material will still be based on laboratory testing as outlined in the appropriate List and the Department's Testing Manual.

2. REMOVABLE TRAFFIC PAINT.

The Department has established a list (V-3, TEMPORARY TRAFFIC MARKING MATERIALS, "Materials, Sources, and Devices with Special Acceptance Requirements" manual) listing Removable Traffic Paint. Refer to Subarticle 106.01(f) and ALDOT-355, "General Information Concerning Materials, Sources, and Devices with Special Acceptance Requirements" for further information.

(b) CONTAINERS.

Containers shall be of at least 5 gallon {18.9 L} capacity, clean, sturdy, and capable of being closed tightly to prevent the entry of air and leakage.

For Departmental purchase orders for traffic paint, containers shall, unless otherwise specified, be open-end drums of 30 to 55 gallon {125 to 230 L} capacity (size to be specified) meeting current specification requirements of the U.S. Department of Transportation for transporting flammable liquids. No secondhand containers shall be used. The drums shall be sealed with a reusable multi-seal sponge gasket of a type which will prevent the entry of air and leakage.

All containers shall be filled to capacity, leaving a minimum of air space above the material.

All containers shall be clearly and legibly identified showing the following information:

1. Name of material.
2. Specification and article number.
3. Batch number.
4. Inspector's number (if any).
5. Project number or purchase order number is available.

Pre-tested material held as stock for future distribution - see Subarticle 856.02(d).

(c) STORAGE.

The following applies to paint producers, jobbers, contractors and anyone who keeps a supply or stock of pretested paints intended for highway use. All materials and their components shall be amply protected from all forms of damage at all times.

Storage space for all materials shall be approved by the Engineer. Improper storage conditions may be cause for rejection of the material stored therein.

The right is reserved to inspect, resample, and retest all previously approved materials whenever it is believed expedient by the Engineer.

(d) PRETESTED STOCKS OF TRAFFIC PAINT.

These shall comply with the following requirements:

1. The Engineer reserves the right to cancel the approval to maintain stocks of paint.

2. All paints are subject to being re-sampled at the job site or in the warehouse. Tests made on these re-samples shall meet the requirements of List V-4 of the manual described in Subarticle 856.02(a). Materials not meeting the requirements shall be rejected and removed. Excessive rejections of a batch of paint shall condemn the batch as a whole.

3. Traffic Paints that are over nine months old shall be retested on such tests that apply to the compounds. Material one year old must meet the requirements of these Specifications and be approved before its use can be continued.

4. The producer, jobber, or contractor shall be held responsible for the expiration dates of the batches of paint in this stock. Request for inspection, resampling, and retesting shall be made not less than six weeks before the expiration date of the material.

5. In the case of unsatisfactory results, and for minor adjustments to the finished compound, the material in question shall be completed to approval or rejection in not more than 60 days after the first unsatisfactory report.

6. Calculations of all results shall be controlled by ASTM E 29 "Practice for Indicating Which Places of Figures Are to be Considered Significant in Specified Limiting Values."

856.03 Thermoplastic.

HOT APPLIED (TRAFFIC STRIPE AND MARKINGS AND LEGENDS).

The Department has established a list of products approved for use through field tests. These products can be found on List V-4, Permanent Traffic Marking Materials. Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355. The Contractor may choose from any of these products, unless otherwise noted. Although the product durability has been approved, acceptance of the material will still be based on laboratory testing as outlined in List V-4 and the Department's Testing Manual.

856.04 Tapes.

The Department has established a list of products approved for use through field tests. These products can be found on List V-4, Permanent Traffic Marking Materials. Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355. The Contractor may choose from any of these products, unless otherwise noted. Although the product durability has been approved, acceptance of the material will still be based on laboratory testing as outlined in List V-4 and the Department's Testing Manual.

856.05 Glass Beads.

(a) STANDARD DROP-ON BEADS.

These glass beads shall meet the requirements of AASHTO M 247 with the gradation modified as follows:

Gradation Table for Glass Beads	
Sieve Size	% Passing by Weight {Mass}
No. 20 {850 µm}	75 - 100
No. 30 {600 µm}	65 - 95
No. 50 {300 µm}	15 - 35
No. 100 {150 µm}	0 - 5

(b) LARGE DROP-ON BEADS.

Large glass beads shall be transparent, clean, colorless glass, smooth, and spherically shaped, free from milkiness, pits, or excessive air bubbles. The beads shall be non-flotation, embedment coated, and conform to the following requirements:

Gradation Table for Glass Beads	
Sieve Size	% Retained by Weight {Mass}
No. 12 {1.70 mm}	0
No. 14 {1.40 mm}	0 - 5
No. 16 {1.18 mm}	5 - 20
No. 18 {1.00 mm}	40 - 80
No. 20 {850 µm}	10 - 40
No. 25 {710 µm}	0 - 5
PAN	0 - 2

Roundness. The beads shall have a minimum of 80 percent rounds per screen for the two highest sieve quantities. The remaining sieve fractions shall be no less than 75 percent rounds.

Angular Particles. The beads shall have no more than three percent angular particles per screen.

Refractive Index. The beads shall have a refractive index of 1.50 to 1.52.

Packaging and Marking. The beads shall be packaged in moisture proofed bags. Each bag shall be stamped with the following information; name and address of the manufacturer, shipping point, trade mark or name, the wording "Large Glass Beads" (for large glass beads only), class, weight {mass}, lot number, and month and year of manufacture.

SECTION 857
TEMPORARY TRAFFIC MARKING MATERIALS

857.01 General.

The Department has established a list of products approved for use through field tests. These products can be found on List V-3, Temporary Traffic Marking Materials. Information concerning this list is given in Subarticle 106.01(f) and ALDOT-355. The Contractor may choose from any of these products, unless otherwise noted. Although the product durability has been approved, acceptance of the material will still be based on laboratory testing as outlined in List V-3 and the Department's Testing Manual.

SECTION 860
ROADSIDE IMPROVEMENT MATERIALS

860.01 Seed.

(a) PURE SEEDINGS.

1. GENERAL.

All seed used shall meet the requirements of these Specifications and comply with the Alabama Seed Law, Act No. 424, General Acts, 1963, Vol. 2, Page 931, and rules and regulations promulgated thereunder, and any revisions of the Act. They shall be tested within nine months prior to use, in accordance with "Rules for Seed Testing" approved by the Association of Official Seed Analysts in July, 1960, and as subsequently amended. Each kind of seed for use either pure, or as a part of mixed seedings, shall be separately packed and delivered to the project in standard seed-tight shipping bags, all prominently identified. Each bag shall bear a tag or label certifying to contents, tests, and analysis. The analysis on any tag or label shall be subject to a check by random sampling by the Engineer and such samples will be tested by the State Department of Agriculture to determine the correctness of labeling. Samples may be drawn at time of planting and stored by the Engineer until a satisfactory stand of grass is obtained. If it is apparent that germination or other problems exist in the establishment of the ground cover, these samples shall be submitted to the State Department of Agriculture for testing. Each tag or label shall serve as a certificate of analysis except when a test by the State Department of Agriculture shows the tag or label to be incorrect, or when in the absence of testing an objectionable amount of noxious weeds results from planting. A seed deficient in purity or germination will be accepted for use, provided the impure and imperfect fraction consists substantially of seeds of plants that can be tolerated consistently along the roadside and provided the Contractor elects to cover the deficiency in either purity or germination by a proportionate increase in the rate of sowing. Seed furnished shall be hulled and scarified where indicated by the letter symbols "H" and "S", respectively. All seeds of legumes, as indicated by letter symbol "N" shall be inoculated just before use, with the appropriate commercial culture manufactured by a reputable concern. Such material shall be approved and used according to the manufacturer's instructions. The following tables specify the quantity by weight {mass} of the different seeds required when sown alone or in mixtures, their purity, germination, and the months of opening and closing their sowing seasons.

2. TABLE OF PURE SEEDINGS, GRASSES.

2. TABLE OF PURE SEEDINGS, GRASSES					
COMMON AND SCIENTIFIC (INTERNATIONAL) NAMES	Seed Reqd. pounds/acre {kg / ha}	Minimum Purity %	Minimum % Germinable	Opening and Closing Months of Sowing Season	
				South Alabama	North Alabama
Abruzzi Rye (Secale-cereale)	70 {78}	98	80	Aug - Nov	Aug - Nov
Dallasgrass (Paspalum dilatatum)	30 {34}	60	60	Feb - May	Mar - May
Bermudagrass (Cynodon dactylon)	30 Unhulled {34 Unhulled}	98	80	Feb - May	Mar - June
Bermudagrass (Cynodon dactylon)	20 (HS) {22 (HS)}	98 (Certified when specified)	85	Mar - Aug	April - July
Pensacola Bahiagrass (Paspalum notatum Var Pensacola)	40 {45}	90	85	Feb - Nov	April - July
Kentucky 31 Fescue (Festuca elatior Var Arundinacea)	30 {34}	98	85	Sept - Dec	Feb - May Sept - Nov
Alta Fescue (Festuca elatior Var Arundinacea)	30 {34}	98	85	Sept - Dec (Northern Counties Only)	Feb - May Sept - Nov
Kentucky Blue Grass (Poa pratensis)	40 {45}	85	75	----------	Sept - April
Sudan Grass (Sorghum vulgare var Sudanense)	50 {56}	98	85	Aug - Sept (For Stubble Mulch Only)	July - Aug
Lovegrass (Weeping) (Eragostis curvula)	5 {6}	97	80	Mar - Nov	Mar - Nov
Brown Top Milet (Panicum fasciculatum va nosum)	30 {34}	97	80	Mar - Aug	May - Aug
Centipede (Eremochola Ophiuroides)	10 {11}	98	80	Mar - April	Mar - April
NOTE: Pure seedings dates will not in all cases agree with mixed seedings dates.					

Method for Correcting Seed Deficient in Purity or Germination:

Multiply the % Minimum Purity times the % Minimum Germinable. This should be done for the minimum percentages shown in the Specifications and that shown on the seed analysis tag. The answer obtained will be the percent of pure live seed. When the pure live seed figure calculated from the percentages shown on the seed analysis tag is less than the pure live seed obtained from the Specifications, a proportionate increase should be made in the seed required.

3. TABLE OF PURE SEEDINGS, LEGUMES.

3. TABLE OF PURE SEEDINGS, LEGUMES					
COMMON AND SCIENTIFIC (INTERNATIONAL) NAMES	Seed Reqd. pounds/acre {kg / ha}	Minimum Purity %	Minimum % Germinable	Opening and Closing Months of Sowing Season	
				South Alabama	North Alabama
Sericea Lespedeza (Lespedeza cuneata ** or Variety Serala, Sericea or Interstate)	50 HS {56 HS}	98	85	Feb - June Slopes	Mar - June (Slopes)
Annual Lespedeza (Lesp. striata Var Kobe)	60 HN {67 HN}	95	80	Feb - May	Mar - June
Caley Pea (Rough Pea) (Lathyrus Hirsutus)	70 HN {78 HN}	98	85	Sept - Feb	Aug - Mar
White Sweet Clover (Melilotus alba)	30 HSN {34 HSN}	95	80	Feb - April (Slopes)	Mar - May (Slopes)
Yellow Sweet Clover (Melilotus Officinalis)	30 HSN {34 HSN}	95	80	Feb - April (Slopes)	Mar – May (Slopes)
Showy Partridge Pea (Chamaecrista Fasciculata)	40 HSN {45 HSN}	90	60	Mar - May (Slopes)	- - - - - - - - - -
Reseeding *Crimson Clover (Trifolium Incarnatum)	30 HN {34 HN}	99	85	Sept - Dec	Aug - Nov
`White Clover (La. Strain) (Trifolium repens)	10 HN {11 HN}	98	85	Sept - Feb	Aug - Mar
Ladino Clover (Adapted) (Trifolium repens)	5HN {6 HN}	98	85	Sept - Dec (Northern Counties)	Sept - Nov
**Regal Ladino Strain	6 HN {8 HN}				
Hairy Vetch (N) (Vicia villosa)	50 HSN {56 HSN}	95	80	Sept - Nov (Slopes)	Sept - Nov (Slopes)
Crown Vetch (Coronilla varia (Certified), Var Emerald, Chemung, or Penngrift)	15 HSN {17 HSN}	95	80	Any Month	Any Month
Bicolor Lespedeza (Lesp. Bicolor)	15 HSN {17 HSN}	95	80	Mar - April	Mar - April
* Certified or Affidavit Grown ** When Specified					
NOTE: Where calcareous soils exist, White Dutch Clover La Strain or Regal Ladino Strain shall be used in lieu of Crimson Clover. Soil tests taken prior to planting will indicate when these substitutions are necessary.					

SEE METHOD FOR CORRECTING SEED DEFICIENCIES, "PURE SEEDINGS, GRASSES" TABLE.

(b) MIXED SEEDINGS.

Each of the kinds of seeds specified for use by its common name in the mixed seedings designated in the following tables shall be of the same quality as provided for seed of that kind in the tabulation for pure seedings.

TABLE 1 (PART 1) MIXED SEEDING- SHOULDERS, MEDIANS AND RELATIVELY FLAT AREAS								
POUNDS PER ACRE {KILOGRAMS PER HECTARE} OF PURE LIVE SEED								
Planting Zone	1		1	1		1		2
Mix Number	1A		1AT	1B		1BT		2A
Planting Dates	March 1 Until May 15	May 16 Until August 1	August 2 Until Jan. 15	March 1 Until May 15	Sept. 1 Until Nov. 15	May 16 Until August 31	Nov. 16 Until Jan. 15	Feb. 15 Until April 15
Annual Rye Grass			25 {28}				25 {28}	
Hulled Burmuda Grass	15 {17}	20 {22}		10 {11}				15 {17}
Unhulled Burmuda Grass	10 {11}			10 {11}				10 {11}
Brown Top Millet						20 {22}		
Tall Fescue				50 {56}	50 {56}			
Weeping Love Grass								
Annual Lespedeza (Kobe)		30 {34}						
Sericea Lespedeza								
White Dutch Clover	5 {6}			5 {6}				5 {6}
Centepede Grass								
Reseed Crimson Clover					30 {34}			
Pensacola Bahia Grass								
Required Permanent Plant	Common Burmuda Grass (3)	Common Burmuda Grass (3)	None - 1st Stage (1) (4)	Tall Fescue (3)	Tall Fescue	None - 1st Stage (1) (4)	None - 1st Stage	Common Burmuda Grass (3)

TABLE 1 (PART 2) MIXED SEEDING- SHOULDERS, MEDIANS AND RELATIVELY FLAT AREAS								
POUNDS PER ACRE {KILOGRAMS PER HECTARE} OF PURE LIVE SEED								
Planting Zone	2	2	3	3	3	3	3	3
Mix Number	2A	2AT	3A	3AT	3B	3BT	3C	3CT
Planting Dates	April 16 Until Aug. 15	Aug. 16 Until Jan. 1	Feb. 15 Until Aug. 31	Sept. 1 Until Feb. 14	Mar.15 Until Aug. 15	Aug. 16 Until Feb. 14	March 1 Until Aug. 15	Aug. 16 Until Feb. 14
Annual Rye Grass		25 {28}		25 {28}		25 {28}		25 {28}
Hulled Burmuda Grass	20 {22}		15 {17}		10 {11}			
Unhulled Burmuda Grass			10 {11}				10 {11}	
Brown Top Millet								
Tall Fescue								
Weeping Love Grass								
Annual Lespedeza (Kobe)	30 {34}		30 {34}		20 {22}		20 {22}	
Sericea Lespedeza								
White Dutch Clover								
Centepede Grass					20 {22}			
Reseed Crimson Clover								
Pensacola Bahia Grass							40 {45}	
Required Permanent Plant	Common Burmuda Grass (3)	Common Burmuda Grass (3)	None - 1st Stage (1) (4)	Tall Fescue (3)	Tall Fescue	None - 1st Stage (1) (4)	None - 1st Stage	Common Burmuda Grass (3)

Notes for Mixed Seeding Table 1:

(1) See specifications concerning temporary (first stage) grassing.

(2) Plant only where designated by plans.

(3) White Dutch Clover may be deleted in urban areas and residential areas at the direction of the Engineer

(4) Planting Date may be extended at the discretion of the Engineer.

TABLE 2 (PART 1) MIXED SEEDING - BACKSLOPES FILL SLOPES AND AREAS NOT SUBJECT TO FREQENT MOWING						
POUNDS PER ACRE {KILOGRAMS PER HECTARE} OF PURE LIVE SEED						
Planting Zone	1		1	2		
Mix Number	1D		1DT	2D		
Planting Dates	March 1 Until July 31	August 1 Until November 15	August 2 Until January 15	February 15 Until June 15	July 1 Until August 31	September 1 Until November 15
Annual Rye Grass			25 {28}			
Hulled Burmuda Grass					15 {17}	15 {17}
Unhulled Burmuda Grass					10 {11}	
Brown Top Millet						30 {34}
Tall Fescue		30 {34}				
Weeping Love Grass	4 {5}			4 {5}	4 {5}	
Annual Lespedeza (Kobe)						
Sericea Lespedeza	50 {56}	75 {84}		50 {56}	75 {84}	75 {84}
White Dutch Clover						
Reseed Crimson Clover						
Pensacola Bahia Grass						
Coreopsis Lancolate						5 {6} *
Required Permanent Plant	Sericea Lespedeza (Interstate Variety) (3)	Sericea Lespedeza (Interstate Variety) (1)	None - 1st Stage (2)	Sericea Lespedeza (Interstate Variety) (3)	Sericea Lespedeza (Interstate Variety) (3)	Sericea Lespedeza (Interstate Variety) (1)

TABLE 2 (PART 2) MIXED SEEDING - BACKSLOPES FILL SLOPES AND AREAS NOT SUBJECT TO FREQENT MOWING						
POUNDS PER ACRE {KILOGRAMS PER HECTARE} OF PURE LIVE SEED						
Planting Zone	2	3	3	1		
Mix Number	2DT	3D	3DT	1E		
Planting Dates	November 16 Until January 15	February 15 Until August 31	September 1 Until January 1	March 1 Until July 31	August 1 Until November 15	November 16 Until February 28
Annual Rye Grass	25 {28}		25 {28}			15 {17}
Hulled Burmuda Grass				15 {17}		
Unhulled Burmuda Grass				10 {11}	15 {17}	30 {34}
Brown Top Millet						
Tall Fescue				30 {34}	30 {34}	30 {34}
Weeping Love Grass		4 {5}		2 {2}		
Annual Lespedeza (Kobe)						
Sericea Lespedeza		50 {56}		30 {34}	30 {34}	
White Dutch Clover						
Reseed Crimson Clover					25 {28}	
Pensacola Bahia Grass						
Coreopsis Lancolate				5 {6} *	5 {6} *	5 {6} *
Required Permanent Plant	None - 1st Stage (2)	Sericea Lespedeza (Interstate Variety) (3) (4)	None - 1st Stage (2)	Mixed Species (3)	Mixed Species	Mixed Species

TABLE 2 (PART 3) MIXED SEEDING - BACKSLOPES FILL SLOPES AND AREAS NOT SUBJECT TO FREQENT MOWING						
POUNDS PER ACRE {KILOGRAMS PER HECTARE} OF PURE LIVE SEED						
Planting Zone	2			3		
Mix Number	2E			3E		
Planting Dates	February 15 Until August 31	September 1 Until November 15	November 16 Until February 14	February 15 Until August 31	September 1 Until November 30	December 1 Until February 14
Annual Rye Grass	5 {6}	10 {11}	10 {11}		10 {11}	10 {11}
Hulled Burmuda Grass	15 {17}	10 {11}		10 {11}	10 {11}	
Unhulled Burmuda Grass	10 {11}	10 {11}	20 {22}	15 {17}	10 {11}	25 {28}
Brown Top Millet						
Tall Fescue		30 {34}	25 {28}		30 {34}	25 {28}
Weeping Love Grass	2 {2}	2 {2}		2 {2}	2 {2}	
Annual Lespedeza (Kobe)	40 {45}			40 {45}		
Sericea Lespedeza						
White Dutch Clover						
Reseed Crimson Clover		25 {28}	25 {28}		25 {28}	25 {28}
Pensacola Bahia Grass	25 {28}	25 {28}	25 {28}	20 {22}	25 {28}	25 {28}
Coreopsis Lancolate		5 {6} *	5 {6} *		5 {6} *	
Required Permanent Plant	Mixed Species (3)	Mixed Species (3)	Mixed Species	Mixed Species (3)	Mixed Species (3)	Mixed Species

Notes for Mixed Seeding Table 2:

(1) Unscarified seed.
(2) See specifications concerning temporary (first stage) grassing.
(3) Do not plant Lovegrass unless slope ar area is unmowable.
(4) Recommended for Northern Counties in Zone 3.
* Plant only when designated by plans for color.

860.02 Grass Sprigs.

(a) GENERAL.

This Article is based on the use of sprigs; however, should the Contractor elect to use plugs of sod, the same basic requirements are applicable except that harvesting shall be in accordance with the provisions of Article 860.05 for solid sod, which in turn shall be cut to proper size (at least 2 inches by 2 inches {50 mm by 50 mm}) by an acceptable procedure before use.

Grass sprigs or plugs of sod turfs shall be common or Tiflawn Bermudagrass, Centipede, Myers Zoysia, Zoysia Matrella, or other perennial running grasses that may be indicated by the plans. All grass shall be native or adaptable to the locality of the work and shall be live, fresh, vigorous, and uninjured at the time of planting and until completion and acceptance of the work. The sprigs shall have well formed and developed root systems and shall be in clusters or tufts at least 1 inch {25 mm} in diameter unless otherwise directed. Sprigs containing Johnsongrass, Bahiagrass, Dallasgrass, or other objectionable grasses or weeds will not be accepted.

(b) PROCURING AND HANDLING SPRIGS.

Before harvesting, the Engineer shall be notified of the source of sprigs for purposes of inspection. Approval of sources on such examination shall not be construed as an acceptance of the material. Unless the grass area has been grazed closely, it shall be mowed to height of 3 inches {75 mm} maximum before harvesting. The sprigs shall be harvested with a sod-cutter, turning plow, or other approved implements in such a manner that at least 2 inches {50 mm} of the root system will be lifted intact. Raking and otherwise harvesting sprigs that remain on the surface after digging and have been allowed to dry out, will not be permitted. Solid sod specified in Article 860.05 may be pulled apart and used as sprigs.

The properly harvested sprigs shall be loaded within one hour after they are dug then transported to the place where they are to be planted. They shall be kept cool, moist and shaded at all times after digging, while being transported to the sprigging site, after being unloaded, and until planted. Small quantities of sprigs left over at the end of the work day or at time of heavy rains may be stocked in thin covered piles and may be used the next day or not over three days later, provided sprigs in the pile are still acceptable. The sprigs will be subject to inspection during the planting period, and any material which has been permitted to dry out or to freeze, or which is not moist and viable, will be rejected.

When large pieces of sprigs are to be broken down into smaller pieces for sprigging, this operation shall be done by hand or by such other means that will avoid severing the roots from the tops of the sprigs.

After unloading, accepted sprigs shall be carried to the planting site in moist cloth or burlap bags and kept therein until ready to be dropped into the furrows.

860.03 Mulching Material.

(a) GENERAL.

Mulch shall be any of the following materials or any approved locally available material. Mulch material which contains matured seed of species which would volunteer and be detrimental to the proposed planting or to adjacent farm land will not be acceptable. Before collection of mulch material is begun or delivery made, the Contractor shall notify the Engineer of sources and quantities of mulch materials for purposes of inspection. If required, representative samples of the materials proposed for use shall be submitted to the Laboratory for testing.

Mulching materials will be broken into two basic classes suitable for use as follows:

Class A.

For use with regular erosion control items that produce grasses such as seeding, sprigging, etc.

Class B.

For use with shrubs, vines, trees, or other plants.

(b) CLASS A. MULCH.

1. GENERAL.

Class A mulch will, in general, require the use of some type of adhesive, a krimper or erosion control netting to hold the mulch in place.

2. HAY.

Hay shall be applied at the rate of not less than 2 tons per acre {4500 kg/ha}, and may be native hay or Sudan grass, broom straw, coastal bermudagrass, or any other acceptable material when approved as compatible with the planted species. Low grade, musty, spoiled, partially rotted hay unfit for animal consumption is acceptable. Hay or straw shall be applied with a moisture content not more than 15 percent or if the moisture content exceeds 15 percent, a proportionate increase shall be made in the rate of application.

3. STRAW.

Straw shall be threshed straw of oats, wheat, or rye, applied at the rate of not less than 1.75 tons per acre {3900 kg/ha} with a moisture content of not more than 15 percent, or if the moisture content exceeds 15 percent, proportionate increase shall be made in the rate of application.

4. EXCELSIOR (WOOD).

This shall be manufactured from freshly cut wood stock, coarse grade, 6 to 10 inches long and 1/16 to 1/8 inches wide {150 to 250 mm long and 2 to 3 mm wide} applied at the rate of not less than 2 tons per acre {4500 kg/ha} with a moisture content of not more than 35 percent or, if the moisture content exceeds 35 percent, a proportionate increase shall be made in the rate of application.

5. WOOD CELLULOSE FIBER OR NATURAL WOOD FIBER.

A mulch for use with the hydraulic application of grass seed shall consist of specially prepared wood cellulose or a natural wood fiber containing clean whole cut chips. It shall be processed in such a manner that it will contain no growth or germination inhibiting factors and shall be dyed an appropriate color to facilitate a uniform spread of the slope by visual inspection. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with fertilizers, grass seeds, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry; and that when hydraulically sprayed on the ground, the material will form a blotterlike ground cover impregnated uniformly with grass seed; and which after application will allow the absorption of moisture and allow rainfall or mechanical watering to percolate to the underlying soil. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished, and that it meets all the foregoing requirements based upon such testing.

The mulch material described above shall be supplied in packages having a gross weight {mass} not in excess of 100 pounds {45 kg}. Weight {mass} specifications of this material from suppliers, and for all applications, shall refer only to air dry weight {mass} of the fiber material. Absolute air dry

weight {mass} is based on the normal weight {mass} standard of the Technical Association of the Pulp and Paper Industry for wood cellulose and natural wood fiber is considered equivalent to 12 ± 3 percent moisture. Each package of the fiber shall be marked by the manufacturer to show the air dry weight {mass} content. The fiber shall be applied at the rate of at least 2000 pounds per acre {2250 kg/ha} with a moisture content not over 12 ± 3 percent, or if the moisture content exceeds 12 ± 3 percent, a proportionate increase shall be made in the rate of application.

6. MOISTURE CONTENT.

Should the Engineer denote excessive moisture in the mulching material, he may order the moisture content checked in accordance with the following, with excessive moisture being cause for rejection of material.

Hay Or Straw.

Run sample at 100 °C to 110 °C until constant weight {mass} is obtained, using the following formula, compute the moisture content:

Moisture content = ((A-C)/(A-B)) X 100

A = Sample and pan weight {mass}
B = Tare weight {mass}, pan
C = Dry weight {mass}, sample and pan
A-B = Sample weight {mass}
A-C = Moisture loss

Excelsior.

ASTM D 1348 Federal Specifications on Excelsior PPP-E-911C.

Wood Cellulose Fiber Or Natural Wood Fiber.

See paragraph 2 of Item 860.03(b)5.

Only approved mulch materials from approved sources shall be acceptable.

7. ADHESIVE OR EROSION CONTROL NETTING FOR USE WITH MULCH.

a. General.

Straw or hay, not requiring the krimper operation, will require the use of either an adhesive or the erosion control netting noted in this Item. Excelsior (wood) or wood fiber does not normally require the use of a krimper, an adhesive or netting.

b. Adhesives.

(1) Asphalt Adhesives.

Asphalt used in the mulching operations shall be suitable for mulching and shall contain no petroleum solvents or other diluents toxic to plant growth. It shall be a homogeneous emulsification of refined asphalt of the CSS-1 or CSS-lh Type as provided in the Emulsified Asphalt Tables of Section 804 and suitable for spray application with or without dilution by additional water applied at a rate of not less than 150 gallons per acre {1400 L/ha} of undiluted emulsified asphalt.

On areas where erosion is likely, the quantity of asphalt adhesive may be increased as directed by the Engineer. An adjustment to the unit price bid will be made for such ordered increase for the cost of the additional volume of asphalt at the certified invoice cost of the asphalt plus two cents per gallon {one cent per liter}.

(2) Tackifier Adhesive.

A tackifier listed on List II-20, TACKIFIERS FOR MULCHING, of the Department's manual "Materials, Sources, and Devices With Special Acceptance Requirements" may be used at the manufacturer's recommended rates. Refer to Subarticle 106.01(f) and ALDOT-355 for further information.

c. Erosion Control Netting.

Erosion control netting shall be of the Class A Type complying with the requirements of Section 659.

8. GLASS FIBER WITH ASPHALT ADHESIVE.

Glass fiber material used for mulching shall consist of continuous fibers drawn from molton glass, coated with a chrome-complex sizing compound; collected into strands and lightly bound together with the use of clay, starch, or like deleterious substances. The glass fibers shall be formed or wound into a cylindrical package in such a manner that the glass fibers can be continuously fed through an ejector driven by compressed air and expanded into a mat of glass fibers on the soil surface. The material shall contain no petroleum solvents or other agents known to be toxic to plant or animal life.

The glass fibers shall conform to the following specific requirements:

Property	Limits	Test Method
Fiber Diameter	0.00035 to 0.00053 inches {0.00875 to 0.01325 mm}	ASTM D 578
yards per pound {meters/kilogram} of fibers	170-300 {344 – 606}	ASTM D 578
Organic content	1.65% Max.	ASTM D 578
Package weight {mass}	30 – 45 pounds { 14 - 16 kg}	ASTM D 578

The glass fibers shall be spread on the area at the approximate rate of 0.25 to 0.35 pounds per square yard {0.14 to 0.19 kg/m²}.

An asphalt adhesive meeting the requirements noted in Subitem 860.03(b)7.b shall be applied at the rate of approximately 0.15 to 0.29 gallons per square yard {0.68 to 0.91 L/m²}.

(c) CLASS B MULCH.

1. GENERAL.

Class B mulch, in general, is suitable only for use with vines, shrubs, and other types of planting.

2. FOREST LITTER.

Forest litter shall be the surface layer of semi-decayed leaves, twigs, needles, and small branches from local woods, and shall be removed in such a way as to avoid injury to the existing trees.

3. HULLS.

Hulls may be the hulls of cotton seed, cotton bolls, peanuts, or ground corncobs.

4. MANURE.

Manure shall be partially decomposed stable manure. It shall contain no more than 25% shavings, sawdust, and be free from noxious weeds and harmful chemicals, and at least three months old.

5. SPHAGNUM MOSS PEAT.

Peat under this requirement shall be partially decomposed material and shall contain not more than 25% ash by dry weight {mass}.

6. SAWDUST.

Sawdust shall be in a decomposition stage. Sources shall be approved by the Engineer.

7. PINE BARK, REDWOOD OR OTHER APPROVED WOOD BARK MULCH.

Pine bark, Redwood, or other approved wood bark mulch for use as a mulching material or as an organic additive for prepared plant topsoil when specified on the plans or proposal. All bark materials shall be clean and free of noxious weed seed, harmful material and basically without decomposition.

Materials shall be graded as follows:

Bark Fines (passes through 1/4 inch {6 mm} screen)
Bark Flakes (retained on 1/4 inch {6 mm} screen)
Chunks (retained on 3/4 inch {19 mm} screen) maximum chunk 2 inches {50 mm}
Cambium and Bark (shredded combination Bark and Cambium)

860.04 Grassy Mulch Material.

(a) GENERAL.

Grassy mulch shall be obtained from the sources of the Contractor's selection and meeting the approval of the Engineer. The Contractor shall furnish such material and construct and maintain hauling roads necessary for obtaining the material, all without extra compensation.

The grass contained in the grassy mulch material shall be live growing grass as provided in Article 860.02 and shall be procured from areas where the soil is fertile as indicated by vigorous growth. The grass shall have a healthy virile root system of dense, thickly matted roots. It shall be reasonably free from obnoxious weeds or other grasses, and shall not contain any matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted. The soil part of the mulch shall be the topsoil in which grass is growing and may include the 2 inches {50 mm} immediately underlying the root system provided it is identical topsoil and no part of the less friable subsoil is taken.

(b) HARVESTING AND HANDLING GRASSY MULCH.

1. HARVESTING OPERATIONS.

Grassy mulch shall be taken only from an approved source. The grassy mulch shall be procured only when the soil is in a moist, friable condition. During extremely dry periods it may be necessary to water the areas from which mulch is to be taken. Previous to any other manipulations, these areas shall be grubbed clear of any bushes or stubs and closely mowed and raked to remove all weeds and long standing stems. The material thus cleaned from the sites shall be burned. Such cleaning is deemed a necessary part of this Item and not considered under the Item of "Clearing and Grubbing." If directed, this operation may be omitted if the grass is sufficiently short and the area satisfactorily cleared of obstructions. After grubbing, mowing and raking, and sprinkling, if considered necessary, the grass shall be disced until the sod has been well mangled and the topsoil loosened to the depth it is to be taken. After discing, the grassy mulch shall be cast into windrows by an approved tractor-drawn or motor-powered blade grader.

2. LOADING.

The well mixed topsoil and grass roots shall be loaded into trucks by hand shovels, power shovels, drag lines, or other mechanical loading devices. No grassy mulch shall be loaded which has been disced, but not windrowed, more than six hours or which has been windrowed more than 24 hours unless the loading operations have been interrupted by rain in sufficient quantity to wet the grassy mulch and make work impracticable. Loading shall be resumed as soon as practicable after such rain ceases. All material windrowed prior to such rain shall be loaded and placed within 24 hours after such rain ceases. In no case shall grassy mulch be used in which the grass has soured, mildewed or started to decay.

860.05 Solid Sod.

(a) GENERAL.

Solid sod shall be obtained from sources of the Contractor's selection meeting with the approval of the Engineer. The Contractor, without extra compensation, shall furnish such material and construct and maintain hauling roads necessary for obtaining the material.

The sod shall be of common Tiflawn Bermudagrass, Centipede, Myers Zoysia, Zoysia Matrella, or other approved types of native or adaptable grasses, suitable for growing in the locality of the work.

(b) PROCURING AND HANDLING SOD.

1. GENERAL.

All sod shall be procured from areas where the soil is fertile and contains a high percentage of loamy topsoil and where the grass is well rooted and full grown and from areas that have been grazed or mowed sufficiently to form a dense turf. (Approximately 2 inches {50 mm} in height at the time of lifting). The soil shall be free from obnoxious weeds or other grasses and shall not contain any matter deleterious to its growth. The sod shall be live, fresh growing grass at the time of harvesting as well as at the time of placement.

2. HARVESTING.

Mechanical devices, such as sod cutters, may be used for cutting the sod into strips, blocks or rolls at least 12 inches {300 mm} wide, except when sod strips are specified, then they shall be at least 3 inches {75 mm} wide. Depth of sod cutting shall be such that approximately 3/4 of an inch {19 mm} of soil is removed with the turf. Care shall be exercised at all times to retain the native soil on the roots of the sod during the process of excavating, hauling, and planting.

3. HANDLING.

Sections of sod shall be cut away below the root line and shall be lifted and loaded in such a manner that no tearing or breaking will occur, and unloaded by hand or approved mechanical method. Dumping from vehicles will not be permitted. All broken or dried sod shall be rejected and removed from the job.

4. CONTROL.

The sod shall, in general, be transplanted within three days from the time it is harvested. However, if held in temporary storage, the sod shall be spread in a shady location with the grass side up. The sod shall be sprinkled with water when and as directed. If required, it shall be covered with moist burlap, straw, or other acceptable material. Any sod permitted by the Contractor to dry out may be rejected whenever, in the judgment of the Engineer, its survival, after placing, shall have been rendered doubtful and no payment for such sod shall be made.

In no event shall more than 10 days elapse between the cutting and planting of the sod.

Prior to permitting sod planting, the Engineer will inspect the sod stacks for retention of native soil. Such may be accomplished by measuring the stack height and determining the average layer thickness (3/4 of an inch {19 mm} minimum).

860.06 Vines, Shrubs And Trees.

(a) GENERAL.

1. The scientific and common names of plants shall be in conformity with the approved names in "Standardized Plant Names" (current edition) prepared by the American Joint Committee on Horticultural Nomenclature.

2. Plants shall be in accordance with the American Standards for Nursery Stock (current edition), except as provided on the plans. All plants shall have normal habit of growth and shall be typically characteristic of the particular variety and species. All plants shall conform to the measurements provided, which are the minimum acceptable sizes. They shall be measured before pruning with branches in normal position. When a minimum and maximum size is provided, an average size is required. Deciduous trees shall be measured by approved calipers. Plants which hare been cut back from larger grades to meet these Specifications will not be acceptable. Plants shall be nursery grown and shall bear evidence of proper top and root pruning unless otherwise provided. No cold storage plants will be accepted. Plants shall have been growing for a period of at least one year under the same climatic conditions as exist at the location to be planted. Where the Specifications or plans permit, planting stock which has been collected, such stock shall be clean, sound stock free from decayed or decaying stumps and from fire injury.

3. For purpose of inspection, the Contractor shall give notice to the Engineer 48 hours in advance of the delivery of plant material. The Contractor shall be responsible for all certificates of inspection of plant materials that may be required by Federal, State or other authority to accompany shipments of plants. All plants shall be subject to inspection and approval by the Engineer at any place and at any time. Plants may be inspected where growing, but approval at place of growth shall not preclude the right of subsequent rejection of plants not fully meeting the requirements of the Specifications. After the award is made, the Engineer reserves the right to place Department seals on any and all materials selected, but such tagging and approval shall cover the type and body quality of the plant only, but not final acceptance. The removal and replacement of rejected plants shall be effected by the Contractor in compliance with the Specifications and shall be without extra compensation.

4. Plants and plant qualities other than those named in the Specifications will be accepted only if approved.

5. Legible labels shall be attached to all separate plants or boxes, bundles, bales, or other containers, indicating the name, size, age, or other necessary detailed information and the quantity contained in the individual bundles, boxes or bales.

(b) PLANTING LIMITATIONS.

Normal planting season for vines, shrubs, and trees is between December 1 and February 15 and the Contractor shall make every effort to accomplish the planting during this period. Should, however, the contract time be such that plants cannot be placed during this period, the Engineer shall direct the placement of the plants at the earliest possible time the plant areas can be made available. Under conditions that require or if the Contractor elects to place the plants out of the normal planting season, all plants shall be container grown or pre-cured and planted in accordance with the following:

Container Grown.

Container grown plants shall have been grown in its container for a minimum of eight months.

After plants are moved to their permanent location, they shall be watered in as specified, mulched, etc. Syringing down of the leaf areas shall be performed as necessary to prevent wilting, dehydration, and excessive shedding of new or old growth. This will require a period of thirty days or longer to assure that a given plant has been successfully transplanted.

Pre-Cured.

Pre-curing of plants is a technique that allows the planting of balled or burlap plant materials during period other than in the dormant period of planting season specified. The following procedure shall generally be followed to precure or hardening off a plant.

1. Specified plants shall be dug and placed unpruned in a lath or green house.
2. The ball shall be covered with well rotted sawdust.

3. Humidity shall be maintained to such a degree that wilting or dehydration does not occur.

4. Spray nozzles shall be of mist type, connected to suitable interrupter devices if necessary, so that water logging of the plant balls does not occur.

5. After root hairs have formed, as evidenced by their emergence through the burlap, and with new and old top growth in a health, turgid condition, the plants shall be transplanted to their permanent location.

6. This pre-curing period shall be a minimum of thirty days.

7. Leaf drop or defoliation shall be limited to one-fourth the total leaves.

8. After plants are moved to their permanent location, they shall be watered, mulched, etc. Syringing down of the leaf areas shall be performed as necessary to prevent wilting, dehydration, and excessive shedding of new or old growth. This will require a period of 30 days or longer to assure that a given plant has been successfully transplanted.

Any plantings accomplished outside of the normal planting season shall be inspected regularly and any plant found defective shall be removed and immediately replaced with the same size and kind in the same manner as originally provided.

Any additional cost involved in planting out of season due either to the Contractor's inability to schedule his work properly or contract time requirements shall be considered incidental to the work and no additional compensation will be allowed.

Planting will not be permitted during periods when the ground is frozen.

(c) DIGGING AND TRANSPORTATION.

1. All plants shall be dug with reasonable care and skill immediately before shipping, avoiding all possible injury to, or loss of roots. Plants shall be of the size, and with balls or roots spread, as shown on the plans. After plants are dug, their roots shall not be permitted to dry out, and they shall not be exposed to artificial heat or freezing temperatures.

2. During transportation, all plants shall be packed or protected in such a manner as to insure adequate protection from sun, wind, and climatic or seasonal injuries. All bare-root plants shall have their roots carefully protected by wet straw, moss, or other suitable material. Tarpaulins or other covers shall be placed over plants when transported by truck or in an open freight car. Shipments made in box cars shall be adequately ventilated to prevent sweating. The head of each tree shall be tied in carefully to prevent fracturing or cracking the branches.

3. Previous to shipment and after delivery to the project, all plants shall be properly protected. Bare-root plants shall be heeled-in in trenches with the bundles opened and the plants spaced separately and all roots covered. Balled and burlapped, and balled and platformed plants, shall have their earth balls protected by earth or wet cloth or straw. Where possible all plants shall be stored in a well-ventilated and shaded place and protected from wind and sun.

(d) TREES.

1. Trees shall be of the size and kind designated by the plans, have a straight trunk with a well-branched, symmetrical top, and with leader intact. Trees shall have no fresh cuts of limbs over 3/4 of an inch {19 mm} which have not completely calloused over, no cut back trees, and no abrasions of the bark. Trees must be free from insect and disease injury. Trees injured in transit or delivered in an unsatisfactory manner will be rejected. Trees must have good fibrous root systems. All root cuts must be cleanly cut.

2. At the time of digging, bare-root trees (B.R.) must be puddled in a clay solution of proper consistency to coat and adhere to all parts of the root system. Any tree may be supplied balled and burlapped instead of bare-root at the unit price bid.

3. Balled and burlapped trees (B & B) shall be adequately balled with firm, natural balls of sufficient size to insure the growth of the plants or cut to size shown on the plans. Balls shall be firmly wrapped with burlap or other approved strong cloth and firmly tied with rope or other satisfactory material. No balled plant will be acceptable if cracked or broken before or during the process of planting, and no plant will be acceptable which is handled by the plant itself and not by the ball. All fibrous and pliable roots encountered in trenching around the ball shall be cut off flush with the outer side of the trench, the ground in the trench loosened with spading fork, and the flexible roots shall be immediately wrapped in burlap, moss, or straw and bound against the side of the ball. Only stiff roots may be cut off flush with the ball. The ball of earth for each tree shall be of sufficient depth to include all lateral roots.

4. Balled and platformed trees (B & P) shall be balled as provided for balled and burlapped trees. Platforms shall be square or octagonal shaped in a size slightly larger than the diameter of the bottom of the soil weight {mass}, inserted under each ball and securely lashed to the ball by means of ties from the platform corners to the rope collar on top of the ball.

(e) SHRUBS.

Shrubs shall be of the size and kind designated by the plans. Bare-root shrubs shall have good fibrous root systems. Balled and burlapped shrubs shall be vigorous, well furnished plants of uniform quality and must have fibrous root systems. Plants provided as sods or clumps shall be collected from good soil which has produced a fibrous root system typical of the nature of the plant. The sods shall be dug with earth and incidental vegetation adhering to the roots. If the soil or habit of the root growth is such that the roots are not adequately protected, the sods shall be wrapped in burlap or other suitable material.

(f) VINES AND PERENNIALS.

Vines and perennials shall be of the size and kind designated by the plans. Bare-root vines shall be vigorous, well furnished plants with good vigorous root systems, puddled before delivery or otherwise protected by an acceptable method. Pot-grown plants (P.G.) shall be vigorous well-developed plants, well established in pots with sufficient roots to hold the earth together intact after removal from containers and at the same time not to be root-bound. Upon permission of the Engineer due to lateness of planting in the spring season causing a hold-over of the planting of vines to the next season, the Contractor may furnish and plant potted plants of the kinds of vines designated as bare-root, provided the potted plants are at least one year old, the pots 2.5 inches {63 mm} minimum diameter, and two plants for the one ordered are furnished and planted in the same pocket holes or beds as specified. The two plants will be paid for at the unit price for one plant. Balled and burlapped vines shall be vigorous, well-developed plants. Perennials shall be field grown unless otherwise provided.

(g) PINE SEEDLINGS.

Pine seedlings shall be Loblolly Pine for the North Alabama Planting Zone and Slash Pine in South Alabama Planting Zone, unless otherwise shown on the plans or in the proposal. Seedlings shall be approximately one year old and 6 to 12 inches {150 to 300 mm} high, except that any longleaf seedlings shall be root pruned and needle clipped.

Pine seedlings that are shipped in bales shall be protected from the sun, wind, and freezing weather at all times before planting. The bales shall be stacked loosely to permit free circulation of air and not more than two bales high. They shall be watered on arrival and every two days thereafter, or as directed. Seedlings from damaged or broken bales shall be "heeled in" by cutting V-bottom trenches approximately 6 inches {150 mm} deep, spreading the pines along the trench with the roots down. Roots shall be covered with fine soil, leaving the tops exposed. Seedlings shall be watered frequently enough to keep the soil moist.

860.07 Seed Inoculating Material.

Inoculating materials as required for coating certain legume seed immediately before sowing shall be an approved commercial culture manufactured by a reputable concern and of the culture group appropriate for the kind of seed to be treated. The material as received on the work shall be fresh stock designated for the current season, packaged and sealed to protect bacteria and insure against moisture loss.

860.08 Plant Topsoil (Topsoil For Backfilling Plant Pits).

Plant topsoil shall be composed of four parts of soil containing not more than 35% clay and not less than 15% nor more than 75% sand, one part mulching material (as defined in Subarticle 860.03(c), 8 pounds {4 kg} of 8-8-8 Commercial Fertilizer, and 5 pounds {2 kg} of agriculture limestone per cubic yard {cubic meter} (mineral additive may be adjusted to fit soil test results).

In lieu of the off-site topsoil noted above, with the approval of the Engineer, material from the plant pit modified with mineral additives as directed may be used.

860.09 Tree Root Protection Material.

The material for root protection shall be aggregate of approved quality, suitably graded from 3/8 to 5 inches {9 to 125 mm} in size. The material may be any suitable aggregate broken to suitable size, or may be gravel, crushed stone, slag, or broken concrete.

860.10 Miscellaneous Materials For General Planting Operations.

(a) BRACING AND ANCHOR STAKES.

Bracing stakes shall be of southern yellow pine or other approved wood, sized in accordance with plan requirements. Stakes shall have a minimum allowable deflection of ten percent. All stakes shall be free from insects and fungi. Anchor stakes or deadmen shall be of the quality and sizes required for the operations calling for their use.

(b) WIRE AND BRACING MATERIALS.

Wire shall be galvanized steel or aluminum, No. 9, No. 10, or No. 12, A.S.&W. gage as specified. The size and quality of cables, turnbuckles, thimbles, lag hooks, eye bolts, rods, washers, and nuts shall be as approved.

(c) PAPER AND TWINE.

Wrapping paper for trees shall be krinkle-kraft or equal, waterproof paper, 30-30-30, in 4 inch {100 mm} strips. The tying material to be used in wrapping trees shall be jute twine not less than two ply for trees 3 inches {75 mm} or less in diameter, and three ply for trees over 3 inches {75 mm} in diameter.

(d) TREE PAINT.

Paint used for tree wounds shall be approved antiseptic, waterproof, adhesive, and elastic, such as asphaltum water emulsion, gutta percha, and certain oils with a fungicide and which remains tacky for four hours and retains elasticity after setting when tested under the heat of the hand. It shall not contain kerosene, coal tar, creosote, or other material harmful to cambium or living tissue.

(e) WIRE PROTECTIVE HOSE.

Hose shall be 1/2, 5/8, or 3/4 of an inch {13, 16, or 19 mm} in diameter, suitable for the purpose intended, or other approved material (hose may be second-handed).

(f) BURLAP.

Burlap shall have a weight {mass} of at least 8 ounces per square yard {0.27 kg/m^2}.

(g) DRAIN TILE PIPE.

Drain tile pipe shall meet the requirements of Section 853. The diameter of the tile shall be 6 inches {150 mm} unless otherwise specified on the plans.

860.11 Erosion Control Netting.

(a) GENERAL.

Netting material furnished for use shall be of sufficient strength to hold the processed ground and/or any cover material (mulch, sod, etc.) in place until an acceptable growth of natural or planted material is established. The following materials have been found acceptable for the class designated; however, other materials having different compositions or dimensions will be considered but such must be approved by the Engineer before being permitted on the project.

Netting may be used, without any Job Control Samples, upon visual inspection of the Engineer and with a certification by the producer that the material meets the specified requirements; however, Job Control Samples may be required at any time deemed necessary by the Engineer. The approval of any material for use is subject to satisfactory field performance and does not preclude the Engineer ordering repairs or replacements for materials which are deteriorated, damaged or otherwise unsatisfactorily performing the intended function.

(b) CLASS A NETTING.

1. JUTE NETTING.

Jute netting shall be a jute netting woven from undyed and unbleached plain, single jute yarn, loosely twisted with approximately uniform diameter yarn in both length and width directions. The finished cloth physical requirements are as follows:

Width - Nominal 48 inches {1200 mm}
Length - Convenient lengths; 50 yard {45 m} minimum
Weight - 1.05 pounds - 1.70 pounds per linear yard of 48 inch wide material
{Mass – 0.5 to 0.769 kg/m of 1200 mm wide material}
Openings - Approximately 1/2" to 1" {13 to 25 mm} in width and length

2. EXCELSIOR, OR BOTANICAL FIBER, BLANKET AND NETTING.

The excelsior blanket and netting shall consist of a machine produced mat of curled wood excelsior formed from 80% 6 inch {150 mm} or longer fibers so formed as to provide a reasonably uniform blanket of the same thickness which shall be covered on at least one side (top) with an approved netting material.

The botanical fiber blanket and netting shall consist of a mat of sufficiently long botanical fibers or straw so formed as to provide a reasonably uniform blanket of the same thickness which shall be covered on at least one side (top) with an approved netting material.

The netting shall be a biodegradable extruded polypropylene or other acceptable plastic material forming a mesh having 1/4 to 1 inch {6 to 25 mm} rectangular or square openings.

The excelsior, or botanical fiber, blanket and netting shall be furnished in rolls meeting the following requirements:

Width - 48 inches {1200 mm}, minimum
Length - Convenient lengths, 20 yard {18 m} minimum
Weight - 0.50 pounds per square yard {0.27 kg/m^{2}}, minimum average

(c) CLASS B NETTING.

1. CLOSED COTTON, RAYON, POLYESTER YARN, OR PLASTIC NETTING.

This type netting shall consist of a uniform open weave fabric having 1/4 to 1 inch {6 to 25 mm} rectangular or square openings woven from undyed and unbleached yarn or extruded polypropylene material. This fabric shall then be firmly affixed to a sheet(s) or intrawoven with strips of heavy or medium weight cellulose tissue. This type netting shall be furnished in rolls meeting the following requirements:

Width - 48 inches {1200 mm}, minimum
Length - Convenient lengths, 50 yard {45 m} minimum
Weight - 0.165 pound per square yard {0.01 kg/m^2}, minimum average

2. EXCELSIOR, OR BOTANICAL FIBER, BLANKET AND NETTING.

The excelsior blanket and netting shall consist of a machine produced mat of curled wood excelsior formed from 80% 6 inch {150 mm} or longer fibers so formed as to provide a reasonably uniform blanket of the same thickness which shall be covered on at least one side (top) with an approved netting material.

The botanical fiber blanket and netting shall consist of a mat of sufficiently long botanical fibers or straw so formed as to provide a reasonably uniform blanket of the same thickness which shall be covered on at least one side (top) with an approved netting material.

Acceptable netting for either blanket shall be one of the following or an approved equal:

(1) Twisted kraft paper with a high wet strength or a cotton, rayon, or polyester fabric forming a mesh having 1/4 to 1 inch {6 to 25 mm} rectangular or square openings.

(2) Biodegradable extruded polypropylene or other acceptable plastic material forming a mesh having 1/4 to 1 inch {6 to 25 mm} rectangular or square openings.

The excelsior, or botanical fiber, blanket and netting shall be furnished in rolls meeting the following requirements:

Width - 48 inches {1200 mm} minimum
Length - Convenient lengths, 20 yard {18 m} minimum
Weight - 0.50 pounds per square yard {0.27 kg/m^{2}}, minimum average

(d) STAPLES OR STAKES.

The use of either staples or stakes shall be as recommended by the manufacturer of the erosion control netting.

Staples used to fasten the erosion control netting to the soil surface shall be steel, U-shaped and shall be approximately 6 inches {150 mm} long and 1 inch {25 mm} wide. Machine made staples shall be of No. 11 gauge or heavier steel wire. Hand made staples shall be made from 13 inch {325 mm} lengths of No. 9 gauge or heavier steel wire.

Stakes used to fasten the erosion control netting to the soil surface shall be of a type, shape and length as recommended by the manufacturer unless designated otherwise by the plans.

(e) CLASS C NETTING.

Class C Netting shall be a flexible, three-dimensional soil reinforcement synthetic mat made from entangled nylon monofilaments, containing a minimum of 0.5% by weight {mass} of carbon black,

fused at their intersections. The mat shall be crush-resistant, pliable, resilient, water-permeable, and highly resistant to chemicals and environmental degradation meeting the following physical properties:

	Class C1	Class C2
Weight (oz/sq. yd.) (minimum) {Mass (approximate) (minimum)}	11.1 {0.41 kg/m^2}	7.3 {0.26 kg/m^2}
Thickness (minimum)	0.75 inches {20 mm}	0.4 inches {10 mm}
Filament Diameter (minimum)	0.016 inches {.004 mm}	0.014 inches {0.003 mm}
Tensile Strength-ASTM D 1682 modified Length Direction (lbs/ft - minimum) Width Direction (lbs/ft - minimum)	 250 120	 190 55
{Tensile Strength-ASTM D 5034 & D 5035 modified Length Direction (minimum)}	{2.3 kN/m}	{1.5 kN/m}
Elongation (% - minimum) Length Direction Width Direction	 75 75	 70 80
Exposure Properties Temperature Range for 80% Strength Retention pH Range for Strength Retention	 -100°F to 250°F {-30° C to 100° C} 3 to 12	

860.12 Fertilizer.

(a) GENERAL.

The fertilizer or fertilizers used shall be of the type and grade provided herein, on the plans and/or the proposal form and when tested by current methods adopted by the Association of Official Agricultural Chemists, shall comply with Alabama Fertilizer Laws, Title 2, Sections 282-300, Alabama Code of 1940, as amended.

(b) MANURE.

Lot or stable manure shall consist of animal droppings which may be mixed with not over 25 percent, by volume, of bedding material and shall be free of materials toxic to plant growth, and reasonably free from refuse. It shall be well rotted and not have lost its strength by leaching or injurious fermentation. It shall not contain an excess amount of water and shall be of such consistency as to mix readily with soil and capable of being broken down or made fine.

(c) MANUFACTURED FERTILIZERS.

1. Manufactured fertilizer shall be standard commercial products and shall contain not less than the percentages by weight {mass} of the ingredients set out in the following table:

TYPE	Nitrogen N	Phosphorus P_2O_5	Potash K_2O
15-0-15	15		15
13-13-13	13	13	13
10-10-10	10	10	10
8-8-8	8	8	8
0-14-14	0	14	14
4-12-12	4	12	12
4-16-8	4	16	8
Super Phosphate		18.0	
Ammonium Nitrate	33.5		
Ammonium Sulphate	20.5		
Sodium Nitrate	16.0		
Potassium Chloride			60.0

2. An allowance of five percent variation or tolerance of the above proportions will be permitted based on relative commercial value.

3. Nitrogen may be derived from any nitrogen-carrying material approved by the State Commissioner of Agriculture and Industries.

4. Cottonseed meal shall contain 41 percent protein or 6.56 percent nitrogen.

5. All fertilizers shall be transported in containers which will insure proper protection, handling, and which are commonly used with such fertilizers.

6. Fertilizers containing pesticide materials produced by a recognized, responsible manufacturer and prequalified for use by the State Department of Agriculture and Industries or the U.S. Department of Agriculture may be used with the approval of the Engineer.

(d) AGRICULTURAL LIMESTONE.

All limestone for agricultural liming purposes shall be crushed or ground to such a degree of fineness that 90 percent of the material will pass through a 10 {2.00 mm} mesh screen and not less than 50 percent of the material will pass through a 60 {250 µm} mesh screen. All such limestone shall also have a neutralizing value of 90 percent calcium carbonate or better.

(e) BASIC SLAG.

Basic slag shall be ground open hearth basic slag containing not less than the percentage by weight {mass} of the following ingredients.

P_2O_5 (Available) ..... 2.0 Iron Oxide 20.0
Magnesium Oxide .....6.0 Calcium Oxide 18.0
Manganese Oxide .....2.0 Neutralizing Value 55.0

At least 80 percent shall pass through a 100 {150 µm} mesh screen and at least 90 percent shall pass a 50 {300 µm} mesh screen.

When basic slag is substituted for limestone in seeding, sprigging, and/or solid sod planting operations, the amount applied shall be adjusted to equal the neutralizing effect of the specified amount of limestone as defined in Subarticle 860.12(d). Blends of basic slag and other elements, such as 0-6-6, 0-5-6 +.05B and 0-4-12 +.05, may be used and the added elements credited to the total element requirements for plant food.

860.13 Water.

Water free from substances harmful to the growth of plantings will be approved as suitable for use with roadway improvement materials.

860.14 Blank.

SECTION 862
UTILITY ENCASEMENT PIPE

862.01 General.

Utility encasement pipe shall comply with the appropriate requirements for the size shown in the following table:

Pipe Diameter inches {mm}	Minimum Wall Thickness* inches {mm}	Pipe Requirements* ** °
< 4 {100}	Sch. 40	ASTM A 53, Sch. 40
4 – 6 {100 – 150}	0.083 {2.11}	ASTM A 139, Grade B
8 – 12 {200 – 300}	0.104 {2.64}	ASTM A 139, Grade B
12 – 20 {355 – 510}	0.134 {3.40}	ASTM A 139, Grade B
22 – 24 {560 – 610}	0.164 {4.17}	ASTM A 139, Grade B
26 – 36 {660 – 915}	0.164 {4.17}	ASTM A 139, Grade B
38 – 42 {965 – 1065}	0.188 {4.78}	ASTM A 139, Grade B
44 – 48 {1115 – 1220}	0.219 {5.56}	ASTM A 283, Grade B
50 – 60 {1270 – 1525}	0.250 {6.35}	ASTM A 283, Grade B

* Minimum requirements unless local codes or ordinances are more stringent.

** All pipe shall be coated inside and out with at least one shop coat of an approved primer paint. In addition the external surface shall be treated with one coat of asphaltum paint. Other approved protection material may be used if approved by the Department.

° Does not require hydrostatic pressure test.

862.02 Joints.

The type of joints used shall be the Contractor's option provided the joint produces a smooth surface on the inside of the pipe suitable for installation of the carrier pipe and is consistent with the installation requirements of the pipe.

SECTION 863
WATER PIPE

863.01 Cast Iron Water Pipe Mains.

Pipes, joints, and fittings shall conform to the requirements of WW-P-421c and the following unless otherwise specified by plan details:

Grade of Pipe.

Grade B (21,000 psi {145 MPa} bursting strength – 45,000 psi {310 MPa} modulus of rupture).

Fittings.

Type II or III, (Push-on or Mechanical), Class 250.

Pressure Class.

150 psi {1030 kPa} minimum.

Wall Thickness.

Wall thickness shall be in accordance with the requirements of ANSI Standard A-21.1 for 5 feet {1.5 m} of cover, laying condition "B".

Pipe Lining.

Pipes and fittings shall be cement lined in accordance with ANSI Standard A-21.4.

Pipe Coating.

Pipes and fittings shall have an outside coating of bituminous material in accordance with ANSI Standard A-21.6, A-21.8 and A-21.51.

863.02 Ductile Iron Water Pipe Mains.

Pipes, joints, and fittings shall conform to the requirements of WW-P-421c and the following, unless otherwise specified by plan details:

Grade of Pipe.

Grade C (60,000 psi {415 MPa} tensile strength – 42,000 psi {290 MPa} yield strength - 10 percent elongation).

Fittings.

Type II or III (Push-on or Mechanical), Class 250.

Pressure Class.

150 psi {1030 kPa} minimum.

Wall Thickness.

Wall thickness shall be in accordance with ANSI Standard A-21.1 for 5 feet {1.5 m} of cover, laying condition "B".

Pipe Lining.

Pipes and fittings shall be cement lined in accordance with ANSI Standard A-21.4.

Pipe Coating.

Pipes and fittings shall have an outside coating of bituminous material in accordance with ANSI Standards A-21.6, A-21.8 and A-21.51.

863.03 Copper Water Pipe.

Pipes and fittings shall meet the requirements of ASTM B 88 and FSS-WW-T-799, and shall be Type K, L or M as specified by plan details.

863.04 Omitted.

863.05 Galvanized Steel Water Pipe.

Pipes and fittings shall meet the requirements of ASTM A 53, Grade B, Schedule 40, unless otherwise specified by plan details.

863.06 Poly (Vinyl Chloride) (PVC) Plastic Pipe.

Pipe and fittings shall be made of PVC 1120, PVC 1220, or PVC 2120 meeting the requirements of ASTM D 1785 or ASTM D 2241. If D 2241 pipe is used, it shall be SDR 26, 21, 17, or 13.5. If D 1785 pipe is used, it may be Schedule 40, 80, or 120 for pipe 8 inches {203 mm} in diameter or smaller, but shall be limited to Schedule 80 or 120 for pipe larger than 8 inches {203 mm} in diameter.

Joints and gasket material shall be as recommended by the pipe manufacturer except that solvent welding of field joints will not be allowed for pipe greater than 1.5 inches {38 mm} in diameter.

863.07 Polyethylene (PE) Plastic Pipe.

Pipe and fittings shall be made of PE3408 meeting the requirements of ASTM D 2239. It shall have an SIDR of 7 and will be limited to pipe having an inside diameter of 2 inches {50 mm} or smaller.

863.08 Incidental Materials.

Such joint and other materials as are necessary for a proper and watertight installation at the greatest operating pressure of water shall be suitable for the purpose intended and of an approved type.

SECTION 864
GUARDRAIL AND BARRIER RAIL MATERIALS

864.01 Rail Elements.

(a) BEAM PLATE GUARDRAIL.

1. STEEL.

Steel rail elements and accessories shall conform to the requirements given in AASHTO M 180.

Zinc coating shall be Type II, 4.00 ounces per square foot {1220 g/m²}, minimum triple spot test.

Chemical composition for Type 4 beams shall conform to one of the following based on ladle analysis.

CHEMICAL COMPOSITION TYPE 4 BEAMS									
Blend	C	Mn	P	S	Si	Cu	Cr	Ni	Zr
No. 1	0-12 Max.	0.20 to 0.50	0.07 to 0.15	0.05 Max.	0.25 to 0.75	0.25 to 0.55	0.30 to 1.25	0.65 Max.	- - -
No. 2	Shall conform to the requirements of ASTM A 606 for Type 4, high strength - low alloy - hot rolled sheet or strip. Members or accessories for beams meeting ASTM A 606 which require welding shall meet the requirements of ASTM A 588 for Grade A or B Material.								

In addition, for Type 4 beams after fabrication, all steel shall be blast cleaned or pickled to remove all mill scale. Blast cleaning shall conform to Steel Structures Painting Council Surface Preparation Specification No. 10 Near-White Metal Blast Cleaning (SSPC-SP10). All pickling acid shall be thoroughly rinsed off. All fabricated steel parts shall be handled with care to avoid gouges, scratches, and dents. The steel shall be kept clean of all foreign material, such as paint, grease, oil, chalk marks, crayon marks, concrete spatter, or other deleterious substances. Natural oxidation of the steel will not be considered foreign material. Storage in transit, in open cars and trucks, for an extended period will not be permitted. Steel parts stored outside in yards or at job-sites shall be positioned to allow free drainage and air circulation.

2. ALUMINUM.

Aluminum alloy rain element shall be aluminum alloy 2023 T-3 conforming to the requirements of ASTM B 209. The rail shall be of such thickness as will meet strength requirements of AASHTO M 180 for the strength class designated; however, in no case will the tensile strength of the full size beam (including a splice at the center) be less than 80,000 pounds {355 kN} for Class A or 100,000 pounds {445 kN} for Class B. The shape shall meet AASHTO M 180 requirements.

(b) BARRIER RAIL.

The barrier rail elements, including all accessories, shall conform to the material requirements shown on the plans for the type material of which the barrier rail is to be constructed.

864.02 Posts.

(a) TREATED TIMBER POSTS.

Timber posts shall be sawed to within plus or minus 1 inch {25 mm} of the length and plus or minus 3/8 of an inch {10 mm} of the full end dimensions shown on the plans. Timber block-outs shall be sawed to within 1/4 of an inch {6 mm} of the length and plus or minus 3/8 of an inch {10 mm} of the full end dimensions shown on the plans. Holes shall be drilled slightly smaller than the designated bolt size so as to provide a driving fit.

All timber shall be Southern Yellow pine, Grade No. 1SR or better, in accordance with the Southern Yellow Pine Inspection Bureau's grading system. Post and blockout treatment shall be in accordance with AWPA-C-14 as applicable to guardrail posts. The preservative shall be one recommended under AWPA-C-14 except that within a contract only one type will be permitted unless otherwise permitted in writing by the Engineer. All timber posts and blockouts should be fabricated and holes drilled before treatment, but where field modifications of necessity are made after treatment, the new surfaces shall be given a preservative treatment in accordance with the provisions of AWPA-M-4 using a method approved by the Engineer.

(b) METAL POSTS.

Steel posts, including block-outs for guardrail, shall comply with the requirements of ASTM A 36, modified to waive the maximum tensile strength. All material shall be new and of the size, shape, etc. noted by the plan details, hot-dip galvanized after fabrication.

Metal posts for barrier rails shall be steel meeting the requirements noted in paragraph one above or when aluminum barrier rail is used, aluminum posts conforming to the requirements of ASTM B 221, Alloy 6351-T4 or 6061-T4 of the size, shape, etc. noted by plan details.

864.03 Anchors.

Concrete for anchors shall be constructed of Class "A" Concrete in conformity with the detailed requirements of Section 501 with attention directed to Item 501.03(k)2. All surfaces shall be given a Class 1 finish with all exposed surface given a Class 2 surface finish.

Metal parts used in anchors shall comply with the appropriate requirements for metals noted elsewhere in this Section or other portions of these Specifications.

Wire rope (cable) for anchors shall be 3/4 inch {19 mm} nominal diameter meeting the requirements of AASHTO M 30, Type II, having a Class A galvanization coating.

864.04 Galvanization.

All metal required by the plans or specifications to be galvanized shall be galvanized after fabrication in accordance with AASHTO M 111 amended to cover the weight {mass} of the zinc coating specified in Article 864.01. Shop fabrication shall be considered to include all work necessary to prepare the unit for immediate and complete installation. No punching, cutting, burning, or welding will be permitted in the field except for special details in exceptional cases as may be directed by the Engineer; however, in such cases, holes shall be drilled and cutting done by sawing and the area treated as provided in Subarticle 630.03(c).

SECTION 870
ADHESIVES

870.01 Description.

This Section shall cover the requirements for adhesives used in the following phases of highway construction.

870.02 Adhesives For Pavement Markers.

(a) PERMANENT MARKER ADHESIVE.

Adhesives furnished for use to affix permanent pavement markers to the pavement shall be listed on List V-2, PERMANENT PAVEMENT MARKERS, MARKER ADHESIVE, DELINEATORS AND HAZARD

MARKERS, of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

(b) TEMPORARY MARKER ADHESIVE.

Adhesives furnished to affix temporary markers to the pavement shall be any suitable type of adhesive for the intended purpose, except that in those locations where the markers will be required to be removed, the adhesive shall be a type that will allow for the complete removal of the marker without scarring or disfiguring the pavement.

870.03 Epoxy Adhesives for Bonding Concrete to Concrete and Concrete to Other Materials.

Epoxy adhesive furnished for use in bonding concrete and other materials (except pavement markers) shall meet the appropriate requirements of AASHTO M 235 for the type of work for which the adhesive is to be used. The "Volatile Content, Cured System" requirement of AASHTO M 235 shall be waived.

The Type, Grade, and Class of the epoxy adhesive to be used in the work will be shown by plan details, by these specifications, or as ordered by the Engineer.

Adhesives furnished for use shall be listed on List II-7, EPOXIES FOR USE WITH PORTLAND CEMENT CONCRETE, of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

870.04 Adhesives for Concrete Anchoring Systems.

Adhesives furnished for use to anchor tie bars in concrete or other concrete anchoring systems shall be listed on List II-15, CONCRETE ANCHORING SYSTEMS, of the Department's "Materials, Sources, and Devices With Special Acceptance Requirements" Manual. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

SECTION 871
FENCING MATERIALS

871.01 Chain Link Fence.

Materials for chain link fence unless specified otherwise on the plans shall conform to the following:

(a) FABRIC.

Fence fabric shall meet the requirements of AASHTO M 181 using 2 inch uniform square mesh made from 0.148 inch (9 gage) {3.75 mm} wire with either a Type I, Class D (zinc coated steel); or Type II (Aluminum coated steel) finish. When a polyvinyl chloride coating is specified either a Class A or a Class B coating will be acceptable.

(b) SUPPORTS.

Supports shall be either metallic coated steel Grade 1 or Grade 2, or Aluminum meeting the requirements of AASHTO M 181.

Minimum sizes and weights of posts, rails and framing for all steel elements shall be as follows:

Steel Fence Supports & Framing	
Line Post 3-6 ft. {1 - 2 m} high fence	1.90" O.D. Pipe @ 2.72 #/ft. {48 mm O.D. Pipe @ 4.05 kg/m}
	1.875" x 1.625" x .105" "C" Section @ 1.85 #/ft. {47 mm x 41 mm x 2.5 mm "C" Section @ 2.75 kg/m}
Line Post 7-12 ft. {2.1 - 4 m} high fence	2.375" O.D. Pipe @ 3.65 #/ft. {60 mm O.D. Pipe @ 5.43 kg/m}
	2.25" x 1.70" x .121" "C" Section @ 2.64 #/ft. {57 mm x 43 mm x 3 mm "C" Section @ 3.93 kg/m}
	2.25" x 1.70" x .143" "H" Section @ 3.26 #/ft. {57 mm x 43 mm x 3.5 mm "H" Section @ 4.85 kg/m}
Corner & Pull Posts 3-6 ft. {1 - 2 m} high fence	2.375" O.D. Pipe @ 3.65 #/ft. {60 mm O.D. Pipe @ 5.43 kg/m}
	2.5" x 2.5" Sq. Tubing @ 5.70 #/ft. {63 mm x 63 mm Sq. Tubing @ 8.48 kg/m}
Corner & Pull Posts 7-12 ft. {2.1 - 4 m} high fence	2.875" O.D. Pipe @ 5.79 #/ft. 73 mm O.D. Pipe @ 8.62 kg/m
	3" x 3" Sq. Tubing @ 9.10 #/ft. {75 mm x 75 mm Sq. Tubing @ 13.54 kg/m}

Steel Fence Supports & Framing (continued)	
Gate Post for Gate Leaf Width 6 ft. {2 m} and less	2.875" O.D. Pipe @ 5.79 #/ft. {73 mm O.D. Pipe @ 8.62 kg/m}
	2.5" x 2.5" Sq. Tubing @ 5.70 #/ft. {63 mm x 63 mm Sq. Tubing @ 8.48 kg/m}
Gate Post for Gate Leaf Width Over 6 ft. to 13 ft. {2 m to 4 m}	4.0" O.D. Pipe @ 9.10 #/ft. {100 mm O.D. Pipe @ 13.54 kg/m}
Gate Post for Gate Leaf Width Over 13 ft. to 18 ft. {4 m to 6 m}	6.625" O.D. Pipe @ 18.97 #/ft. {168 mm O.D. Pipe @ 28.23 kg/m}
Gate Top & Middle Rail	1.625" O.D. Pipe @ 2.27 #/ft. {41 mm O.D. Pipe @ 3.38 kg/m}
Gate Frames	1.625" O.D. Pipe @ 2.27 #/ft, {41 mm O.D. Pipe @ 3.38 kg/m}
	2" x 2" Sq. Tubing @ 3.85 #/ft. {50 mm x 50 mm Sq. Tubing @ 5.73 kg/m}

Tolerances for Steel Tubing and Shapes		
Shape and Size	Dimension	Weight {Mass}
Tubular, to and incl. 1 1/2" {38 mm}	+ 1/64", - 1/32" {+ 0.5 mm, - 1 mm}	± 5%
Tubular, larger than 1 1/2" {38 mm}	± 1%	± 5%
"C" Section, to and incl. 2.25"x 1.70" {57 mm x 43 mm}	± 0.0625 { ± 1.5 mm}	± 5%
"H" Section, 2.25"x 1.70" {57 mm x 43 mm} & larger	± 0.0937 { ± 2.5 mm}	± 5%

Minimum sizes and weights {masses} of posts, rails and framing for all aluminum elements shall be as follows:

Aluminum Fence Supports & Framing	
Line Post 3-6 ft. {1 - 2 m} high fence	2.375" O.D. Pipe @ 1.25 #/ft. {60 mm O.D. Pipe @ 1.86 kg/m}
	2.25" x 1.95" "H" Section @ 1.25 #/ft. {57 mm x 49 mm "H" Section @ 1.86 kg/m}
Line Post 7-12 ft. {2.1 - 4 m} high fence	2.875" O.D. Pipe @ 2.00 #/ft. {73 mm O.D. Pipe @ 2.98 kg/m}
	2.5" x 2.5" Sq. Tubing @ 1.25 #/ft. {63 mm x 63 mm Sq. Tubing @ 1.86 kg/m}
Corner & Pull Posts 3-6 ft. {1 - 2 m} high fence	3.0" O.D. Pipe @ 2.62 #/ft. {75 mm O.D. Pipe @ 3.90 kg/m}
Corner & Pull Posts 7-12 ft. {2.1 - 4 m} high fence	3.0" O.D. Pipe @ 3.00 #/ft. {75 mm O.D. Pipe @ 4.46 kg/m}
Gate Post for Gate Leaf Width 6 ft. {2 m} and less	3.0" O.D. Pipe @ 2.62 #/ft. {75 mm O.D. Pipe @ 3.90 kg/m}
	3.0" x 3.0" Sq. Tubing @ 2.0 #/ft. {75 mm x 75 mm Sq. Tubing @ 2.98 kg/m}

Aluminum Fence Supports & Framing (continued)	
Gate Post for Gate Leaf Width Over 6 ft. to 13 ft. {2 m to 4 m}	4.0" O.D. Pipe @ 3.0 #/ft. {100 mm O.D. Pipe @ 4.46 kg/m}
Gate Post for Gate Leaf Width Over 13 ft. to 18 ft. {4 m to 6 m}	6.625" O.D. Pipe @ 7.0 #/ft. {168 mm O.D. Pipe @ 10.42 kg/m}
Gate Top & Middle Rail	1.660" O.D. Pipe @ 0.786 #/ft. {42 mm O.D. Pipe @ 1.17 kg/m}
Gate Frames	1.660" O.D. Pipe @ 0.786 #/ft. 42 mm O.D. Pipe @ 1.17 kg/m
	1.5" x 1.5" Sq. Tubing @ 0.684 #/ft. {38 mm x 38 mm Sq. Tubing @ 1.02 kg/m}

(c) HARDWARE AND FITTINGS.

Hardware and fittings shall be either metallic coated steel or Aluminum meeting the requirements of AASHTO M 181.

(d) MISCELLANEOUS WIRE.

Tension wire shall be metallic coated steel or aluminum as per AASHTO M 181. Wire used for tying shall be either No. 11 gage {3 mm} metallic coated steel or aluminum.

871.02 Woven Wire Fence.

Materials for woven wire fence unless specified otherwise on the plans shall conform to the following:

(a) FABRIC.

Fence fabric shall meet the requirements of ASTM A 116, Zinc Coated Steel Woven Wire Fabric, 1047-6-9, Grade 60, Class 3, or ASTM A 584, Aluminum Coated Steel Woven Wire Fabric, 1047-6-9.

When so designated on the plans for replacement of farm fencing, or fencing placed as a right-of-way consideration, etc., the Contractor may at his option use fabric as listed above or zinc coated steel wire, ASTM A 116, 1047-6-12 ½, Class 1 coating unless otherwise noted on the plans.

(b) SUPPORTS AND FRAMING.

Supports for woven wire fence shall be either wood or steel as noted on plan details and if not specified either may be used. Support requirements are as follows:

1. STEEL.

Steel supports shall meet the requirements of either AASHTO M 181, metallic coated steel posts, rails, or gate frames, Grade 1 or Grade 2, or posts meeting AASHTO M 281, 8 feet {2.4 m} long, galvanized to AASHTO M 111, with anchor plates.

When so designated on the plans for replacement of farm fencing, or fencing placed as a right-of-way consideration, etc., the Contractor may at his option use posts as listed above or painted steel posts meeting AASHTO M 281, unless otherwise noted on the plans.

Minimum sizes and weights of posts, braces and framing for all steel elements shall be as follows:

Steel Fence Supports & Framing	
Line Post	1.90" O.D. Pipe @ 2.72 #/ft. {48 mm O.D. Pipe @ 4.05 kg/m}
	1.875" x 1.625" x .105" "C" Section @ 1.85 #/ft. {47 mm x 41 mm x 2 mm "C" Section @ 2.75 kg/m}
	Studded "T" Post with Spade Plate @ 11.3 #/post {Studded "T" Post with Spade Plate @ 5.1 kg/post}
Corner, End & Pull Posts	2.375" O.D. Pipe @ 3.65 #/ft. {60 mm O.D. Pipe @ 5.43 kg/m}
Brace Posts	1.625" O.D. Pipe @ 2.27 #/ft. {41 mm O.D. Pipe @ 3.38 kg/m}
Gate Post, Hinge Side	4.0" O.D. Pipe @ 9.10 #/ft. {100 mm O.D. Pipe @ 13.54 kg/m}
Gate Post, Latch Side	2.375" O.D. Pipe @ 3.65 #/ft. {60 mm O.D. Pipe @ 5.43 kg/m}
Gate Frames	1.90" O.D. Pipe @ 2.72 #/ft. {48 mm O.D. Pipe @ 4.05 kg/m}

Tolerances in dimensions and weight shall be the same as specified in Subarticle 871.01(b). Weight tolerance for "T" posts shall be ± 5%.

2. WOOD.

Wood supports shall meet the requirements noted herein except as modified by details shown on the plans. Posts shall be sound and free from decay, other defects, or loose knots. Posts may be round or square sawed meeting the applicable requirements of Section 833. The slope of the grain in sawed posts shall not exceed one in ten. All posts shall be reasonably straight. Round posts shall be free of multiple crooks and in no case will posts, where the geometric center lies more than 1 inch {25 mm} outside of a straight line drawn from the center of the post at the butt end, less the burying depth to the center of the tip end, be acceptable. Square sawn posts shall not have crooks in excess of 1 inch in 5 feet {25 mm in 1.5 m}. The length and sizes of wood posts shall be as detailed on the plans within the following tolerances.

When so designated on the plans for replacement of farm fencing, the Contractor may at his option use posts as listed above or wood posts purchased from local dealers, unless otherwise noted on the plans.

a. Round Posts.

The furnished posts may include posts from the minimum diameter specified up to, but not to include, those 1 inch {25 mm} or larger than the minimum diameter designated. When tapered posts are furnished, the diameter at the butt end should not be more than one and one-half inches larger than the diameter measured at the tip end.

b. Sawed Posts.

The furnished posts shall be of the dimensions shown on the plans, plus 1/2 inch { 12 mm} or minus 1/4 inch {6 mm}.

c. Lengths.

The furnished posts shall not measure over one inch less than specified on the plans. Lengths greater than those shown on plans may be acceptable at the discretion of the Engineer, if not detrimental to the appearance of the fence.

All posts shall be pressure treated in accordance with the provisions of Section 833. All job cuts shall be painted with three coats of hot preservative composed of 60 percent Creosote Oil and 40 percent roofing pitch.

The Contractor shall have the choice of selecting one of the types of treated timber posts shown on the plans. Once a choice is made and erection begun, the Contractor will not be permitted to change to another type without the written permission of the Engineer.

(c) FASTENERS.

Fasteners for attaching fencing fabric and wire to wooden posts shall be staples formed from 0.148 inch (9 gage) {3.75 mm} diameter galvanized wire, approximately 1.5 inches {38 mm} long. Fasteners for attaching wire to steel posts shall be as designated in Subarticle 871.01(d).

871.03 Barbed Wire Fence.

Materials for Barbed Wire Fence shall be as follows, except as modified by plan details:

(a) BARBED WIRE.

Barbed wire shall meet the requirements of AASHTO M 280 with a Class 3 galvanized coating, or Aluminum coated steel barbed wire, Type I (Standard), ASTM A 585.

When so designated on the plans for replacement of farm fencing, or fencing placed as a right-of-way consideration, etc., the Contractor may at his option use wire as listed above or substitute wire meeting AASHTO M 280, with a Class 1 coating unless otherwise noted on the plans.

(b) SUPPORTS AND FRAMING.

Supports and framing shall meet the requirements of Item 871.02(b)2.

(c) FASTENERS.

Fasteners shall meet the requirements of Subarticle 871.02(c).

871.04 Gates.

Gates, where required, shall be swing-gates as detailed or specified on the plans. The gate frames shall be the height of the top of the posts and covered with the same wire and fabric used on the fence. The frames shall be formed from tubular shapes meeting the requirements noted in Subarticle 871.01(b) complying with plan details, with all joints welded, or otherwise constructed, to form a rigid unit.

Gates for woven wire fencing of another acceptable design may be permitted provided that the gates are so constructed that they will not sag and the design has been approved in writing.

All gates shall be furnished complete with approved (tamper-proof) hinges, latches, auxiliary braces, and all other necessary fittings, including a heavy padlock with two keys and one master key for each gate furnished.

871.05 Concrete For Setting Posts.

Concrete for setting posts, etc., shall be Class A concrete complying with applicable portions of Section 501, with the following modifications.

The concrete may be dry batched at a central mixing plant and delivered to the project. Before the concrete is placed water shall be added. This may be done in small amounts as needed and mixed on a mixing board or mortar box. After water is added, the mix shall be used within sixty (60) minutes. Posts, braces and brace struts shall be held in proper position until the concrete hardens. The concrete for all corner, brace and line posts shall have cured for 72 hours before any strain is placed on them.

SECTION 880
SIGN MATERIALS

880.01 Sign Panels.

(a) ALUMINUM SIGN MATERIALS.

1. GENERAL.

Aluminum sign materials shall conform to the details and thickness's shown on the plans and the following:

The materials used, unless otherwise noted by plan details, shall meet the requirements noted below and, in addition, the material used shall be free from corrosion, white rust, water stains, dirt, and grease with the panels processed as noted in Item 2 below.

USE	ALLOY & TEMPER DESIGNATION
Sign Panels	ASTM B 209 Alloy 5052-H38 or 6061-T6
Angles (including Stiffeners)	ASTM B 308 Alloy 6061-T6
*Bolts	ASTM B 211 Alloy 2024-T4
*Spring Lock Washers	ASTM B 211 Alloy 7075-T6
*Hex. Nuts (Plain)	ASTM B 211 Alloy 6262-T9
*Hex. Lock Nuts	ASTM B 211 Alloy 2017-T4

* Unless otherwise specified.

Aluminum bolts, nuts, and washers shall have an anodic coating of at least 0.0002 inch {0.0051 mm} in thickness and shall be chromate sealed.

Galvanized bolts, nuts, and washers as specified under Galvanized Signs, or stainless steel hardware meeting the requirements of ASTM F 593, will be acceptable in lieu of the above.

2. SPECIAL TREATMENT OF ALUMINUM SIGN MATERIAL.

Each panel shall receive a chemical conversion treatment that will produce an acceptable etched surface suitable for either porcelainizing or attachment of reflectorized or non-reflectorized sheeting.

3. TESTS AND SAMPLES.

The Contractor shall furnish certified test reports confirming compliance with the requirements noted and, in addition, shall furnish samples of all materials used in the signs in accordance with current Departmental policy for evaluation and verification tests.

(b) GALVANIZED STEEL SIGN MATERIAL.

1. GENERAL.

Galvanized steel sign sheets shall conform to the details and thickness designated on the plans and the following:

The materials used for Galvanized Steel Signs, unless otherwise noted by plan details, shall meet the following specifications:

USE	ASTM For METAL	ASTM For GALVANIZING
Sign Panels	A 446 Grade A	A 123
Angles (including Stiffeners)	A 36	A 123
Bolts, Nuts and Washers, Unless otherwise specified.	A 307 *	A 153
* Aluminum bolts, nuts, and washers as specified under Aluminum Signs, or stainless steel hardware meeting the requirements of ASTM F 593, will be acceptable in lieu of.		

Galvanized steel sheets and parts other than bolts, nuts and washers shall be mill galvanized with a 2 ounce per square foot {57 g per 0.1 m^2} coating in accordance with ASTM A 446, Grade A. The galvanizing shall be a continuous coat, extra smooth, minimum spangle process. After galvanizing, the sheets are to be given a light, tight, crystalline phosphate coating.

No galvanizing of any steel part may be done until all welding, cutting, milling, punching, and drilling of the part has been completed. This includes all holes necessary for attaching demountable copy.

2. TESTS AND SAMPLES.

The Contractor shall furnish certified test reports confirming compliance with the requirements noted and in addition shall furnish samples of all materials used in the signs in accordance with current Departmental policy for evaluation and verification tests.

(c) ALUMINUM LAMINATED PANELS.

1. GENERAL.

Panels shall consist of sheet aluminum laminated to a honeycomb core, sealed completely around the perimeter with an extruded aluminum frame to form a surface of the length, width and depth required. These panels may be used either with sign face sheeting meeting the requirements of Article 880.02 or a porcelain enameled face sheet. These laminated panels shall be fabricated in accordance with these Specifications and to sizes and shapes as shown on the plans. The minimum number of panels shall be used for each sign. Panels shall be mounted horizontally on all signs having widths up to and including 24.0 feet {7.3 m}; panels may be mounted vertically on signs having widths exceeding 24.0 feet {7.3 m}. The span between supports on 1 inch {25 mm} thick panel shall not exceed 9.0 feet {3 m} with overhang not in excess of 3.0 feet {1 m}. The span for a 2.5 inch

{62.5 mm} thick panel shall not exceed 14.0 feet {4.4 m} with overhang not in excess of 4.75 feet {1.45 m}.

All metal materials shall meet the requirements of Subarticle 880.01(a) unless otherwise specified in this Subarticle.

2. PANEL FACE AND BACKING.

The face sheet shall be fabricated in one piece from a sheet meeting the following requirements:

For porcelainized panels the face sheet shall comply with the requirements of Item 880.01(d)3.

For panels to be covered with sign sheeting the face sheet shall meet the requirements specified for the back sheet.

The back sheet shall be fabricated in one piece from a sheet of 3003 alloy, tempered to provide a minimum tensile strength of 18,000 psi {124 MPa} and a minimum yield strength of 12,000 psi {82 MPa} and otherwise meeting the requirements of ASTM B 209. Sheets shall not be less than 0.04 inches {1.02 mm} thick and free from all soil or corrosion prior to lamination.

3. PERIMETER FRAME.

Each panel section shall be provided with a perimeter frame. Frames shall be fabricated of extruded shapes of #6063-T6 Aluminum, with all joints mitered, and firmly affixed together with the exterior framing sealed against moisture penetration. The horizontal top and bottom frame members shall have an integral retainer track for affixing mounting bolts with an additional slot milled in the frame for field insertion of post clip bolts. If the horizontal finished dimension of the sign exceeds 24 feet {7.3 m} and vertical panels are used, the vertical frame members shall have an integral retainer track for mounting bolts. On the perimeter of the finished sign, a 1/8 inch {3 mm} tolerance from flush between the sheets and frame will be allowed and all edges shall be straight within 1/8 inch {3 mm} from a straight plane. All sharp edges that would present a hazard in handling shall be smoothed.

4. CORE MATERIAL.

Core material shall be of the appropriate thickness, as required, and shall be phenolic impregnated paper honeycomb. Thickness of core materials shall be held within a tolerance of plus or minus 0.010 inch {0.254 mm}. Core material shall meet Specification MIL-D-5272 for resistance to fungus. Cell size, approximately 1/2 of an inch {13 mm}; weight {mass} of paper, 80 pounds {36 kg}; impregnation, 18 percent by weight {mass} minimum.

a. Laminating Adhesive.

The laminating adhesive shall be a thermoplastic neoprene rubber base solvent type or a thermo-setting type exhibiting a permanent oil and water resistant bond.

b. Tensile Strength.

The tensile strength of the honeycomb type laminated construction shall have a minimum of 20 psi {138 kPa} when tested in accordance with ASTM Designation C 297 and aged in accordance with ASTM Designation C 481, Cycle "B".

5. FLATNESS.

All adhesively bonded panels shall have an exterior face of such flatness that when measured at normal room temperature of 70 to 80 °F {21 to 27 °C}. The maximum wave slope of the surface at any point, measured from the nominal plane of the surface, shall not exceed 1% for panel to which sign face sheeting is to be attached or 1.5% for panels which have porcelainized face sheets. (Wave slope shall be computed in the following manner: Measure the distance between high points (Dimension A). Place a straight edge across the points and measure the depth of slope (Dimension B). Divide one half of A into B to determine percentage of wave slope.)

6. SEAM CLOSURE.

Where multiple panels adjoin, the face and edges shall be milled to a tolerance of plus or minus 1/32 of an inch {0.8 mm} from a straight plane, so that when adjoining panels are assembled, no gap over 1/16 of an inch {1.6 mm} shall be visible between panels. Panels may be milled up to 1/4 of an inch {6 mm} on each side in order to achieve edge uniformity.

Seam closure extrusion between panels shall be as provided by the manufacturer of Type 6063-T6 aluminum. Seam closure extrusion may be set in 3 inches {75 mm} from edge of panels for clearance of rivets and frame.

7. RIVETS.

Rivets appearing on the face side of the panel shall be anodized a color similar to that required for the face of the panel. Rivets for mounting letters shall be as specified.

8. WEEP HOLES.

Weep holes of approximately 1/8 of an inch {3 mm} in diameter shall be drilled in the perimeter frame at the bottom of each panel. Holes are to be spaced approximately 3 inches {75 mm} in from either end and in the center of each panel.

9. FABRICATION OF LAMINATED SIGNS.

Each completed sign face shall comply with the requirements noted in this Section with the legend and border laid out on the sign face in accordance with the approved shop drawing; signs that do not meet these requirements shall be corrected or removed and replaced in acceptable condition without additional cost to the State.

10. TESTS AND SAMPLES.

The Contractor shall furnish certified test reports confirming compliance with the requirements noted in this Section in addition to samples of materials used in the manufacturing of the signs in accordance with current Departmental policy for evaluation and verification tests.

(d) PORCELAIN ENAMEL SIGNS.

1. GENERAL.

Porcelainized signs may be fabricated from flat aluminum or steel sheets or Aluminum Laminated panels. Materials shall meet the requirements of Subarticles 880.01(a), (b), or (c), unless otherwise modified in this Subarticle.

Porcelain enamel surfaces shall be in accordance with the following requirements. These requirements are basic manufacturing quality controls, and certified test reports will be accepted in lieu of samples. However, samples of each color to be used and for each separate production run shall be furnished for verification of tests of requirements as required by current testing schedule.

a. Coating.

Porcelain enameled signs shall have a base or ground coat, designed to develop minimum adherence, applied to all surfaces which are to be porcelainized. At least one separately fired cover coat, in addition to the base or ground coat, shall be applied to all surfaces being porcelainized.

All porcelain enamel shall conform to the Porcelain Enamel Institute's Specification ALS 105.

The thickness of the enamel coating shall not be less than 0.002 inches {0.051 mm}.

b. Color.

The finish color shall be uniform colors, matching the Alabama Green Chip and the standard interstate colors within the Hue, Value and Chroma ranges of the color Tolerance Charts published by the Federal Highway Administration.

c. Gloss.

The porcelain enamel shall have a gloss reading of 50 to 70 units at an angle of 45° when measured on a photovoltmeter, or a meter capable of giving equal results. (Reference Federal Test Method 6101, and current ASTM Standard Method C 346.)

Panels shall be checked for gloss every 1000 square feet {100 m^2} of production run.

d. Adherence.

Adherence shall be checked by accelerated spall test in accordance with Porcelain Enamel Institute Process Bulletin C-703 AL-1a, (Section 6, Spall Test to Determine Retention of Adherence.)

This test conforms with current ASTM C 703, "Method of Test for Spalling Resistance of Porcelain Enameled Aluminum." Tests shall be performed on process evaluation test specimens, 3 inch x 12 inch {75 mm x 300 mm}, processed with the production run. Test samples shall be processed at a minimum rate of one set of samples per every 1000 square feet {100 m^2} of the production cycle or total order, whichever occurs first, and marked with the date and time of the production run. Extra process evaluation test specimens shall be processed to check any change in processing such as cleaning, enamel formulation, firing, etc. The number of specimens constituting one set of samples shall be three unless otherwise directed by the Engineer.

Failure of any process evaluation test specimen to satisfactorily pass the spall test shall be cause for holding and retesting the 1000 square feet {100 m^2} of the production cycle the

specimen represents. For the purpose of retesting, process evaluation test specimens shall be taken from production pieces of the production cycle being held. Failure of any one of the process evaluation test specimens, taken from production pieces, to satisfactorily pass the spall test prescribed by these specifications shall be cause for total rejection of that 1000 square feet {100 m^2} of the production cycle or total order being retested.

e. Acid Resistance.

The porcelain enamel shall have a mass loss of less than 20 mg/square inch {20 mg/645 mm^2} in the boiling 6% citric acid test. Reference test is described in ASTM Standard C 283 "Standard Method of Test for Resistance of Porcelain Enamels to Boiling Acid."

Tests shall be performed on process evaluation test specimens, 3 inch x 12 inch {75 mm x 300 mm}, processed with the production run. Test samples shall be processed at a minimum rate of one set of samples per every 1000 square feet {100 m^2} of the production cycle or total order, whichever occurs first, and marked with the date and time of the production run. Extra process evaluation test specimens shall be processed without any change in processing such as frits, mill formula, fineness of grind, firing, etc. The number of specimens constituting one set of samples shall be three unless otherwise directed by the Engineer.

Failure of any process evaluation test specimen to satisfactorily pass the acid resistance test shall be cause for holding and retesting the 1000 square feet {100 m^2} of the production cycle the specimen represents. For the purpose of retesting, process evaluation test specimens shall be taken from production pieces of the production cycle being held.

2. ALUMINUM OR STEEL FLAT OR MULTIPLE FLAT PANELS.

a. Metals.

All materials shall meet the requirements of Subarticles 880.01(a) or (b) unless otherwise specified in this Item.

Aluminum panel sheets shall be an aluminum-alloy or aluminum clad alloy (6061-Core) especially designed for enameling and capable of being porcelain enameled to meet the Specifications noted herein. The aluminum sheets, after enameling, shall have a minimum ultimate strength of 18,000 psi {124 MPa}, a minimum yield strength of 12,000 psi {83 MPa} and an elongation of not less than four percent. If the porcelain enameling process materially alters the temper of the aluminum sheets such that the minimum yield point of the material is below 12,000 psi {83 MPa}, they shall be artificially aged or processed to raise the yield point of the panels to the required minimum stress.

Steel Sheets and Backing Strips shall meet the requirements of ASTM Designation A 424, Type II, and be capable of being porcelain enameled to meet the Specifications noted herein. All steel sheets and backing strips shall be shaped and formed before porcelainization. The exposed surfaces shall be provided with a protective coating of either porcelain or galvanization.

b. Porcelain Coverage.

In addition to the requirements of Item 880.01(d)1, the following shall apply. The base or ground coat may be applied to the entire exposed surface area of the sheets, including face and back. If both sides are covered, the coating thickness's shall be equal and rack marks will be allowed on the back of panels. The face and back shall be of the same color.

c. Flatness.

Each completed sign face, after erection, shall not vary more than 1/8 inch {3 mm} in any 4 foot {1.2 m} length with the maximum variation of 1/4 inch {6 mm} from a flat surface in any 8 foot {2.4 m} length.

3. PORCELAINIZED ALUMINUM LAMINATED PANELS.

All materials shall meet the requirements of Subarticle 880.01(c) except as noted. Porcelainization of the face sheet shall be as specified in Item 880.01(d)1.

Aluminum Face Sheets shall be an aluminum alloy or aluminum clad alloy (6061-Core) especially designed for enameling and capable of being porcelain enameled to meet the Specifications noted in this Section. The aluminum sheets, after enameling, shall have a minimum ultimate strength of 18,000 psi {124 MPa}, a minimum yield strength of 12,000 psi {83 MPa} and an elongation of not less than four percent. If the porcelain enameling process materially alters the temper of the aluminum sheets such that the minimum yield point of the material is below 12,000 psi {83 MPa}, they shall be artificially aged or processed to raise the yield point of the panels to the required minimum stress.

Face sheets shall not be less than 0.063 inches {1.6 mm} thick after porcelainization.

4. FABRICATION OF PORCELAIN ENAMELED SIGNS

Each completed sign face shall comply with the surface flatness requirements noted in this Section, with the legend and border laid out on the sign face in accordance with the approved shop drawings; signs that do not meet these requirements shall be corrected or removed and replaced in acceptable condition without additional cost to the State.

5. TESTS AND SAMPLES.

The Contractor shall furnish certified test reports confirming compliance with the requirements noted in this Section and, in addition, samples of materials used in manufacturing of the signs in accordance with current Departmental policy for evaluation and verification tests, but in no case less than one 3 inch x 12 inch {75 mm x 300 mm} sample of each color used shall be furnished for each separate production run of the porcelain enameled panels.

Verification of the porcelain colors by comparison with the Alabama Green Chip and the Color Tolerance Charts published by the FHWA shall be made on all samples. Noticeable variation of color in a production run shall be cause of ordering inspection of all sign faces and the rejection of any sign face outside of the tolerances provided by the Color Charts.

(e) ALUMINUM LOUVERED PANELS.

1. GENERAL.

Aluminum louvered sign panels shall consist of aerodynamically designed louvers assembled into a sign panel which is self-supporting, internally braced, and capable of withstanding the wind loading indicated by plan requirements. The complete design assembly shall provide for an efficient flow of air in a horizontal direction with at least 50percent reduction in wind loading, normal to sign face, than that of a solid sign panel of the same size and yet display a solid opaque background when viewed from an angle of 10° or less below the horizontal line of sight.

Louvers shall be of such dimensions as to help maintain the panel rigidly and provided with sufficient internal support and bracing to support and retain the stacked louvers along with preventing aeolian vibrations.

The front face of the sign panel shall have provisions for affixing standard demountable copy (borders and legends) in a firm, rigid manner. The back face of the sign panel shall have provisions for attachment of the panel to the Department's standard supports (ground or overhead).

The Contractor shall obtain Departmental approval of the panel design he proposes to furnish under this specification before such will be allowed on the project. To obtain approval, drawings of the proposed design, along with any necessary supporting data to verify the design, must be submitted.

2. MATERIALS.

Aluminum shall meet the requirements of Subarticle 880.01(a) and the following:

USE	ALLOY AND TEMPER DESIGNATION
Louvers	ASTM B 221 Alloy 6061-T6
Miscellaneous Parts	ASTM B 209 Alloy 6061-T6
Castings	ASTM B 85 Alloy SC84B

All exposed parts of the sign panel shall have a baked enamel finish consisting of primer coat and at least two finish coats providing not less than a 1.5 mil {0.338 mm} coverage. The enamel shall be made of first class materials providing colors within the color tolerance charts published by the FHWA except that the highway green shall be the same shade, etc., as used on the Department's "Porcelain enameled" sign (a color sample will be made available upon request).

3. FABRICATION OF SIGN PANELS.

a. Each completed sign face shall be assembled in accordance with the approved design and accepted shop drawings and shall, after erection, provide a rigid panel firmly attached to the sign supports. Sign panels not meeting these requirements shall be corrected or removed and replaced in acceptable condition without additional cost to the State.

b. The legend and border shall be laid out on the sign face in accordance with the contract plans. Spacing and layout of legend and border shall be approved by the Engineer before affixing of the legend and borders to the sign face.

4. TESTS AND SAMPLES.

The Contractor shall furnish certified test reports confirming compliance with the requirements noted in this Subarticle and, in addition, samples of materials used in the manufacturing of the signs in accordance with current Departmental policy for evaluation and verification tests, but in

no case less than one 3 inch x 12 inch { 75 mm x 300 mm} sample of each color used, shall be furnished.

Verification of color by comparison with Color Tolerance Charts, etc. as noted in Item 2 above will be made on all samples. Noticeable variation of color in a panel shall be cause for ordering inspection of all signs and the rejection of any sign face outside the tolerances provided by the Color Charts.

All signs shall be inspected for faulty application, blemishes, or other faults that might impair the serviceability of the sign. Any noticeable color mis-matching, when viewed from a distance of 25 feet {7.6 m} under both daylight or nighttime conditions, shall be cause for rejection of the sign face.

880.02 Reflective And Non-Reflective Sheeting.

(a) GENERAL.

Reflective sheeting used in the fabrication of sign faces shall meet the requirements for ASTM D 4956. All reflective sheeting shall be of the Type III classification, unless otherwise required by plan details or the proposal.

Non-reflective sheeting, Type I-N, shall be a smooth, flat durable gloss plastic film meeting the requirements of ASTM D 4956, Type I, with the Specific Intensity requirements waived.

Sheeting will be classified by type in accordance with the following:

Type I	A medium-intensity retroreflective sheeting referred to as "engineering grade" and typically enclosed lens glass-bead sheeting. Typical applications for this material are permanent highway signing, temporary traffic control devices, and delineators.
Type I-N	Non-reflective sheeting
Type II	A medium-high-intensity retroreflective sheeting sometimes referred to as "super engineering grade" and typically enclosed lens glass-bead sheeting. Typical applications for this material are permanent highway signing, temporary traffic control devices, and delineators.
Type III	A high-intensity retroreflective sheeting, that is typically encapsulated glass-bead retroreflective material. Typical applications for this material are permanent highway signing, temporary traffic control devices, and delineators.
Type IV	A high-intensity retroreflective sheeting. This sheeting is typically an unmetallized microprismatic retroreflective element material. Typical applications for this material are permanent highway signing, temporary traffic control devices, and delineators.
Type V	A super-high-intensity retroreflective sheeting. This sheeting is typically a metallized microprismatic retroreflective element material. This sheeting is typically used for delineators.
Type VI	An elastomeric high-intensity retroreflective sheeting without adhesive. This sheeting is typically a vinyl microprismatic retroreflective material. This sheeting is typically used for orange temporary roll-up warning signs, traffic cone collars, and post bands.
Type VII	A super-high-intensity retroreflective sheeting (ASTM D 4956 Table 1). This sheeting is typically unmetallized, with the highest values of retroreflection attained at long and medium roadway distances. Typical applications are temporary traffic control devices, delineators, and permanent highway signing.
Type VIII	A super-high-intensity retroreflective sheeting (ASTM D 4956 Table 2). This sheeting is typically unmetallized, with the highest values of retroflection attained at long and medium roadway distances. Typical applications are temporary traffic control devices, delineators, and permanent highway signing.
Type IX	A very-high-intensity retroreflective sheeting which is typically unmetallized with the highest values attained at short roadway distances where viewing angles may be critical. Typical applications are permanent highway signing, temporary traffic control devices and delineators.

(b) TESTS AND SAMPLES.

The Department's Product Evaluation Board has established a list of sheetings (V-1, "Materials, Sources, and Devices with Special Acceptance Requirements", manual). Only the materials on this list shall be furnished for use. Refer to Subarticle 106.01(f) and ALDOT-355 "General Information

Concerning Materials, Sources, and Devices with Special Acceptance Requirements" for further information.

In addition these materials will be inspected, sampled, and tested in accordance with the Department's Testing Manual and Laboratory Manual.

(c) APPLICATION OF SHEETING.

Application of sheeting shall be in accordance with the manufacturer's recommendations; splicing of sheeting will be allowed on sign faces provided such splices have a minimum overlap of 1/2 inch {13 mm} and are held to a minimum. More than one splice per 48 square feet {4.5 m^2} of panel is considered excessive.

On signs which consist of one panel only, the sheeting shall extend to the edge of the sign panel, except where indicated in the plans. On all signs which are sufficient size to require two or more panels, sheeting shall be applied separately to each panel. No attempt shall be made to extend the sheeting from one panel to adjacent panels. Sheeting shall be applied in strict conformity with the recommendations of the manufacturer.

(d) FLUORESCENT ORANGE / FLUORESCENT YELLOW / FLUORESCENT YELLOW-GREEN COLOR REQUIREMENTS.

1. COEFFICIENT OF RETROREFLECTION.

The requirements for minimum coefficient of retroreflection (R_A) for fluorescent orange / fluorescent yellow sheeting shall be the same as those shown for orange / yellow respectively in Tables 1, 2, 3, and 8 of ASTM D 4956, depending on the type of sheeting required .

The requirements for minimum coefficient of retroreflection (R_A) for fluorescent yellow-green sheeting shall be those shown in the following table.

Observation Angle	Entrance Angle (cd/lx/m^2)	
	-4°	30°
0.2°	325	205
0.5°	240	110
1.0° (This is a supplementary requirement that shall apply only when shown on the plans)	65	35

2. CHROMATICITY COORDINATES.

The following table for the chromaticity coordinates for fluorescent orange/fluorescent yellow-green sheeting shall be utilized as a supplement to Table 13 of ASTM D 4956:

Color Specification Limits (Daytime)								
Color	1		2		3		4	
	x	y	x	y	x	y	x	y
Fluorescent Orange	0.583	0.416	0.523	0.397	0.560	0.360	0.631	0.369
Fluorescent Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472
Fluorescent Yellow-Green	0.387	0.610	0.460	0.540	0.421	0.486	0.368	0.539

3. LUMINANCE FACTOR / SPECTRAL RADIANCE.

The following table for the luminance factor for fluorescent orange/fluorescent yellow-green sheeting shall be utilized as a supplement to Table 9 of ASTM D 4956:

	Luminance Factor (Y Percent) (Daytime Luminance)		Spectral Radiance
Color	Minimum	Maximum	Maximum
Fluorescent Orange (New)	30	- -	110%
Fluorescent Orange (Weathered)	20	45	60%
Fluorescent Yellow (New)	40		
Fluorescent Yellow-Green (New)	50		

4. DAYTIME COLOR.

The chromaticity of fluorescent retroreflective materials shall be determined in accordance with ASTM E 991, using instrumentation which complies with the requirements set forth in E 991 and which has circumferential viewing (Illumination). The instrumentation shall illuminate the specimen with light having the spectral irradiance criteria for CIE Standard Illuminant D-65 as set forth

in Section 5.1 of E 991 for the testing of fluorescent specimens. The reflectance data for the CIE 1931 2° Observor shall be computed in accordance with ASTM E 308.

5. ARTIFICIAL WEATHERlNG.

Four panels shall be tested. The panels shall be exposed for 1500 hours in a xenon arc weatherometer in accordance with ASTM G 26, Type B, Method A. Following exposure, the panels shall be washed with a five percent HCl solution for 45 seconds, and rinsed thoroughly with clean water, blotted with a soft clean cloth, brought to equilibrium at standard temperature conditions, and then tested for coefficient of retroreflection as in Section 7.6.3 of ASTM D 4956. The average of the four panels shall be reported.

Retroreflectivity measurements after artificial weathering shall be made at only 0.2° observation and -4° entrance angles at which point the sheeting shall have an R_A value of not less than 55 cd/lx/m^2.

880.03 Sign Copy.

(a) APPLIED COPY.

1. GENERAL.

Applied copy is classified as copy applied directly to the sign background as distinguished from demountable copy which is affixed to the sign background by approved fasteners.

All standard Class 3, 4, 5, 7 and 8 signs shall have the sign copy applied by either the direct or reverse screening (silk screen) method as noted in Items 2 and 3 below. All standard signs requiring reflective white copy and colored background shall use the reverse-screening process for application of the sign copy.

Special Class 3, 4, 5, 7 and 8 signs may utilize cut-out copy as noted in Item 5 below, if so noted by the plans or on the approved shop drawings.

2. DIRECT SCREENING PROCESS.

This method is used for applying a non-reflective copy to a sign background.

3. REVERSE SCREENING PROCESS.

This method is used for applying white reflectorized copy to a reflectorized colored background by utilizing a transparent color stencil paste applied to a white reflectorized background.

4. SCREENING MATERIAL AND APPLICATION.

Material for application by the silk screen method shall be a top quality exterior baking screen enamel or stencil paste manufactured especially for use on roadway signs and compatible with the type sign background material being used. Application of screened copy and curing thereof shall be in strict compliance with the manufacturer's recommendations of the background material.

Colors shall be durable and consistent with the requirements of the FHWA Standards Colors Charts for Signs. The color shall be uniform in acceptable Hue when viewed in daylight and under normal headlights at night.

5. SUBSTITUTION OF CUT-OUT COPY FOR SCREEN COPY.

Certain signs for which standardization is impractical, such as destination signs, may be authorized to use cut-out copy. Said cut-out copy shall be fabricated from the appropriate class sheeting by individually cutting of the borders, legends, numerals, and symbols, and applying them to the required background in strict compliance with the sheeting manufacturer's recommendation.

When cut-out copy is authorized, borders, legends, symbols, or numerals shall be either screened or cut-out copy; mixing of the two to form a border, a legend, a symbol, or numerals will not be permitted except when authorized on construction warning signs.

White copy shall be formed from Type III sheeting; non-reflective copy shall be formed from Type I-N sheeting.

(b) DEMOUNTABLE COPY.

1. GENERAL DESIGN.

Letter design shall meet the Federal Standard Alphabet Series; digits, arrows, borders, and other accessories shall be of approved design, all in accordance with the details shown on the plans.

All Items shall be fabricated from sheet aluminum of alloy 3003 B 209 or equal, of not less than 0.032 inches {0.813 mm} in thickness. Mounting holes shall be provided within the frames, in accordance with the manufacturer's directions, to permit the use of rivets or other acceptable fasteners.

The demountable copy shall be fastened to sign panels either by aluminum rivets or galvanized self-tapping sheet metal screws with heads of the same color as the copy. The number of rivets or screws with heads shall be as recommended by the manufacturer of the demountable copy and as approved by the Engineer. Border sections shall be full standard length, except where it is necessary to use less than a standard length to fit a sign dimension. Border units shall fit snugly together without visible gaps.

All Items shall be reflectorized, unless otherwise specified by plan details, by one of the following methods:

(1) Prismatic reflectors installed in the copy frame as noted in Item 2 below, or

(2) Encapsulated lens reflective sheeting mounted on the copy frame as noted in Item 3 below.

Non-reflectorized demountable copy, when specified, shall be finished in the same manner as provided in Subitem 880.03(b)2b meeting the same requirements except that the finished color shall be black or white porcelain enamel as required.

The type of reflectorization for the demountable copy will be at the option of the Contractor except when (1) a specific type is designated by plan details or (2) when repairing or adding to an existing sign, the new copy shall be consistent with that retained. The type of reflectorization, once selected, shall be consistent throughout the project.

2. PRISMATIC REFLECTORIZATION.

a. General.

Prismatic reflectors shall be supported by embossed frames with reflectors installed so as to be an integral part of the character, or otherwise securely affixed to prevent displacement by handling or servicing; the use of tape to hold reflectors in place is not acceptable.

The size and spacing of the reflectors shall be such as will provide maximum night legibility and visibility of the unfinished cutout figure.

b. Finishing of Frame.

After the metal fabrication has been completed, the finishing process shall be as follows:

Preparation: Aluminum frames shall be degreased, etched, neutralized, and treated as specified in Item 880.01(a)2.

Enameling: After treating, frames shall be finished in white porcelain enamel, unless otherwise specified by plan details. The porcelain finish shall be in accordance with the Porcelain Enamel Institute Specification ALS-105. When subject to Porcelain Enamel Gloss Test T-18, the enamel shall have a gloss reading at 45° of 50 to 70 units.

c. Prismatic Reflectors.

(1) General.

The reflectors shall consist of a transparent acrylic plastic face, hereafter referred to as the lens, and an opaque back hermetically sealed to form a unit permanently sealed against dust, water, and water vapor. The reflector lens shall be crystal or as designated on the plans.

Reflectors shall meet the requirements of AASHTO M 290, with sampling and qualification requirements being governed by the Department's Testing Manual, Laboratory Manual, and Materials, Sources and Devices with Special Acceptance Requirements Manual.

(2) Sampling Procedure and Test Requirements.

The Department's Product Evaluation Board has established a list (V-2, "Materials, Sources, and Devices with Special Acceptance Requirements" manual) for reflectors. Refer to Subarticle 106.01(f) and ALDOT-355, "General Information Concerning Materials, Sources, and Devices with Special Acceptance Requirements" for further information.

3. ENCAPSULATED LENS REFLECTORIZATION.

Encapsulated lens sheeting used for demountable copy shall be of a white or silver-white color mounted on an aluminum frame as noted in Item 1 above. The reflective sheeting shall meet all the requirements of Subarticle 880.02(a) for Type III reflective requirements.

Fabrication of the cut-out character shall be such that the entire exposed surface of the character will be covered by the reflective sheeting.

880.04 Sign Supports.

(a) GROUND MOUNTED SIGN SUPPORTS.

1. GENERAL.

Ground mounted supports shall fall into two categories, a light weight {mass} or bendaway post and a standard or rigid post.

The light weight {mass} or bendaway posts are normally single "U" channels (aluminum or steel) and tubular shapes (round, square, etc.) of such size and design that when hit by a moving vehicle, will easily bendaway from the vehicle without seriously damaging it.

The standard or rigid posts shall be of various designs (shapes, tubular, etc.) which by size and design will not easily bendaway when hit by a moving vehicle. This type post, unless otherwise noted by plan details, will require a "breakaway" feature to be incorporated with the post. The material and design of the breakaway features for the various shapes of standard posts shall be shown by the plan details.

Breakaway features constructed of steel shall have all elements galvanized, unless otherwise provided by the plan details. Damage to galvanization or any bare spots developed during construction shall be treated with two coats of approved galvanizing paint (Section 855) or approved zinc spelter paint. Aluminum elements will require no special treatment, unless so specified by plan details.

All materials furnished for use shall be new, unless otherwise specified by plan details or provisions of the contract.

All tubular post shapes whose design will have a tendency to collect water shall be provided with an approved type of tight fitting post cap fabricated of material compatible with that of the post.

2. STEEL POSTS.

a. Tubular Type (Std.)

This type of post shall be fabricated from standard steel shapes of the size and weight {mass} shown by plan details. Round shapes shall conform to the requirements of ASTM A 53, Grade B, Schedule 40 or better (no pressure test required). Other shapes and materials shall be as noted by plan details.

b. Beam Type (Std.)

This type of post shall be fabricated from standard beam shapes of the size, shape, and weight {mass} shown on the plans. The material shall conform to the requirements of either ASTM A 588 or A 572, Grade 50, unless otherwise noted by plan details.

c. Light Weight {Mass} or Bendaway Type.

(1) This post shall be fabricated to acceptable shape and design to provide the Moment of Inertia and Section Modulus for the requirements of the designated post size shown by the plan details. The posts shall be made of rerolled rail steel meeting the requirements of ASTM A 499, Grade 60, or a comparable new billet steel meeting the requirements of ASTM A 572, Grade 60. The steel in the posts shall meet the chemical requirements of ASTM A 1 for rails having a nominal weight {mass} of 91 pounds per yard {37 kg/m} or greater. Shaped sections shall be provided with 3/8 inch {9.5 mm} diameter holes placed on 1 inch {25 mm} centers starting 1 inch {25 mm} from the top of the post and extending the full length of the post.

(2) Tubular sections shall be fabricated from steel meeting the requirements of ASTM A 446. Tubular sections shall be provided with 3/8 inch {9.5 mm} diameter holes placed on 1 inch {25 mm} centers starting 1 inch {25 mm} from the top of the post and extending the full length of the post (holes shall extend through the opposite walls).

In lieu of the above, tubular steel posts may conform to ASTM A 570, Grade 33 or better. The posts shall be provided with 7/16 inch {11 mm} diameter die-cut knockouts on 1 inch {25 mm} centers on all four sides.

d. Post Finish.

Standard posts shall be hot dipped zinc galvanized after fabrication in accordance with ASTM A 123 for beam shape and ASTM A 53 for tubular shape.

Light weight {mass} or bendaway posts shall be zinc galvanized in accordance with the following:

"U" Channel Section - ASTM A 123 after fabrication.

Tubular Section - ASTM A 525, Grade G90 or better. An alternate coating may be an in-line hot dip galvanized zinc coating per AASHTO M 120, followed by a chromate conversion coating and cross-linked polyurethane acrylic exterior coating, with the inside surface given a double in-line application of a full zinc-based organic coating.

3. ALUMINUM POSTS.

a. Tubular Type (Std.)

This type of post shall be fabricated from extruded tubing to the size, shape, and wall thickness shown on the plans and shall conform to the Aluminum Association, Alloy 6061-T6 (ASTM B 221).

b. Beam Type (Std.)

This type of aluminum support shall be fabricated from extruded shapes of the size, shape, and weight {mass} shown on the plans and shall conform to the Aluminum Association, Alloy 6061-T6 (ASTM B 308).

c. Light Weight {Mass} or Bendaway Type.

This type of aluminum support shall be fabricated from acceptable extruded shapes meeting the design requirements (Moment of Inertia and Section Modulus) for the designated post size shown in the plan details. Materials shall conform to the requirements of Alloy 6061-T6 of ASTM B 221.

Holes 3/8 inch {9.5 mm} in diameter shall be placed on 1 inch {25 mm} centers starting 1 inch {25 mm} from the post top and extending the full length of the post or within 8 feet {2.4 m} or less of the bottom of the post (holes in tubular sections shall extend through the opposite walls),

d. Finish.

Aluminum supports shall be provided with a smooth non-glare finish.

4. BOLTS, NUTS, WASHERS AND MISCELLANEOUS HARDWARE.

High strength bolts, nuts, and washers shall meet the requirements of Article 836.33. Bolts, nuts, and washers other than high-strength shall meet the requirements of ASTM A 307 for bolts and the appropriate requirements noted in Subarticle 836.33(a) for nuts and washers.

All bolts, nuts, and washers shall be galvanized utilizing zinc in accordance with the provisions of ASTM A 153, Class C or AASHTO M 232, Class C. Other miscellaneous hardware shall be galvanized in accordance with ASTM A 153, Class B.

(b) OVERHEAD SIGN SUPPORTS.

The materials required for overhead sign supports shall be furnished in accordance with the requirements given in Section 891.

880.05 Protection Of Sign Material.

All sign panels shall be protected by packaging after fabrication and during shipment and storage. Packaging and packing shall be adequate to prevent damage to any part of the sign panel, legends, copy, or borders. Before packaging all paint shall be thoroughly dry and all signs free of moisture. Adhesive tapes shall not be used on any sign face. All packaged signs shall be kept entirely dry.

All assembled or partially assembled signs, other than flat sheet signs, shall have sufficient braces securely attached to prevent buckling or warping at all times from after assembly has begun until the signs have been attached to their permanent supports.

880.06 Sampling and Testing of Sign Materials.

All hardware such as nuts, bolts, washers, angles, channels, etc., sign panels along with the samples of the materials used in the panels and any certified test reports required and sign supports shall be shipped to the project site. The Engineer will assemble all samples in accordance with current sampling policy and forward such to the Central Lab for testing. Inasmuch as certain tests require actual inspection of all sign panels, the Contractor shall supply at the time of inspection the necessary personnel for uncrating and movement of the panels.

Until test reports are issued on the sign materials, the Contractor will not be permitted to install the sign materials, unless written approval for such has been obtained from the Central Office.

Should any material samples fail or any question arise concerning submitted samples being representative of those on the project, additional samples shall be selected from those on hand at the job site. Failure of resamples shall be cause for rejection of all items of the type involved.

Verification of color by comparison with Color Tolerance Charts published by the FHWA shall be made. Noticeable variation in color shall be cause of ordering inspection of all sign faces and the rejection of any sign face outside the tolerances provided by the Color Charts.

All signs shall be inspected for faulty application, blemishes, or other faults that might impair the serviceability of the sign or any noticeable color mismatching when viewed from a distance of 25 feet {8 m} under both daylight and nighttime conditions shall be cause for rejection of the sign face.

SECTION 881
DELINEATORS AND HAZARD MARKERS

881.01 Standard Delineators.

(a) GENERAL.

A delineator shall consist of one or more colorless or colored reflector units mounted as shown on the plans. A reflector unit shall consist of a hermetically sealed acrylic plastic prismatic reflex reflector with a sealed plastic back or housed in an embossed aluminum housing.

(b) REFLECTOR UNITS.

1. REFLECTOR LENS.

The reflector lens shall be methyl methacrylate meeting the requirements of Federal Specifications L-P-380, Type 1, Class 3 or ASTM D 788, Grade 8 and shall be of clear or colored transparent plastic, with a minimum of 7 square inches {4500 mm^2} of reflective area. The lens shall have a smooth front surface, free from projection or indentation other than a central mounting hole and identification, and a rear surface bearing a prismatic configuration, such as will effect essentially total reflection of light. The manufacturer's trademark shall be molded legibly on the face or back of the reflector unit.

The backing shall be a heat sealable plastic or metallic foil fused to the lens under heat and pressure around the entire perimeter of the lens and the central mounting hole to form a unit permanently sealed against dust, water, and vapor.

2. REFLECTOR HOUSING.

To retain the acrylic reflector, the delineator shall have a sealed plastic back or aluminum housing conforming to the following:

The housing shall be a minimum 0.02 inch {0.51 mm} aluminum conforming to ASTM B 209, alloy 1100-TO or alloy 5052-TO, and formed as shown on the plans.

Delineators shall have either a plastic or metal gromet 3/16 of an inch {5 mm} in diameter.

3. OPTICAL REQUIREMENTS.

The specific intensity per unit area of each reflector shall be equal to or exceed the following minimum values when tested in accordance with AASHTO M 290. Measurements shall be made with the reflector spinning to obtain an average reading.

Observation Angle	Entrance Angle	Specific Intensity candle power/square inch/foot candle {candelas/lux/m^2}			
		Crystal	Amber	Red	Green
0.1°	0°	17.0 {2448}	10.0{1440}	4.0 {576}	4.0 {576}
0.1°	20°	6.5 {936}	4.0 {576}	1.5 {216}	1.5 {216}

4. SEAL REQUIREMENTS.

When tested in accordance with AASHTO M 290, the reflector shall show no evidence of moisture intrusion.

5. HEAT RESISTANCE REQUIREMENTS.

The reflector shall show no signs of deformation or change in shape nor loss of reflective quality when tested in accordance with AASHTO M 290.

6. PREQUALIFICATION.

All types of reflectors must be evaluated for conformance with the MUTCD requirements as well as the physical requirements listed above prior to use. The Department maintains a list (V-2) of reflectors meeting these requirements in the manual "Materials, Sources, and Devices With Special Acceptance Requirements". Other reflectors may be used upon evaluation and approval of the Department's Product Evaluation Board.

7. SAMPLING AND TESTING.

Sampling and testing shall be done in accordance with the Department's Testing Manual.

8. PACKAGING.

The reflectors shall be supplied in suitable containers which will protect the units from damage during shipment and storage. Containers shall be legibly marked with the name, type, lot, etc. of the contents.

(c) POSTS.

The posts shall be of the design and weight {mass} as shown on the plans. Posts shall be straight with no bending, warping, splits, or other defects. Mounting holes shall be punched or drilled on the centerline of the web, as shown on the plans.

Steel Posts shall be manufactured from rerolled rail steel meeting the requirements of ASTM A 499, Grade 60, or a comparable new billet steel. The steel in posts shall meet the chemical requirements of ASTM A 1 for rails having a nominal weight {mass} of 91 pounds per yard {45 kg/m} or greater, modified to require the carbon content to be between 0.67 and 0.89 percent. The posts shall be hot dip galvanized after forming, cutting, punching, or drilling has been completed. Galvanization shall be in accordance with ASTM A 123. Aluminum posts shall be manufactured from aluminum alloy 6063-T6.

Other types of posts may be used upon evaluation and approval of the Department's Product Evaluation Board.

881.02 Reflective Hazard Markers.

(a) GENERAL.

A hazard marker may be either a series of reflector units (three or more) mounted on a backup plate or a designated standard or special reflectorized sign panel.

(b) REFLECTORS.

The reflectors shall comply with the requirements for delineator type reflectors noted in Subarticle 881.01(b), except the metal housing and metal center grommet will not be required.

(c) BACKUP PLATES.

The backup plates for the hazard markers shall be at least 0.064 inch {1.6 mm} thick aluminum sheets. The surface of the marker facing traffic shall be treated with a coating of baked on yellow enamel (Highway yellow). Attachment of the reflectors to the backup plate and of the backup plate to the post or mounting surface shall be in accordance with the details shown on the plans or an approved substitute.

(d) POSTS.

Posts used for mounting hazard markers shall be in accordance with the details shown on the plans and the requirements of Subarticle 881.01(c).

(e) MOUNTING.

Mountings other than on posts shall be in accordance with plan details.

(f) SAMPLING AND TESTING.

Sampling and Testing of the reflector units shall be as prescribed in Subarticle 881.02(b).

(g) STANDARD OR SPECIAL SIGN PANELS.

The panel shall comply with the requirements of Section 880 for signs with the legend or marking as required by plan details.

Sign panels shall be sampled and tested as prescribed in Section 880.

SECTION 882
PAVEMENT MARKERS

882.01 General.

(a) SAMPLING PROCEDURE AND TEST REQUIREMENTS.

1. PERMANENT MARKERS.

The Department has established LIST V-2, PERMANENT PAVEMENT MARKERS, MARKER ADHESIVE, DELINEATORS, AND HAZARD MARKERS, of the Department's manual, "Materials, Sources, and

Devices With Special Acceptance Requirements", for permanent pavement markers. Only markers on this list shall be furnished for use. Refer to Subarticle 106.01(f) and ALDOT-355 concerning this list.

2. TEMPORARY MARKERS.

The Department has established LIST V-3, TEMPORARY TRAFFIC MARKING MATERIALS, of the Department's manual, "Materials, Sources, and Devices With Special Acceptance Requirements", for temporary pavement markers.

Markers on either LIST V-3 or LIST V-2 may be used as temporary markers. Only markers on these lists shall be furnished for use. Refer to Subarticle 106.01(f) and ALDOT-355 concerning these lists.

(b) PACKAGING.

The markers shall be supplied in suitable containers which will protect the units from damage during shipment and storage. Containers shall be legibly marked with the name and type, etc. of the contents.

882.02 Reflective Markers.

(a) CLASS "A" MARKER.

Class "A" pavement markers shall meet the requirements of ASTM D 4280 with Surface Characteristics: No Designation - Marker with plastic lens surface.

(b) CLASS "A-H" MARKER.

Class "A-H" pavement markers shall meet the requirements of ASTM D 4280 with Surface Characteristics: Designated "H" - Marker with hard, abrasion-resistant lens surface.

882.03 Non-Reflective Markers.

(a) GENERAL.

Class B pavement markers shall be formed of heat fixed ceramic base material constructed in such a manner as to form a solid, watertight unit. The markers shall be of the general size and shape shown on the plans with smooth rounded corners. Any change in the curvature shall be gradual. The top and sides of the marker shall be smooth and free from mold marks, pits, indentations, air bubbles, or other objectionable marks or discolorations. The base of the marker shall be flat (deviation from a flat surface shall not exceed 0.05 inch {1.27 mm}) rough textures (comparable to at least that of a fine grade sand paper) and free from gloss or substances which may reduce the markers bond to the adhesive.

(b) MATERIALS.

Ceramic - Heat fired, vitreous, ceramic base and a heat fired, opaque, glazed top surface. The bottom surface shall be unglazed, suitable for cementing to the road surface. The marker may be produced from any suitable combination of intimately mixed clays, shales, talcs, or other inorganic material. The marker shall be thoroughly and evenly matured and free from defects which will affect the appearance and serviceability.

(c) TESTS.

1. Color.

White - Brightness relative to Magnesium Oxide - 80% Minimum.

Yellow - Brightness relative to Magnesium Oxide - 40% Minimum and match the standard shade within the red and green balances when compared with Color Chip 33538 of Federal Standard No. 595.

2. Water absorption - 2% Max. (ASTM C 373)

3. Hardness - Moh Hardness - 6 Min.

4. Autoclave Test - shall not craze, spall, or peel when subjected to one cycle at 250 psi {1724 kPa} - ASTM C 424.

5. Glaze Thickness – 0.005 inch {0.13 mm} Min.

6. Strength - Markers shall be capable of supporting a load of 1500 pounds {680 kg} applied as follows:

A marker shall be centered over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be at least 1 inch {25 mm} high, with an internal diameter of approximately 3 inches {75 mm}, and with a minimum thickness of 1/4 inch {6 mm}. Loading shall be slowly applied to the top of the marker through a 1 inch {25 mm} diameter by 1 inch {25 mm} high metal plug centered on the top of the marker.

An average compressive strength of three markers shall be obtained; however, any individual marker which fails under a compressive load of less than 1200 pounds {500 kg} shall be cause for rejection of the marker lot being tested.

7. Adhesive Bond Strength -

The adhesive tensile bond strength to the bottom of the marker accepted for use on the project and the epoxy adhesive accepted for use on the project shall be not less than 1500 psi {10 MPa}.

882.04 Adhesives For Pavement Markers.

Bituminous adhesive used to affix permanent pavement markers to the pavement shall be one of those listed in List V-2 of the Department's manual "Materials, Sources, and Devices with Special Acceptance Requirements."

The adhesive used to affix the temporary markers to the pavement shall be any suitable type of adhesive for the intended purpose, except that in those locations where the markers will be required to be removed, the adhesive shall be a type that will allow for the complete removal of the marker without scarring or disfiguring the pavement.

SECTION 885
SIGN LIGHTING MATERIALS AND SERVICES

885.01 General.

The following requirements for materials and services will govern the construction of roadway sign lighting unless otherwise specified by plan details or special provisions.

All construction and installations shall be made by workmen skilled in this type of work and under the supervision of an experienced and qualified electrical supervisor. All work shall be executed in a neat and workmanlike manner and shall present a neat and mechanical appearance when completed. Upon completion of the contract, the Contractor shall deliver to the Engineer a corrected plan showing in detail all changes on construction from the original plans, especially location and depth of conduits, complete schematic circuit diagrams, and the like.

CODES, PERMITS, AND INSPECTIONS.

Installation shall comply with all laws applying to electrical installations in effect in this community, with the requirements of the latest edition of the National Electrical Code and the latest edition of the National Electrical Safety Code, Handbook H-81, where such requirements do not conflict with those laws and with the service rules of the utility company furnishing electricity. The Contractor shall obtain and pay for all permits required by the local ordinances at the time of bidding. After completion of the work, the Contractor shall verify by certificate of final inspection and approval from the local inspector, where there is a local inspector, that the installation complies with all local regulations governing same.

DRAWINGS AND SPECIFICATIONS.

The approved electrical drawings and any plan detail drawings along with these specifications are complementary to each other. What is called for by one shall be as binding as if called for by both. In case of difference between drawings and these Specifications, the Specifications shall govern. Omissions from the drawings and Specifications or the misdescription of details of work which are evidently necessary to carry out the intent of the drawings and Specifications, or which are customarily performed, shall not relieve the Contractor from performing such omissions and details or work, but they shall be performed as if fully and correctly set forth and described in the drawings and Specifications. In any case of discrepancy in the figures, catalog numbers, or descriptions in the drawings or in the Specifications, the matter shall be promptly submitted to the Engineer who shall promptly make a determination in writing. Any adjustment in the plans by the Contractor without written approval shall be at the Contractor's own risk and expense.

CHANGES AND ADDITIONAL WORK.

No change shall be made from the work called for by these Specifications and drawings except on the written order of the Engineer. No charges for extra work will be allowed unless such work has been authorized by a written order of the Engineer stating the charge to be made for the work.

885.02 Systems Of Wiring.

Sign lighting systems shall be of one of the following classes:

CLASS 1

A three wire grounded single phase service for a nominal voltage of 120/240 volts, 60 Hertz.

CLASS 2

A two wire grounded single phase service for a nominal voltage of 480 volts, 50 Hertz.

885.03 Service Feeders.

For a Class 1 wiring system, extend conductors and conduit of the sizes shown on the drawings underground or overhead from service pole to sign bridge. Extend underground conduit up pole to overhead service and up sign bridge support to control mounted thereon. Raceway running under roadway, including usable shoulder and raceway exposed about grade, may be rigid galvanized conduit or Type 40 heavy wall PVC at the Contractor's option. The service raceway shall be buried to provide a minimum depth of 2.5 feet {750 mm} along its entire run. Terminate feeder near top of service pole with service entrance fittings. Service fitting shall be Type F as manufactured by Crouse-Hinds, Appleton, or Killark.

For a Class 2 wiring system, extend 2 - #6 AWG insulated and 1 - #6 AWG bare conductors in 1 inch {25 mm}, or larger, conduit underground from flush junction box as shown on drawings to control on sign bridge. Conduit shall be rigid galvanized conduit. Conductors shall be cross-linked polyethylene insulated copper conductors. Underground portion of feeder shall be 2 feet {600 mm} or more below grade.

885.04 Control And Protection Of Equipment.

(a) GENERAL.

1. CLASS 1 WIRING SYSTEM.

Service control and protective equipment shall consist of not fusible switch mounted on service pole, a circuit breaker loadcenter, and magnetic multiple relay mounted on sign bridge unless shown otherwise on the drawings.

a. Fusible Switch.

A switch shall be mounted approximately 10 feet {3 m} above grade on the service pole. This switch shall be NEMA Type HD, quick-make, quick-break in NEMA-3R raintight enclosure, 3 pole, solid neutral, fusible type switch of the size shown on the drawings, Square D Company, I.T.E., Westinghouse, or approved equal. A not fusible switch of the same type shall be provided on the structure to serve as disconnect.

b. Multiple Lighting Relays,

Lighting relays shall be 40 ampere, 2 pole, 120/240 volt relays, with built-in lighting arrestors, mounted in cast aluminum weatherproof case with receptacle for photo control and with hanger for mounting. The relays shall be mounted in the vicinity of the bottom chord of the sign bridge. Relays shall be South Bend Current Controller Company, Inc., Type MR-OI, Spec. No. 6319, or equivalent as manufactured by Westinghouse or McGraw Edison Company.

c. Protective Device.

Where shown on the drawings, provide a Circuit-breaker Loadcenter in NEMA-3R raintight enclosure with raintight hub. Circuit breakers shall be single pole thermal-magnetic circuit-breakers with an interrupting capacity of not less than 10,000 amperes RMS. Loadcenter shall be Type Q02-4ARB as manufactured by the Square D Company or equivalent as manufactured by General Electric Company, I.T.E., or Westinghouse.

2. CLASS 2 WIRING SYSTEM.

Control and protective equipment shall consist of a not fusible switch and magnetic multiple relay mounted on sign bridge.

a. Not Fusible Switch.

The switch shall be mounted approximately 10 feet {3 m} above grade. The switch, unless otherwise noted on the plans, shall be NEMA Type HD, Quick-make, quick-break in NEMA 3R raintight enclosure, 30 ampere, 3 pole, 480 volt solid neutral, not fusible, Square D Company, I.T.E., Westinghouse, or approved equal.

b. Multiple Lighting Relays.

Lighting relays, unless otherwise noted on the plans, shall be South Bend Current Controller Company Type MR-PH, Specification 6419, 480 volt A.C. street lighting control or approved equal as manufactured by Westinghouse or McGraw Edison Company. Control shall be mounted in cast aluminum weatherproof case with receptacle for photoelectric control, hanger for mounting, built-in lighting arrestor, fuses, control transformer, and control switch. Control shall be mounted in the vicinity of the bottom chord of the sign bridge. Fuses shall be 30 ampere dual element fuses.

(b) PHOTOELECTRIC CONTROL.

1. GENERAL.

The Contractor shall furnish and install on the receptacle provided on the multiple lighting relay a photoelectric control with a factory setting for turn on of approximately 30 footcandles {325 lux} and a turn off of approximately 40 footcandles {430 lux}. The control shall satisfactorily withstand an ambient temperature range of –65 °F to +158 °F {-54 °C to +70 °C} and shall be moisture proof. The housing shall be approximately 2.25 inches {57 mm} high with a base diameter of not more than 3.25 inches {83 mm}. The chassis shall be molded phenolic with three locking type blades and neoprene gasket, conforming to EE 1 Publication No. 148, NEMA Publication No. SH 18-1959. The housing shall be weatherproof clear acrylic, internally sprayed. The control shall be suited for the class of wiring being used as noted in this Subarticle.

2. CLASS 1, WIRING SYSTEM.

The control shall operate on a supply voltage of 105-285 volts, 50/60 Hz, AC, with an inrush rating of 120 amperes at 110 volts and 60 amperes at 220 volts and a lamp load capacity of 1800 volt-amperes for mercury vapor lamps. Rated life at full load shall be 8000 on-off operations minimum. Relay contacts shall be SPST NC. Dielectric strength shall be 5000 volts minimum between any current carrying part and metal mounting surface. Control shall be Fisher-Pierce Series 6690B (Modified) or approved equal as manufactured by General Electric Company or Crouse-Hinds.

3. CLASS 2, WIRING SYSTEM.

The control shall be the same as noted in Item 2 above.

(c) GROUNDING.

1. GENERAL.

All exposed non-current carrying metallic parts of electrical equipment, including raceways, shall be grounded with driven ground rods and copper conductor. Where non-metallic raceway is used, a separate continuous ground conductor shall be extended from the service ground to all equipment and shall be used for grounding purposes only. Where a continuous metallic raceway system is used, the raceway properly bonded to provide a continuous system may be used in lieu of the separate conductor. Ground rods shall be copper-clad or hot-dipped galvanized steel rods. Conductor shall be #6 AWG soft drawn copper. Connections to rods shall be made with ground wire clamps with safety screws. Rods and connectors shall be as manufactured by McGraw-Edison, Joslyn Manufacturing and Supply Company, or A. B. Chance Company. All connections required to give such continuous connection shall be provided.

2. SERVICE GROUNDS.

Provide a minimum of one 3/4 inch x 8 foot {20 mm x 3 m} rod driven full length plus 1 foot {300 mm} into the earth not less than 2 feet {600 mm} from pole. After installation is completed, tops of ground rods and horizontal conductors shall be approximately 1 foot {300 mm} below finished grade. Vertical conductors shall be protected by a half-round wood molding from the ground line to a point at least 8 feet {2.4 m} above grade. Staple conductor to pole at intervals of 3 feet {1 m} or less. Staple molding to pole at intervals of 2 feet {600 mm} or less. Staples shall be galvanized steel of types designated for specific purposes of its use. Minimum conductor size shall be #6 AWG.

885.05 Types Of Wiring.

(a) OPTIONS.

Underground service feeder shall be of the following types: The type used shall be the Contractor's option.

1. TYPE I.

Metallic conduit with insulated conductors.

2. TYPE II.

Non-metallic conduit with insulated circuit conductors and a bare grounding conductor.

(b) CONDUCTORS.

All conductors in the underground circuit shall be annealed copper with not less than 98% conductivity and shall be insulated for 600 volts or more with rubber insulation and a neoprene jacket or with cross-linked polyethylene insulation. The type used shall be at the Contractor's option. Conductors, #8 AWG and larger, shall be Class B Stranded. Grounding conductors may be bare. If insulated, they shall be identified by a continuous green color or a continuous green color with a yellow stripe.

All above ground lighting and control circuits shall be installed in rigid galvanized or rigid aluminum conduit. Conductors shall be as specified for underground circuits or polyvinyl - Chloride insulated conductors meeting the requirements of U/L No. 83 for THW insulation and U/L No. 719 for UF insulation. (Types THW or UF conductors shall not be used for underground circuits.)

All conduit systems shall be complete before conductors are pulled in.

Splices and taps shall be made with solderless split bolt or pressure type connectors as manufactured by O.Z. Manufacturing Company, Burndy Corporation, Thomas & Betts Company, or approved equal. A minimum of three layers of rubber tape shall be applied to each splice or tap in uniform half-lap wrapping. On top of this, apply not less than three layers of high dielectric, high tensile strength plastic tape in uniform half-lap wrapping over the rubber tape. Tape shall be as manufactured by Okonite Company, Minnesota Mining and Manufacturing Company, Johns-Manville Corporation, or equal.

Self-insulating connectors of a type approved by the Engineer may be used in lieu of taping.

Phase or current carrying conductors for underground feeder shall be of the following type or types:

TYPE A:

Rubber insulation meeting the requirements of U/L No. 44 for RHW insulation with a neoprene jacket applied over the insulation. Conductors shall meet the requirements of IPCEA Standard S-19-81. Thickness of insulation shall be not less than 4/64 inch {1.58 mm}. Neoprene jackets shall be not less than 2/64 inch {0.79 mm}. Cable shall be single conductor as manufactured by Anaconda, Phelps-Dodge, General Electric Company, or equal.

TYPE B:

Cross-linked polyethylene meeting the requirements of Interim Standard #2, IPCEA Publication No. S-66-524, NEMA Publication No. WC7-1966, Phelps-Dodge "Thermolene", General Electric Company "Vulkene", Anaconda "Unicon", or equal. Thickness of insulation shall be not less than 0.045 inch {1.14 mm}.

885.06 Conduit Systems.

(a) METALLIC CONDUIT.

All metallic conduit shall be rigid thick-wall, hot-dipped galvanized or "sherardized" conduit as manufactured by National Electrical Products, Pittsburgh Standard Conduit Company, Triangle Conduit and Cable Company, or approved equal, or rigid aluminum conduit as manufactured by Kaiser Aluminum and Chemical Sales, Reynolds Metal Company, or National Electric Products Corporation, or approved equal. Aluminum conduit shall not be installed below grade or in contact with earth.

Bends and off-sets shall be avoided where possible but, where necessary, shall be made with proper hickey, pipe bender, or conduit bending machine. Conduit which has been crushed or deformed due to improper bending or handling shall not be installed.

Conduits shall be installed in a manner to insure against trouble from collection of trapped condensation where possible.

Conduits shall be supported and substantially fastened to structural members at intervals of not more than 6 feet {2 m}.

All exposed conduits shall be supported with two-hole, hot-dip galvanized straps secured by means of bolts and expansion anchors or inserts in concrete or masonry, machine screws or bolts on metal surfaces, or lag screws on wooden surfaces. Straps shall be heavy duty steel pipe supports for standard pipe as manufactured by Elcen Metal Products Company, Grinnel Company, or Fee & Mason. Expansion anchors shall be of the self-drilling expansion shell type or of the machine screw drive-in lead-expansion anchor type. Lag or machine bolt shields and percussion driven anchors in concrete or masonry will not be accepted.

Exposed conduit shall be installed with runs parallel or perpendicular to walls, structural members or intersections or vertical planes with right angle turns consisting of cast metal fittings or symmetrical bends.

Conduit shall be capped to prevent entrance of deleterious materials during construction.

All metallic conduit below grade or in contact with the earth, unless encased in concrete, shall be completely coated with asphalt, bituminous, or other paint suitable for the service. All exposed conduits shall be painted to match adjacent structure or as directed by the Engineer.

Rigid metallic conduit shall be placed under existing pavement by approved jacking or drilling methods. Pavement shall not be disturbed. Jacking and drilling pits shall be kept at least 2 feet {600 mm} clear of the edge of any type pavement whenever possible. Excessive use of water that may cause undermining of the pavement will not be permitted. Excavation and backfill incidental to the operation will not be paid for separately. Where conduit is used for raceway for installation of combination cable and duct, such conduits shall be provided with appropriate bushings at the ends.

(b) NON-METALLIC CONDUIT.

Conduits run underground may be Type II (Type 40) plastic conduit and fittings conforming to the requirements of Federal Specification W-C-1094, February 10, 1966, with conductors of the type specified under "Conductors". Where non-metallic conduits join metallic conduit stubouts, connections shall be made using appropriate couplings to form a water-tight raceway.

885.07 Sign Lighting Fixtures.

Sign lighting fixtures shall be provided in quantities and sizes to produce uniform illumination of the signs to be lighted. The lighting system shall provide a minimum maintained average intensity of 40 footcandles {430 lux} with a maximum to minimum brightness ratio of not more than 6 to 1 at 60 °F {16 °C} ambient temperature. For basis of calculating to determine the maintained illumination, a maintenance factor of 0.64 shall be used. Lamps used shall be 175 watt, 250 watt, or 400 watt mercury vapor deluxe white, or metal additive lamps as required to provide specified intensity and true color rendition of the lighted signs. Minimum size lamps required to provide the specified lighting intensity shall be installed.

Information shown on the drawings is based on the use of Crouse-Hinds Catalog Numbers SL175 and SL400 Knight-Light. Sign light shall consist of Alzak Aluminum reflector which shall also serve as the lamp housing, tempered glass lens held to reflector by watertight rubber gasket, lamp socket with projecting male contacts to mate with quick disconnect receptacle, designed for pre-set aiming angle. The female part of the disconnect shall be threaded for 1.25 inch {35 mm} conduit and shall be provided with a locking screw set. Lighting fixtures shall be mounted on conduit and supports as shown on the drawings. Where necessary, conduits shall be bent up or down to provide proper tilt of fixture to give proper light distribution for full coverage of the lighted sign. This fixture is individual in type and style. Mercury vapor fixtures suitable for sign lighting as manufactured by Westinghouse, Holophane, or General Electric Company will be considered. In any event, the Contractor shall furnish to the Electrical Engineer, for approval, calculations, photometric data, and detailed drawings of equipment proposed for use in this installation. Acceptance of the Contractor's proposed installation does not preclude the measured illumination requirements.

Transformers or ballast shall be of the types as shown on the drawings and shall be suitable for use with the lamps furnished. Ballasts shall be as manufactured by one of the above listed manufacturers or an approved equal.

885.08 Service Poles.

When required a treated southern pine service pole of the class and size shown on the drawings conforming with American Standards Specification 05.1 shall be provided. Preservative shall conform to American Wood Preservers' Association Standard Specification for creosote oil. Each pole shall be marked on the face 10 feet {3 m} above butt showing size, class, and manufacturer. Guy wires shall be utilities grade 7 strand, 3/8 inch {9.5 mm} galvanized wire with a Line Material Cat. No. WEV633m 3 way malleable iron expanding anchor and a Line Material Cat. No. DA2s6 5/8 inch x 6 foot {16 mm x 1.8 m} hot-dip galvanized steel anchor rod. A half round type hot-dip galvanized guy protector with rolled edges shall be provided on the guy cable, Line Material Cat. No. DG5G1 or similar and equivalent guying material as manufactured by Joslyn, Chance, or Hubbard will be accepted.

885.09 Operational Check And Adjustment Of Equipment.

After completion of all work under this Section and prior to final acceptance of the project, the electrical equipment shall be put through a full operational check. The period of test shall cover 30 calendar days. During the test period, the Contractor shall perform any necessary adjustments and replace any malfunctioning parts of the equipment required to place the equipment or system in an

acceptable operational condition. No extra compensation will be allowed for work so required, such being considered incidental to the furnishing and/or installation of the equipment.

During the test period, provided all other work of the contract is complete and the project is ready for acceptance, subject to completion of the operational check of the equipment, time charges may be suspended and the State may assume the responsibility of any damage caused to the work by the traveling public.

885.10 Guarantee.

The Contractor shall guarantee all work performed under this Section, against defective materials (except lamps) and workmanship for a period of six months after the final acceptance of the project.

SECTION 890
TRAFFIC SIGNAL EQUIPMENT

890.01 General.

The following are the requirements for traffic signal equipment. These requirements may be supplemented or amended by the requirements given elsewhere in the proposal, on the plans, and on the details in the Special and Standard Highway Drawings.

Requirements specified in these specifications shall comply with the latest editions of the NEC, and NESC. All equipment shall conform to the requirements in the NEMA Standards Publication No. TS 1-1989, "Traffic Control Systems" or latest revisions and shall conform to the requirements specified within these specifications. All equipment shall meet the latest NEMA Environmental and Operating Standards. In case of conflict with cited Standard Publications and these specifications, the requirements of these specifications shall govern.

For purposes of these specifications wherever the following terms or abbreviations are used, the meaning shall be interpreted as follows:

A	Amps
AC	Alternating Current
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
AWG	American Wire Gage
DC	Direct Current
Hz	Hertz
IMSA	International Municipal Signal Association
ITE	Institute of Transportation Engineers
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electrical Code
NEMA	National electrical Manufactures Association
NESC	National Electrical Safety Code
UL	Underwriters Laboratories
V	Volts
VA	Volt Amps
W	Watts

Descriptions and definitions of the equipment, words, and terminology used in these specifications are given in the MUTCD, the NEMA TS 1-1989 Standards Publication, ITE publications, and the NEC.

890.02 Controller Assembly.

(a) DESCRIPTION.

A controller assembly shall consist of a controller unit, conflict monitor, auxiliary devices, electrical devices and other equipment as specified in these specifications, plans, or proposal mounted and wired into a cabinet to make a complete operational traffic controller assembly.

(b) CABINET DESIGN.

The cabinet shall be an approved weatherproof enclosure. It shall be designed for base mount or pole mount as shown on the plans. The cabinet shall be clean-cut in design and appearance.

1. FABRICATION MATERIAL.

The cabinet shall be fabricated from cast aluminum or shaped sheet aluminum.

2. CABINET DIMENSIONS.

The cabinet shall be large enough to provide ample space to house the controller unit, conflict monitor, auxiliary devices, electrical devices, and other equipment as specified in these specifications, plans or proposal. The cabinet shall accommodate the largest controller dimensions for the specific number of phases required by the plans or proposal.

The minimum size of pole mounted controller cabinet shall be 41 inches {1025 mm} in height, 28 inches {700 mm} in width, and 16 inches {400 mm} in depth.

The minimum size of base mounted controller cabinet shall be 54 inches {1350 mm} in height, 38 inches {950 mm} in width, and 16 inches {600 mm} in depth.

3. DOORS.

When closed, the doors shall fit closely to gasketing, making the cabinet weather-resistant and dust-tight. Door hinges, bolts, and pins shall be of stainless steel or equivalent corrosion resistant material.

Main Cabinet Door: A hinged main cabinet door shall be provided permitting complete access to the interior of the cabinet. When opened, this door shall be provided with a device designed to hold the door in an opened position.

Auxiliary Cabinet Door: A small, hinged, auxiliary door (police compartment door) shall be provided on the outside of the main cabinet door. The auxiliary door shall permit access to a switch panel, but shall not allow entrance to the controller mechanism nor to exposed electrical terminals.

4. GASKETING.

Gasketing shall be provided on all door openings and shall be dust tight. Gaskets shall be permanently bonded to the metal. The mating surface of the gasketing shall be covered with a silicone lubricant to prevent sticking to the mating.

5. LOCKS AND KEYS.

The main cabinet door shall be equipped with a sturdy brass or stainless steel lock. The lock shall be a traffic industry conventional lock and operate with a No. 2 key. The lock shall be permanently lubricated and shall be covered with a weatherproof tab.

The small auxiliary door (police compartment door) shall be equipped with a lock. The auxiliary door (police compartment door) shall use a standard skeleton key.

Two keys shall be furnished for each lock.

6. SHELVES.

The cabinet shall be supplied with two mounting shelves. One shelf shall be used for storage of the controller and its associated hardware and the other shelf for storage of detectors.

7. FINISH SURFACE PREPARATION.

Unless otherwise shown on the plans, the cabinet shall be aluminum finish.

When painting of the cabinet is specified, the cabinet shall be primed and finished with two coats of high-grade enamel paint, complying with the requirements of Section 855.

8. POLE MOUNT HARDWARE.

A cabinet intended for side-of-pole mounting shall be provided with an adapter (exclusive of lag bolts or banding) necessary to permit mounting to a 4.5 inch {115 mm} diameter or larger pole. The adapter shall accommodate lag bolts up to 3/8 inch {10 mm} diameter or banding up to 1 inch {25 mm} wide. Mounting holes shall be provided at or near the top and bottom of the cabinet.

9. GROUNDING.

Ground electrodes at controllers shall be non-ferrous coated material 5/8 inch {16 mm} in diameter, driven to a depth of 8 feet {2.4 m} and bonded by copper wire or strap of the same cross sectional area as No. 6 AWG {4.25 mm} wire.

10. CABINET VENTILATION.

Louvered vents shall be located on the main cabinet door. Vents shall allow the release of excessive heat and any explosive gases that might enter the cabinet.

A cabinet vent air filter, minimum size of 16 inches x 12 inches {406 mm x 305 mm}, shall be mounted on door and held in place by a spring.

A thermostatically controlled power vent and fan shall be provided. The thermostat shall activate the fan at 110 °F {43 °C} and de-activate the fan at 90 °F {32 °C} with an accuracy of + 5 °F {+ 2 °C}.

11. INDENTIFICATION PLATE.

An aluminum identification plate shall be affixed to the cabinet door.

The identification plate shall be sized to provide the message "Alabama Department of Transportation" either etched or embossed in 1 inch {25 mm} high letters.

The letters shall be delineated in black enamel.

12. SERIAL NUMBER.

A serial number shall be engraved or stenciled on the cabinet. The serial number shall be the same number as the controller unit serial number.

13. DATA LABEL.

A data label shall be placed on the inside of the cabinet door to provide the following information:

Manufacturer's name – All equipment installed cabinet
Date of Manufacture
Wiring Schematics Number
Controller Model Number
Controller Serial Number
Conflict Monitor Model Number
Conflict Monitor Serial Number
Time Base Coordinator Model Number (If applicable)
Time Base Coordinator Serial Number (If applicable)
Communication Unit Model Number (If applicable)
Communication Unit Serial Number (if applicable)
Master Model Number (If applicable)
Master Serial Number (If applicable)
Time Clocks Model Number (If applicable)
Time Clocks Serial Number (If applicable)
Project Number or Transportation Department P.O. Number.

(c) AUXILIARY DEVICES.

1. GENERAL.

Auxiliary devices shall conform to the requirements of NEMA Standard Publication No. TS 2-1992, "Traffic Controller Assemblies".

2. SOLID STATE FLASHERS.

The flasher shall be jack mounted.

3. FLASH TRANSFER RELAY.

The flash transfer relay shall be a heavy-duty relay designed for continuous duty. It shall mount on an eight pin spade plug base.

A 40 A mercury contactor type input power relay shall be furnished.

4. SOLID STATE LOAD SWITCH.

The signal load switches and signal load base plate shall be furnished and wired in place for each phase provided.

Load switches shall be triple signal, NEMA input light indicating, rated for 10 A at 165 °F {75 °C}. The actual switching component shall have a minimum 500 V PIV rating.

5. DETECTOR TEST SWITHCES.

When specified, detector test switches shall be furnished to check all detector control circuits.

(d) TERMINALS AND FACILITIES.

1. GENERAL.

The following define the performance and construction requirements of cabinet terminals and facilities that are considered to be of the attached or nonplug-in type. These additional specifications cover the physical requirements, electrical requirements, interface, cabling, supporting terminal facilities, and labeling.

2. OPENINGS.

The cabinet shall be provided with necessary openings for mounting and connection as specified.

3. ARRANGEMENT OF DEVICES.

The controller equipment and terminal blocks shall be so arranged within the cabinet that they will not upset the entrance, training, and connection of the incoming conductors.

4. TERMINAL AND PANEL WIRING.

No printed circuit boards will be allowed in the cabinet wiring facility, every panel and terminal shall be hardwired.

Each controller assembly is to be furnished with panels in the cabinet mounted in such a way as to provide visibility and accessibility.

All panel wiring shall be neat, firm, and hardwired.

5.TERMINAL PANEL.

As a minimum, the panel shall be provided with the following terminal blocks:

Terminal block to provide connections for the circuit breaker and power supply line.

Terminal block unfused, for neutral side of power supply line.

Terminal blocks for conductors of signal control cable. One terminal for each signal circuit and one or more terminals for the common conductor shall be provided.

The terminal blocks shall be located at least 6 inches {150 mm} from the bottom of the base mount cabinet and arranged for adequate electrical clearance between terminal blocks.

6. POWER TERMINAL STRIP.

Terminal strip shall be supplied for incoming power.

7. INSERT TERMINALS.

All components, connectors, plug terminals, and insert terminals shall be clearly annotated.

8. TERMINAL STRIP SHIELDING.

If terminal points are located adjacent to a shelf so that possible shorting can be accomplished by shifting of components, the terminal strips shall be shielded.

9. TERMINAL POINTS AND TERMINAL STRIPS.

All terminal points and terminal strips shall be the double tie type and shall be clearly annotated.

There shall be no more than two connections made on any terminal point.

Connections shall be made by using ring tongue terminal connections stamped from one piece of pure copper.

The barrel will be formed with a brazed butted seam and shall be pre-insulated with an appropriate sleeve.

The terminal connections shall be required to be the correct size for the wire and terminal strip bolts.

Terminal connections used on solid wire shall be soldered.

10. WIRING.

Wiring with controller cabinet shall be neatly laced and identified.

All wires shall be cut to a proper length before assembly. No wire shall be doubled back to take up slack.

The outgoing traffic control signal circuits shall be of the same polarity as the line side of the power supply; the common return of the signal circuits shall be of the same polarity as the grounded side of the power supply.

All wiring to AC+ shall be colored black. All wiring to AC- shall be colored white. All wiring to chassis ground shall be colored green.

11. CABLES.

All cables shall be self-contained and have continuous jackets from terminal facility into connector.

The jacket shall be solid flexible sleeving or expandable self-fitting polyester sleeving. Spiral wrap type sleeving will not be accepted.

The position of cables between the components must be such that when the door is closed, it does not press against the cables or force the cables against various components inside the cabinet.

All cables shall be self-contained and shall not be split to feed more than one connector.

12. DETECTOR PANEL.

A separate panel shall be furnished for detector wiring with all NEMA functions available and wired to the terminal strips.

The panel shall also include an earth ground buss with terminal points parallel and adjacent to the loop connection terminals for lightning protection.

A twelve-position double tie blank terminal strip shall be mounted on detector panel for future use.

13. SWITCH PANELS.

An internal switch panel shall be mounted on the inside of the main door. All switch functions shall be permanently and clearly labeled.

14. GROUNDING.

All logic ground, AC neutral, and chassis ground within the equipment and cabinet shall be isolated, split with separate ground buses being required for AC neutral and earth ground.

All lightning protection shall be grounded to the chassis ground.

All neutral conductors shall be grounded at the controller and at each terminal point.

15. LINE FILTERS.

Line filters shall be furnished to protect the controller from line voltage surges. Line filters for two phase controllers shall be rated at 25 A and four phase controllers shall be rated at 30 A through eight phase shall be rated at 45 A.

16. RADIO INTERFERENCE SUPPRESSION.

Each cabinet shall be equipped with a radio interference suppressor installed. The suppressor shall be connected to filter interference completely from the controller and associated equipment.

17. CONVENIENCE RECEPTACLE.

A convenience outlet shall be provided as part of the terminals and facilities. The convenience receptacle shall be a duplex, three prong, NEMA Type 5 – 15R grounding type outlet and shall have independent ground fault circuit protection.

18. LIGHT FIXTURE.

Each cabinet shall be provided with a florescent lighting fixture mounted on the inside top of the cabinet near the front edge. The fixture shall be provided with an F15T8 cool – white lamp operated from a normal power factor UL or ETL listed ballast.

19. DOOR ACTUATED LIGHT SWITCH.

A cabinet door actuated switch that turns the light off when the door is closed shall be provided.

20. POLICE PANEL SWITCHES.

The police door switch panel shall contain only two switches, a power ON/OFF switch, and a flash ON/OFF switch.

The power ON/OFF switch shall be an equipment power and not an AC power for the cabinet.

The flash ON/OFF switch shall apply to a stop timing signal to the controller but shall not interrupt the controller power. Flash ON/OFF switch shall place controller in flash mode but shall leave the controller to continue cycling.

21. MAINTENANCE PANEL SWITCHES.

The maintenance panel shall contain a power ON/OFF switch, controller power ON/OFF switch, and a flash ON/OFF switch, and a signal ON/OFF switch.

The flash ON/OFF switch shall place controller in flash mode and allow the controller to continue cycling.

22. MAIN CIRCUIT BREAKERS.

A circuit breaker shall be furnished. Circuit breakers shall be rated at 20 A for two phase controllers, shall be rated at 30 A for three and four phase controllers, and shall be rated at 40 A for five through eight phase controllers.

The main circuit breaker shall turn off all power to the cabinet and shall not be used for the power switch, which is located in the service panel.

23. CONTROLLER CABINET POWER SUPPLY.

Unless otherwise specified the controller unit and associated equipment shall operate reliably on 115 V; 60 Hz single phase alternating current.

Any internal DC voltages required to satisfactorily operate a controller assembly shall be from a regulated power supply designed to generate all DC voltages required, constructed as an integral part of the controller assembly.

The grounded side of the power supply shall be carried throughout the controller in a continuous circuit.

24. TIMER CONNECTIONS.

The electrical connections from the timer to the outgoing and incoming circuits shall be made in such a manner that the timer may be replaced with a similar unit, without the necessity of disconnecting and reconnecting the individual wires leading there from. This can be accomplished by means of a multiple plug and jack, a spring-connected mounting, or equivalent arrangement.

25. SIGNAL LOAD SWITCH ARRESTOR.

Each side of the load switch output shall have a metal-oxide varistor, Type V150LA20A.

26. REPLACING LIGHTNING PROTECTION.

All lightning protection devices shall be replaceable without removing any panels.

27. INDICATOR LIGHTS.

Controllers having indicator lights with a design or incircuit life of less than 75,000 hours shall have a micro-switch located on the cabinet door that will extinguish the indicators when the door is closed.

28. NEMA INDICATION WIRING.

All NEMA functions plus NEMA coded status bits and voltage monitor outputs as listed in the NEMA Standards Publication No. TS 1-1989. Outputs shall be brought out and wired to an individual tie point of a terminal strip before further routing.

29. PREEMPTION (PRIORITY CONTROL).

When preemption is required by the plans or proposal, electrical devices, logic circuits and special wiring shall be provided which will assume control over local traffic control equipment to require display of special safety modes giving preferential right-of-way to emergency vehicles or protection at railroad crossings.

(e) CONFLICT MONITOR.

1. TYPE.

Conflict Monitor shall be a NEMA Type 12L and conform to the requirements of NEMA Standards Publication No. TS 1-1989 Section 6, "Conflict Monitor Specifications", or any subsequent publication, plus the following features:

2. MONITOR REMOVAL.

The intersection shall remain in flash operation when the monitor has been removed.

3. BLOWN FUSE MONITOR.

The intersection shall go to flashing operation when the monitor fuse blows.

4. POWER SUPPLY MALFUNCTION.

The intersection shall go to flashing operation when the controller power supply malfunctions.

5. CONTROLLER POWER WITH TRIPPED CONFLICT MONITOR.

The conflict monitor shall not interrupt controller power when tripped.

6. STOP TIMING WITH TRIPPED CONFLICT MONITOR.

The conflict monitor shall apply stop timing on the controller when tripped.

7. INDICATION OF DRIVE FAILURE.

The conflict monitor shall indicate which drive failure has occurred (Red Fail).

8. DISPLAY AND PRINTING.

The unit shall have a LCD display, it must also have a printer port, RS232, and be capable of printing all memory-stored failures, with the type failure and date.

9 CLOCK.

The unit shall have a real time clock.

10. EVENT LOG.

The unit shall have an event log that contains the following data:

AC power interruption/restoration logging;
Logs reset after failure;
Log 24 V values;
Log CVM failure;
Load switch failure;
Log all faults with time and date.

11. EXTENDED MONITORING.

The unit shall have the following extended monitoring:

Dual indication monitoring per channel;
Short vehicle clearance detection.

12. DISPLAY OF INTERSECTION STATUS.

The unit shall be capable of displaying intersection status.

13. READBACK.

The unit shall have program card readback.

14. TERMINATION OF UNUSED INPUTS.

All unused inputs will be brought out and terminated on a terminal strip.

15. MONITOR INPUT WIRING.

Monitor inputs shall be wired directly to field output terminals.

(f) WIRING DIAGRAM.

Three copies of cabinet wiring diagram shall be supplied as well as copies of the following:

Three each of:

Controller circuit diagrams and schematics;
Controller Operations Manual;
Conflict Monitor diagrams and schematics.

Two each of:

Flasher diagrams and schematics;
Load Relay diagrams and schematics;
Diagrams and schematics of any external hardware supplied;
Template of Base Mounting if base mounted.

Cabinet prints shall include flash color change instructions for all phases and all overlaps.

Cabinet print shall be keyed to show every input and every output from every terminal. If prints use multiple ground and neutral busses, busses shall be numbered. All grounds and neutrals shall be keyed to the busses that they are connected to.

Cabinet prints shall show every connector.

(g) CONTROLLER UNIT.

1. TYPE.

The phase requirements required on the plans will indicate the physical and electrical construction of the controllers; however, controller unit shall conform to NEMA requirements.

Controller units shall be classified in the following categories:

Type II: Solid State Pre-timed
Type III: Traffic Actuated Solid State Modular (NEMA)

For Type III controller units, controller indicators as outlined in NEMA Standards Publication No. TS 1-1989, Section 14.3.05 shall contain information which shall be displayed simultaneously for both rings in a dual ring controller.

Unless otherwise described in these specifications, or required by the plans or the proposal, the following requirements are applicable to all controller units.

2. CONTROL LOGIC.

Unless otherwise required by the plans or proposal, all control functions shall be performed by microprocessor logic

3. OVERLAPS.

All overlaps shall be internally generated, available, and programmable.

4. INTERCONNECTION AND COORDINATION.

The controller shall be capable of being interconnected and coordinated in accordance with requirements of the plans or proposal. Any phase shall be capable of being coordinated.

5. OPERATIONAL REQUIREMENTS.

Phase Skip: The controller shall provide the ability to automatically skip any phase when there is an absence of demand.

Signal Operation Plan: The signal operating plan in the plans will determine the number of phases required and the necessary phase sequence requirements of the controller in accordance with NEMA standards.

Changing Operation: Changes from flashing to stop-and-go operation shall be made at the beginning of the major street green interval preferably at the beginning of the common major street green interval, (i.e., when a green indication is shown in both directions on the major street). Programmed changes from stop-and-go to flashing operation shall be made at the end of the common major street red interval, (i.e., when a red indication is shown in both directions on the major street).

Programmable Flashing Operations: Flashing operations shall be programmable by terminal strip jumpers for all phases and all overlaps.

Type III Controller Unit: Type III, traffic actuated solid state controller unit, shall feature one or more of the following timing features as required by the plans or proposal.

Standard timing;
Density timing;
Vehicle Occupancy timing;
Pedestrian timing;
Preemption.

Timing for phase modules shall be furnished in accordance with the plans and shall be accomplished by using the digital timing concept.

All phase timing modules shall be provided with dual maximum timing capabilities.

6. TIME BASE COORDINATION.

Electrical devices, logic circuits and special wiring shall be provided which will provide direct supervision of a local controller when time base coordination is shown on the plans.

The time based coordinator shall be a solid state digitally timed microprocessor device.

The unit shall contain a sealed battery capable of maintaining sufficient power to the RAM to protect, intact, any operator programmed data for a period of at least sixty days without AC input to the controller unit. The battery shall be maintained in a fully charged state through a trickle charge during normal operation.

An LED shall be provided to indicate when the voltage of the battery is over or under tolerance levels.

There shall be means for automatic change for daylight savings time.

Local coordination shall be accomplished by utilizing a time base coordinator capable of operating as a (a) yearly programmer with time of day, day of week, week of year programming, (b) sync pulse generator with time of day, day of week, week of year programming, (c) coordinator with time of day, day of week, week of year programming. The unit shall be capable of the following coordination features: four cycle lengths, four split plans, three offsets per cycle, minimum of three permissive periods per split, a minimum of four force-offs per split.

890.03 Master Controller Assembly and Secondary Controller Assembly.

(a) MASTER CABINET AND SECONDARY CABINET.

The following additional requirements shall apply to the cabinet for a master controller assembly and a secondary controller assembly.

The master and secondary controller cabinet shall house a hardwire master interconnect panel to provide for seven wire interconnect 120 V to be complete with three NEMA load switches, and complete with 120 V relays. The required functions provided shall consist of three dials; three offsets and flash; outputs and inputs. Panels shall have all components mounted on 0.125 inch {3.2 mm} sheet aluminum. The panel shall be completely wired in-place to include all necessary harness, and shall be wired to conform to the requirements of the MUTCD for system flash.

Terminal block facilities shall be provided for the interconnect.

(b) MASTER CONTROLLER UNIT.

1. GENERAL.

The master controller for an interconnected traffic control signal system shall be the apparatus required to provide supervisory functions under normal operation as described for interconnected controllers.

2. MOTOR.

The master controller shall be driven by a synchronous motor or be provided with a synchronous control mechanism which will maintain a constant time cycle; however, when it is not necessary to keep a traffic control signal system in step with adjacent systems or adjacent non-interconnected controllers, an induction motor driven master controller may be specified.

3. SUPERVISORY FUNCTIONS.

Means for automatically establishing offset time relations of local controllers.

Hand operated switch for turning off completely all traffic control signal lights at interconnected local controllers.

Hand operated switch for transfer of traffic control signal lights at each local controller to give flashing indications.

Hand operated switch for selecting offset at which all interconnected local controllers shall operate in accordance with three distinct timing plans.

Hand operated switch for selecting two or three interval setups on which each of the interconnected local controllers shall operate.

The above requirements of shall be obtainable when specified, by means of an automatic time switch, in which case the automatic switching schedule shall be required.

4. TIME CYCLE.

The variation of the time cycle settings of all interconnected local controllers shall be accomplished by a simple adjustment at the master controller. There shall be at all times an accurate visual indication of the time cycle at which the traffic control signal system is operating.

It shall be possible to accurately set or adjust the time cycle between the limits of 30 and 120 seconds with accurate and definite settings within this range in 5 second steps up to 90 seconds and 10 seconds steps above 90 seconds.

890.04 Surge Protection for Controller Assembly.

(a) PROTECTION OF CONTROLLER ASSEMBLY CABINET.

All controller assembly cabinets shall be furnished with a surge protector on the AC service input, which meets or exceeds the following performance requirements.

Unit shall be capable of withstanding repeated 20,000 A surges a minimum of 25 times.

Unit shall have internal follow-current limiters (resistive elements).

Unit shall contain a minimum of three active clamping stages.

Unit shall self-extinguish within 8.3 milliseconds after the trailing edge of surge.

Parallel impedance of limiters shall be less than 0.15 Ω.

Unit voltage shall be to the circuit breaker before cabinet voltage filters.

Electrical connections on the unit shall be durable enough to accommodate a No. 6 AWG {4.25 mm} wire.

The unit shall have a mounting plate for easy removal and replacement and shall be mounted in a neat workmanlike manner in the controller cabinet with as short a run as possible from the power input to the circuit breaker.

(b) PROTECTION OF SIGNAL LOAD SWITCHES.

Each load switch shall be furnished with a gas tube or metal-oxide varistor, Type 150LA20A.

Unit shall have an impulse breakdown of less than 1000 V in less than 0.1 microsecond at 10 kV per microsecond.

Unit shall be capable of withstanding 20 A AC for 1 second applied 10 times at 3 minute intervals on either section.

Unit shall have a current rating of 20,000 A (8/impulse) one time.

Unit shall have a striking voltage of 300 to 500 V DC.

Unit shall have a minimum holdover of 155 V DC.

Unit shall be installed across the Triac of each section of the load switch. The center electrode of the gas tube surge protector shall be connected to pin number 12 of the load switch plug.

The load switch receptacle pin number 12 shall be wired to a minimum No. 8 {3.35 mm} wire ground buss. The ground buss shall be connected to the chassis ground and a ground rod. Connection terminal shall be provided a minimum distance possible from the physical center of the ground buss.

(c) PROTECTION OF CONTROLLER UNIT AND CONFLICT MONITOR.

Power and neutral for controller and conflict monitor shall be wired through a high-speed approved suppressor. The output of the arrestor to failsafe, controller, etc., shall be through shielded cable or twisted pair to the units AC plus and AC minus inputs.

The surge protection device shall meet or exceed the following performance requirements.

Protectors, after being subjected to twenty five 20 kA (8 X 20 μs) pulses must remain operative and exhibit less than 5 percent plus or minus change in clamp voltage before and after the test.

The protector clamp shall never exceed 250 V when subjected to the 20 kA surge.

The peak current shall be 20,000 A.

The continuous service current shall be, 10 A maximum, 120 V AC, 60 Hz.

FILTERING SPECIFICATIONS, MIL-STD-220 Insertion Loss Test Data		
Insertion Loss Requirements		
Frequency		Insertion Loss (db)
60	Hz	0
10	kHz	34
50	kHz	55
100	kHz	76
500	kHz	68
2	MHz	58
5	MHz	58
10	MHz	58
20	MHz	63

(d) PROTECTION OF REMOTE DETECTOR AND INTERCONNECT CABLE.

Each remote detector input line and interconnect line, as it enters the cabinet shall be furnished with a surge protection device that meets or exceeds the following requirements.

Unit shall be capable of withstanding 10,000 A 10:20 microsecond standard waveform surges a minimum of 50 times.

Unit shall have internal follow-current limiters (resistive elements).

Unit shall self-extinguish within 8.3 milliseconds after the trailing edge of surge.

Unit shall not have thermal circuit breakers in place of limiters.

Limiter resistance shall be between 0.15 Ω and 0.39 Ω.

Unit shall have a mounting plate for easy removal and replacement and shall be mounted in the controller cabinet in a neat workmanlike manner.

(e) PROTECTION OF LOOP DETECTORS (EXTERNAL SURGE PROTECTION).

External surge protection for each detector must meet the following requirements.

Unit shall be a three terminal device capable of protecting the detector against differential (between the loop leads) surge, and against common mode (between leads and ground) surges.

Unit shall be of the inductive type with a maximum DC resistance of 150 mΩ.

Unit inductance shall be able to protect the detector electronics when the detector is subjected to a 400 A surge across the detector leads.

Unit shall be a two stage device.

Unit shall clamp a 250 A surge to 25 V within 40 nanoseconds. Surge shall be applied between the two detector leads.

Unit shall clamp a 250 A COMMON mode (between leads and ground) surge to 35 V. These do not include protector lead IR drop.

Unit shall withstand repeated surges.

Unit and loop terminals to be physically mounted approximately 6 inches {150 mm} from bottom of cabinet.

890.05 Vehicular Loop Detector.

(a) GENERAL.

Vehicular detectors shall be capable of providing reliable detection of all vehicles present when the inductance shift of the loop is 0.05 percent of the total inductance of the loop and lead-in when operating in the high sensitivity mode of the detector. Sensitivity of the detector shall remain constant over the operating temperature of –35 °F to +165 °F {-37 °C to 74 °C}.

Vehicular detector operation shall not be affected by changes in the inductance of the loop resulting from environmental changes encountered in the State, nor shall the sensitivity be markedly affected.

Vehicular detector shall have a self-contained power supply, capable of furnishing all necessary power, operate from a 115 V, 60 Hz source.

Vehicular detector shall have a built-in lightning protection device and shall have a built-in fail-safe relay to require a detector call to the controller upon failure of the detector.

Vehicular detector shall have the ability of being connected to multiple loops of various sizes and shall detect vehicles of various sizes with the capability of continuously registering the presence of a conventional passenger car on a 6 foot x 50 foot {2 m x 15 m} two-turn loop for a minimum time of ten minutes when in the presence mode.

Vehicular detector shall operate on loops of various sizes located up to 750 feet {225 m} from the loop.

Vehicular detector circuit boards and power supply shall consist of printed circuit design on a G10 grade or equivalent fiberglass epoxy with 2 ounces {57 g} copper track and coated with protective finish to minimize oxidation.

Vehicular detector boards and power supply shall consist of flow or wavesoldered copper connections, including fixed components.

Vehicular detector shall operate on an electronic tuned resonant circuit composed of lumped capacity and inductance provided by the loop embedded in the roadway. The detector shall provide detection by phase comparison means with accuracy of better than 99 percent of all vehicles passing over the loop at speeds of 1 mile per hour to 80 miles per hour {1 km/hr through 130 km/hr}. The voltage across the loop combination reflecting any change shall be used as a signal for relay operation.

Tuning capacitors shall be ceramic enclosed and epoxy filled.

Vehicular detector shall have the capability to function when loops are shorted or leaking to ground at one point.

Detection indication shall be provided in the form of indicator lamps on the face of the unit.

(b) SINGLE CHANNEL VEHICULAR LOOP DETECTOR.

Single channel vehicular loop detectors shall conform to the following additional requirements.

The loop detector shall be a digital solid state unit with the capability of automatic tracking of environmental changes after automatic or manual initial tuning. The unit shall have pulse and presence modes all, which are activated by, wire loops embedded in the roadway. Loop influence shall be adjustable so as not to extend beyond the sawcut more than 12 inches {300 mm}.

The loop detector shall have a minimum of two sensitivity modes, two presence modes and two operating frequencies that will enable the detector to accommodate the usual configuration of loops and lead-ins.

Total power consumption shall not exceed 5 W.

The loop detector shall have a tuning inductance range of at least 75 to 400 μHz.

A Type MS-3102A-18-1P with ten male contacts shall be provided. The pin functions of the connector shall be assigned as follows:

Pin No.	Use
A	117 V AC Connection
B	Relay Output Common
C	117 V AC Line
D	Input from Loop
E	Input from Loop
F	Relay Output Normally Open
G	Relay Output Normally Closed
H	117 V AC Ground
I	Not Used
J	Not Used

(c) TWO CHANNEL VEHICULAR LOOP DETECTOR.

Two channel loop vehicular detectors shall conform to the following additional requirements.

The loop detector shall be a digital solid state unit with capability of automatic tracking of environmental changes after automatic initial tuning. The two channel unit shall have pulse and presence modes for each channel, which are activated by wire loops embedded in the roadway. Loop influence shall be adjustable so as not to extend beyond the sawcut more than 12 inches {300 mm}.

The loop detector shall have a minimum of two sensitivity modes, two presence modes and two operating frequencies for each channel, which will enable the detector to accommodate the usual configuration of loops and lead-ins. Crosstalk between channels within the detector shall be eliminated by sequential scanning of loops.

Each channel shall be capable of tuning to any effective loop inductance within the range of 0 to 2000 μHz.

Total power consumption shall not exceed 8 W.

Two Type MS-3102A-18-1P connectors with ten male contacts shall be provided. The pin functions of each connector shall be assigned as follows:

Pin No.	Use
A	117 V AC Connection
B	Relay Output Common
C	117 V AC Line
D	Input from Loop
E	Input from Loop
F	Relay Output Normally Open
G	Relay Output Normally Closed
H	117 V AC Ground
I	Not Used
J	Not Used

(d) FOUR CHANNEL VEHICULAR LOOP DETECTOR.

Four channel loop vehicular detectors shall conform to the following additional requirements.

The loop detector shall be a digital solid state unit with capability of automatic tracking of environmental changes after automatic initial tuning. The four channels shall have pulse and presence modes for each channel, which are activated by wire loops embedded in the roadway. Loop influence shall be adjustable so as not to extend beyond the sawcut more than 12 inches {300 mm}.

The loop detector shall have a minimum of two sensitivity modes, two presence modes and two operating frequencies for each channel which will enable the detector to accommodate the usual configuration of loops and lead-ins. Crosstalk between channels within the detector shall be eliminated by sequential scanning of loops.

Each channel shall be capable of tuning to any effective loop inductance within the range of 0 to 2000 μHz.

Total power consumption shall not exceed 8 W.

A Type MS-3102A-22-14P connector with nineteen male contacts shall be provided.

890.06 Interconnect Cable.

(a) DESCRIPTION.

Interconnect cable shall be used to transmit information between intersections or other control points in a traffic control system.

(b) MATERIALS.

Interconnect cable shall conform to the requirements of this specification unless otherwise specified on the plans or in the proposal. If in such case that the plans designate fiber optic cable material be used for the interconnect cable then Section 734 shall apply.

(c) UNDERGROUND INTERCONNECT CABLE.

Underground interconnect cable, for closed loop systems, shall be shielded and conform to the requirements of Rural Electrification Administration (R.E.A.) Specification PE- 39, filled telephone cable, No. 19 AWG, 6 pair.

Underground interconnect cable for time base coordination shall conform to the requirements of IMSA 20-1 No. 14 AWG, 9 conductors.

(d) AERIAL INTERCONNECT CABLE.

Self-supporting aerial interconnect cable, for closed loop systems, shall be shielded and conform to the requirements of Rural Electrification Administration (R.E.A.) Specification PE- 38, No. 19 AWG, 6 pair.

Standard aerial interconnect cable, for closed loop systems, attached to a messenger strand in the field, shall conform to the requirements of Rural Electrification Administration (R.E.A.) Specification PE- 22, No. 19 AWG, 6 pair.

Self-supporting aerial interconnect cable, for time base coordination, shall conform to the requirements of IMSA 20-3, No. 14 AWG, 9 conductors.

Standard aerial interconnect cable, for time base coordination, attached to a messenger strand in the field, shall conform to the requirements of IMSA 20-1, No. 14 AWG, 9 conductors.

(e) INTERCONNECT CABLE SUPPORT WIRE.

A support cable, whether separate or integral to aerial interconnect cable, having a minimum diameter of 0.25 inch {6.35 mm} shall be provided for interconnect cable that is not self-supporting.

Support cable shall be steel wire strand Class A (double galvanized) and conform to the requirements of ASTM Standards Publication No. A 475-89, "Standard Specifications for Zinc-Coated Wire Strand".

(f) CABLE ATTACHMENT HARDWARE.

Attachment hardware shall be stainless steel or non-corrosive material and shall be provided with tensile strength adequate for application.

890.07 Electrical Power Service Assembly.

(a) DESCRIPTION.

Electrical power service assembly shall consist of equipment to provide a pole attached raceway and disconnect switch for use with power cable routed from the service entrance to the controller cabinet and nearest supporting structure with luminaire. The electrical power service assembly shall include a weatherhead, conduit and fittings, a disconnect switch with enclosure, and attachment clamps.

Electrical power service shall be in accordance with these specifications, NEC requirements, local utility codes, and on the details shown in the Special and Standard Highway Drawings.

(b) MATERIALS.

Materials shall be tested and approved by a nationally recognized testing laboratory and shall meet the following requirements.

1.SERVICE POLE (WOOD POLE).

Service pole shall be southern yellow pine treated in accordance with the latest American Wood-Persever's Association (AWPA) standards and conform with the requirements of Section 833, Table 1.

Unless otherwise noted on the plans, service pole used for service lateral drop shall be a 35 foot Class 3 wood pole and shall conform to the requirements of ANSI Standards Publication No. 05.1-1992, "American National Standards for Wood Poles – Specifications and Dimensions".

The poles shall not have more than 180 degrees of twist in grain over the full length and the sweep shall be no more than 4 inches {100 mm}.

2. ATTACHMENT HARDWARE.

Attachment hardware shall meet the requirements as shown on the details in the Special and Standard Highway Drawings.

3. CONDUIT.

Conduit shall conform to the requirements specified in this Section.

4. WEATHERHEAD.

Weatherhead shall be made of a copper-free aluminum alloy or galvanized ferrous material.

5. ELECTRICAL CABLE.

Phase or current carrying conductors shall be of the type RHH, RHW, USE, or XHHW. Conductors shall be stranded annealed copper with not less than 98 percent conductivity and shall be insulated for 600 V or more with rubber insulation and a neoprene jacket, or with cross-linked polyethylene insulation.

Service wire to supply the controller shall be No. 6 AWG, stranded copper, two conductors rated for dry and wet conditions.

Service wire to supply the traffic signal luminaries shall be No. 8 AWG, stranded copper, three conductors rated for dry and wet conditions.

6. METER BASE.

When a meter base is required, meter base shall be a meter base approved by the local electric power company.

7. SERVICE DISCONNECT.

Enclosure Cabinet: The cabinet shall conform to NEMA standards, made of galvanized steel, aluminum, stainless steel or other material approved by the Engineer. The enclosure shall have a hinged door with a padlock. Padlock No. 3210 keyed for a No. 3 key shall be provided. One key shall be hung within the controller cabinet.

Circuit Breaker: A manually resettable circuit breaker shall be installed, which has a current rating of the circuit to which electrical power is provided.

Transient Protective Device: A surge lightning arrestor rated for a maximum permissible line to ground voltage of (175 V AC) shall be installed, meeting the requirements of NEMA standards for surge arrestors.

890.08 Span Wire Assembly.

(a) DESCRIPTION.

Messenger cable shall be attached to supporting structures to support traffic signal heads, signs, and electrical cables.

(b) MATERIALS.

1. STEEL WIRE STRAND.

Steel wire strand shall be Class A (double galvanized) and shall conform to the requirements of ASTM A 475-89.

Messenger Cable: Messenger cable used to support signal heads shall be 3/8 inch {9.5 mm} nominal diameter, 7 wires twisted into a single strand.

Messenger cable shall be extra high-strength grade with a minimum breaking strength of 15,400 pounds {68.4 kN}.

Tether Cable: Tether cable used to attached to the bottom of signal heads shall be 1/4 inch {6.4 mm} nominal diameter, 3 wires twisted into a single strand.

Tether cable shall be utilities grade with a minimum breaking strength of 3,150 pounds {14.0 kN}.

890.09 Vehicular Signal Heads.

(a) GENERAL.

All signal heads shall conform to the requirements of the ITE Standards Publications "Adjustable Face Vehicular Traffic Control Signal Heads" and "Vehicle Traffic Control Heads" and the following, assembled in accordance with the latest edition of the MUTCD.

(b) HOUSING, DOOR, and VISOR.

1. GENERAL

Housing: The housing shall be constructed of cast corrosion-resistant, copper free non-ferrous metal of not less than 17,000 psi {117 MPa} with all parts clean, smooth and free from flaws, cracks, blow holes and other imperfections.

The housing shall be of unitized sectional construction of as many sections as are optical levels, rigidly and securely fastened together into one watertight assembly.

Each housing shall be arranged with round openings in the top and bottom so as to be capable of being rotated about a vertical line between the waterproof supporting brackets or trunnions and of being securely fastened at increments of not more than 7 inches {175 mm} of rotation.

Doors: The door shall also be cast units from similar material to that used for the main section housing suitably hinged and shall be forced tightly against the gasket on the body of the housing by simple stainless steel locking devices.

All other exterior hardware, such as hinge pins, lens, clips, etc., shall be of stainless steel.

Neoprene gaskets shall be provided between the body of the housing and the doors, between the lenses and the doors, and between the lenses and reflectors to exclude dust and moisture.

The lens opening in the doors shall provide a visible diameter of not less than 7.75 inches {197 mm} nor more than 8 inches {203 mm} for a nominal 8 inch {200 mm} round lens, and a visible diameter of not less than 11 inches {279 mm} nor more than 11.5 inches {292 mm} for a nominal 12 inch {300 mm} round lens. The dimensions of the opening in doors for rectangular lenses shall provide for a visible area of not less than 8.5 inches x 8.5 inches {205 mm x 205 mm}, nor more than 8.5 inches x 8.5 inches {215 mm x 215 mm}, for a more nominal 9 inch {225 mm} rectangular lens and a visible area of not less than 11 inches x 11 inches {279 mm x 279 mm} nor more than 11.5 inches x 11.5 inches {290 mm x 290 mm} for a nominal 12 inch {200 mm} rectangular lens.

Visors: Each signal head shall have a tunnel visor for each signal indication. The door shall have an integrally cast collar not less than 3/16 of an inch {4.8 mm} around the lens opening, and the visor shall be designed to fit tightly against the collar and door, and shall not permit any perceptible filtration of light between the door and the visor. The percentage enclosure of the lens shall be as specified by the purchaser. The visor shall be a minimum of 9.5 inches {241 mm} in length for 12 inches {300 mm} diameter lenses, and 7 inches {175 mm} in length for 8 inch {200 mm} diameter lenses, and not less than 0.05 inches {1.27 mm} in thickness, with a minimum downward tilt of 3.5 degrees. The visor shall be of corrosion-resistant nonferrous material. Visors shall be mounted with twist-on slots and stainless steel screws positioned for either vertical or horizontal mounting of the signal.

2. OPTICAL UNIT.

Reflectors shall be specular Alzak finished aluminum or an approved equal.

Reflectors shall be mounted in a cast aluminum reflector support attached to the housing, or shall be an integral reflector and support of formed sheet aluminum.

The reflector assembly shall be pivoted to the housing, and shall be designed so that it can be swung out or easily removed without the use of any tools.

The method of mounting and fastening reflectors shall be sufficiently rigid to secure proper alignment between the lens and reflector when the door is closed.

The construction of the signal head and its components shall be such that the fit between the reflector and the lens will eliminate all possibility of false indicators.

Reflectors shall have an opening in the back for the lamp socket.

Each optical unit shall be so designed that each lens will be illuminated separately.

3. TRUNNIONS, BRACKETS, AND SUSPENSIONS.

All trunnions, brackets, and suspensions used for assembling and mounting vehicle traffic control signal faces shall be entirely weather-tight.

Wire entrance fittings for signal heads and span wire hangers shall be cast aluminum tri-stud with aluminum span wire hinge with stainless steel nuts, bolts, and washers.

Wire raceway areas within brackets, trunnions and suspensions shall be of adequate size to carry all necessary wires without crowding, and raceway surfaces shall be free of sharp edges or protrusions that might damage insulation on wires.

Suspensions for mast arm or span wire mounting shall include a device to permit adjustment for proper vertical alignment of the signal head.

4. EXTERIOR FINISH.

All exterior parts of the signal head except the lens, the insides of visors, and the entire surface of louvers or fins shall be finished of the best quality of synthetic resin enamel of highway yellow.

The inside of the visors and the entire surface of louvers or fins shall be painted dull black using best quality synthetic resin enamel. All enamel shall conform to the appropriate requirements of Section 855.

5. LENSES.

Lenses shall be of glass; the quality and processing of which shall be the best for the purpose. The composition must be durable on prolonged exposure to weather; all lenses shall be uniformly colored throughout the body, true to size and form, and free from any streaks, wrinkles, chips, or bubbles that in any way detract from their efficiency or use.

Each lens shall have pressed on its flange the word "TOP" to indicate the proper positioning of the lens in the door for obtaining the light distribution required, together with the diameter and other designations including the name or trademark of the manufacturer needed for proper application and help in purchasing replacements.

Lens Sizes and Tolerances shall be in accordance the following requirements:

- Circular Convex Lenses:

The nominal 8 inch {200 mm} lens shall have an outside diameter of from 8.313 inches to 8.375 inches {211.1 mm to 212.7 mm}. The nominal 12 inch {300 mm} lens shall have an outside diameter of from 11.938 inches to 12.031 inches {303 mm to 306 mm}.

- Rectangular Lenses:

The nominal 9 inch {225 mm} lens shall have minimum dimensions of 9 inches by 8.75 inches {228 mm by 222 mm}. The nominal 12 inch {300 mm} lens shall have minimum over-all dimensions of 12 inches by 12 inches {305 mm by 305 mm}.

All lenses shall comply with the design designated by ITE for the use intended.

The color of the lens shall be of a color approved for use by ITE for the use shown on the plans.

6. BACKING FOR ARROW LENSES.

All lenses shall be covered except for the arrow with dull or dark gray enamel of a thickness sufficient to totally hide the light from a 200 watt lamp placed behind it.

The enamel shall be baked or fired into the glass. The enamel shall be hard and durable and shall not peel or flake when subject to the heat of a signal lamp when the lens is in use nor when the lens is washed.

The arrow shall be the only illuminated portion of the lens.

7. LAMPS.

Lamps used in traffic signal heads shall conform to the standards set forth in the ITE latest Standard for Traffic Signal Lamps, not smaller than 125 V, 8000+ hour rated life clear bulb in accordance with the following:

8 inch	{200 mm}		69 W	
12 inch	{300 mm}	Red lens	150 or 165 W	3 inch light center length
12 inch	{300 mm}	Yellow lens	69 W	3 inch light center length
12 inch	{300 mm}	Green lens	116 W	3 inch light center length

8. WIRING.

Each lamp receptacle shall be provided with coded No. 18 AWG {1.06 mm} or larger wires type TEW, 600 V, securely fastened to the socket.

A suitable terminal block for connection of the wires from the socket and the incoming wires to the traffic signal head shall be provided in the signal housing.

9. BACKPLATES.

Backplates, when so required as shown on the plans, shall have a 5 inch {127 mm} border constructed of black metal.

10. SIGNAL HEAD COVER.

Signal head covers shall be opaque, black, and cover the entire face of the signal head. The cover shall be weather and ultra violet resistant.

The Engineer shall approve the method of attaching the cover over the signal head.

(c) PROGRAMMED VEHICULAR SIGNAL HEAD.

Programmed vehicular signal heads shall provide an optical system of such design that will permit the required visibility zone of the indication to be determined optically. The projected signal may be visible or selectively veiled anywhere within 15° of the optical axis. Indication shall not result from external illumination nor shall one indication illuminate a second.

The optical system shall provide an imaging surface, at focus on the optical axis for objects 900 feet to 1200 feet {275 m to 365 m} in distance and permit an effective veiling system to be variously applied as determined by the desired visibility zone.

Lamps shall be nominal 150 W, 120 V AC, three prongs, sealed beam type with integral reflector having a rated life of 6000 hours.

The objective lens may be glass or hermetically sealed plastic within a flat lamination of weather-resistant acrylic. The lens shall be symmetrical in outline allowing rotation to any 90° orientation about the optical axis.

The limiter and/or diffuser shall be provided with a positive means of indexing and shall be formed of heat resistant material.

Signal intensity controls shall be provided for each signal indication (color).

All other components of the Programmed Vehicular signal heads shall conform to the requirements specified in this Article.

(d) DUAL INDICATION SIGNAL HEAD.

The dual indication signal shall provide a dynamic means of selectively displaying two separate colored indications from the same section during different intervals of the signal cycle.

The dual indication signal Heads shall conform to the applicable requirements for Programmed Vehicular Signal Heads including exterior finish and ITE Standards Publication "Adjustable Face Traffic Control Signal Heads".

No indication shall result from external illumination nor shall one light unit illuminate a second and only one indication shall be apparent to any viewer at one time.

(e) LED VEHICULAR SIGNAL HEAD.

Light Emitting Diode (LED) vehicular signal head shall conform to ITE's interim specifications for LED vehicle traffic signals.

890.10 Pedestrian Signal Heads.

(a) GENERAL.

All pedestrian signal heads shall conform to the requirements of the ITE Standards Publication "Adjustable Face Pedestrian Signal Heads" and the following, assembled in accordance with the latest edition of the MUTCD.

(b) INCANDESCENT PEDESTRIAN SIGNALS.

1. HOUSING, DOOR, and VISOR.

Housing: Housing shall be rectangular and constructed of lightweight die cast aluminum. The housing assembly shall form a dust tight and moisture resistant compartment.

The top and bottom of the signal shall be provided with two holes suitable for entrance of 1.5 inch {38 mm} conduit. Surrounding each hole shall be cast aluminum serration containing 72 teeth at 5° on center by 0.062 inches {1.57 mm} deep. The overall dimension of the pedestrian signal shall be 17.5 inches horizontal x 16.875 inches vertically x 9.875 inches front to back { 445 mm horizontal x 429 mm vertically x 251 mm front to back} including the visor. A door hinge is provided at the bottom of the case and two upset flanges at the top, to enable draw bolts to adequately draw down the door against the case. A neoprene gasket shall be fitted around the front edge of the case to provide a waterproof compartment when the door is closed.

Door: The door shall contain an offset upon which an endless neoprene gasket will seat, for the purpose of holding the lens, and causing a watertight fit of door to housing.

All components shall be readily and easily accessible from the door.

Two hinge lugs shall be cast at the bottom of the door, which shall mesh with two pairs of hinge lugs cast in the bottom of the housing. Stainless steel drive pins shall connect these hinges to

permit the door to rotate downward. Two reinforced lugs, each with a vertical slot (open at the top) shall be cast integrally in the top of the door. The top of the front of these lugs shall be slightly offset to prevent the hinge bolts from sliding out of the slots. Two pairs of lugs shall be cast integrally with the top of the housing compartment. Two stainless steel hinge bolts with captive stainless steel wing nuts and plain washers shall be attached to the housing lugs with the use of a stainless steel 0.25 inch {6.5 mm} drive pin.

Visor: A single unit sun shield eggcrate type visor shall be attached to the cast door without the use of any screws and be capable of being removed only when the door is opened. The visor shall sit directly on the door. The visor shall consist of 15 vertical 0.30 inch {7.6 mm} thick polycarbonate strips and 26 horizontal 0.030 inch {0.76 mm} polycarbonate strips. The strips shall be slotted such that they fit together in cross hatch fashion. The polycarbonate strips when assembled shall be bordered by a two piece extruded 0.040 inch {1.0 mm} aluminum channel that shall be pop riveted together to provide a solid support for the polycarbonate strips. The visor shall have two horizontal mounted 1/8 inch {3.2 mm} diameter aluminum reinforcement rods. The visor assembly shall be 1.5 inches {38.1 mm} deep and the grid pattern shall measure approximately 0.5 inches X 0.5 inch {12.7 mm X 12.7 mm}.

2. OPTICAL UNIT.

The reflector shall be a one-piece reflector made of die cast aluminum with an Alzak finish. The inside surface of the reflector shall be metalized silver and overcoat for endurance. The reflectors shall consist of two parabolic curves, one situated behind the UPRAISED HAND symbol one behind the WALKING PERSON symbol. Two lamp sockets shall mount directly to the back of the reflector. The reflector shall be designed to accept 69 watt bulbs through 150 watt bulbs depending upon the light intensity required. Higher wattage lamp shall not cause any degradation to the die cast aluminum reflector or lens.

Internal illumination shall be used.

3. HARDWARE.

All screws, bolts, nuts, washers, hinge pins, and other necessary fasteners shall be made of 18-8 stainless Type 304.

4. EXTERIOR FINISH.

Before painting, housing shall be cleaned and treated in accordance with Military Specification 5541.

The housing, door, and visor channel shall be cleaned and etched prior to paint and then painted with one coat of primer and two coats of baking enamel.

When a visor is required, the inside of the visor must be Flat Black. The balance of the signal shall be Federal Yellow.

5. LENES.

The symbols shall transmit light through a prismatic surface. The prismatic surface shall be on the inside. The molded lenses shall have the proper colors, Portland Orange for the UPRAISED HAND and Lunar White for the WALKING PERSON, molded in the glass. The background shall be opaque black. Lunar White and Portland Orange shall conform to ITE requirements.

The UPRAISED HAND indication shall be mounted directly above or integral with the WALKING PERSON indication.

The lens size shall be 14 inches X 14 inches {350 mm X 350 mm}. The lens material shall be two pieces, 1/4 inch {6.4 mm} molded glass.

The letter height shall be 4.5 inches {115 mm}.

6. WIRING.

Each pedestrian signal shall be wired completely internally and ready for connection of field wiring. There shall be a four point terminal block inside the housing to which a wiring harness consisting of 18 AWG wiring shall be attached. The other end shall be sufficient to allow the reflector to be fully removed from the signal.

(c) LED PEDESTRIAN SIGNALS.

Light Emitting Diode (LED) pedestrian signal head shall conform to ITE's interim specifications for LED pedestrian traffic signals.

890.11 Pedestrian Detectors.

(a) GENERAL.

Pedestrian detectors shall conform to the American with Disabilities Act Accessibility Guidelines, Section 14.2.5(1) "Crossing Controls", dated 1994.

(b) MATERIALS.

Pedestrian detector shall be capable of actuation by a force equal to or less than 5 pound force {22.2N}.

A control button shall be raised or flush and shall be a minimum of 2 inches {50.8 mm}.

The microswitch shall be dustproof, water resistant type.

The splice between the cable and the detector leads shall be waterproof.

The pipe or other protective cable covering to the detector housing shall be secure.

The detector shall be provided with a housing to prevent the entrance of water.

Where a push button is attached to a pole, the housing shall be shaped to fit the curvature of the pole and secured to provide a rigid installation. Saddles shall be provided to make a neat fit when required.

Where a push button is to be mounted on top of a post, the housing shall be provided with a slip-fitter fitting and screws for securing rigidly to the post.

(c) HARDWARE.

Hardware and fittings shall be constructed of galvanized steel or non-corrosive metal.

890.12 Signal Cable.

(a) DESCRIPTION.

Signal cable shall be used to supply electrical power to vehicle and pedestrian signal heads, lane control signals, electrically powered signs, and pedestrian detectors.

(b) MATERIALS.

Signal cable shall conform to the requirements of IMSA Specification No. 20-1, polyethylene insulated, polyethylene jacketed communication cable.

Unless otherwise noted on the plans, signal cable conductors shall be solid copper, No. 14 AWG. The number of conductors shall be provided as follows:

Pedestrian Push Button Assembly	2 Conductors
Pedestrian Signal Head	3 Conductors
Flashing Beacon	3 Conductors
3 – Section Signal Head	4 Conductors
5 – Section Signal Head	7 Conductors

890.13 Loop Detector Wire.

(a) DESCRIPTION.

Loop detector wire shall be used to provide a zone of detection (sensor loop) and designed so that the passage or presence of a vehicle in the zone causes a decrease in the inductance of the loop.

(b) MATERIALS.

1. WIRE.

Wire shall be Type USE-2, Type RHH, or Type RHW-2 XLP, 600 V cross-link polyethylene insulated cable.

Wire shall be No. 12AWG.

Wire shall have a single conductor that is soft annealed stranded wire of not less than 98 percent conductivity.

The outer jacket shall be surface printed indicating the manufacturer, national research testing laboratory listing, maximum rated voltage, AWG size, the proper type letter or letters for the type of wire or the IMSA specification number every two feet {0.6 m} or less.

2. LOOP SEALANT.

Proposed loop sealant shall be included in the proposed material submittal as required in Section 730.

890.14 Loop Detector Lead-In Cable.

(a) DESCRIPTION.

Loop detector lead-in cable shall be used to connect the sensor loop to the input of the loop detector unit.

(b) MATERIALS.

Loop detector lead-in cable shall conform to the requirements of IMSA Specification No. 50-2, polyethylene insulated, polyethylene jacketed shielded, loop detector lead-in cable.

The cable shall have stranded tinned copper conductors, No. 12 AWG.

The cable shall have two conductors individually insulated in a twisted pair configuration.

890.15 Junction Box.

(a) DESCRIPTION.

Junction box shall be provided to splice loop wires to shielded lead-in-cable, to allow access to ground rods located beneath sidewalks, and to decrease friction drag of pulling underground cable through conduit.

(b) MATERIALS.

1. JUNCTION BOX.

The junction box shall be constructed of non-concrete plastic mortar reinforced with heavy-weave fiberglass. It shall be capable of withstanding a vertical load test of 20,000 pounds {9.07 metric tons} over a 10 inch { 254 mm} by 10 inch {254 mm} area.

Junction box shall conform to the dimensions shown on the details in the Special and Standard Highway Drawings.

2. JUNCTION BOX COVER.

All junction boxes shall be supplied with a heavyduty cover tested to 20,000 pounds {9.07 metric tons} over a 10 inch {254 mm} by 10 inch {254 mm} area. All covers shall conform to the American Association of State Highway and Transportation Officials' (AASHTO) Specification H10 10 Ton GVW HA Cover Rating. All covers shall comply to ASTM Standard Publication No. ASTM C857, "Practice for Minimum Structural Concrete Utility Structures" and conform to) load test, 20,000 pounds {9.07 metric tons} performed as stated in AASHTO T280-87, "Standard Method of Testing For Concrete Pipe, Section, or Tile". The junction box shall have a locking cover. The junction box cover shall be embossed with "TRAFFIC CONTROL" in standard block type not less than 1.5 inches {38.1 mm} in height.

890.16 Conduit.

(a) DESCRIPTION.

Conduit furnished shall be metallic or non-metallic, of the size specified on the plans.

(b) METALLIC CONDUIT.

Metallic conduit shall be galvanized rigid steel, thick wall.

Galvanized rigid conduit shall conform to UL Standard Publication No. 6-2000, "Standard For Rigid Metallic Conduit", and ANSI Standard Publication No. C80-1-1977, "Rigid Steel Conduit Zinc-Coated (GRC)".

(c) NON-METALLIC CONDUIT.

Non-metallic conduit shall be Type II, Schedule 40, PVC conduit. All PVC conduit and fittings shall conform to UL Standard Publication No. 651-1995, "Schedule 40 and 80 Rigid PVC Conduit" and ANSI Standard Publication ANSI/NEMA TC 2-1983, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)".

(d) LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT.

Liquidtight flexible metal conduits shall be UL listed type UA, 2 inch {53 mm}. Connectors shall be either angle or straight and be UL listed for the intended use.

890.17 Supporting Structures.

(a) GENERAL.

Supporting structures (metal traffic signal pole, prestressed concrete traffic signal pole, mast arm pole, and pedestal pole) used for mounting signal equipment shall conform to the requirements of Section 718 and Section 891.

(b) METAL AND CONCRETE SUPPORTING STRUCTURE FEATURES.

Handholes with covers shall be provided to facilitate installation and wiring.

Adapter with provisions for overhead wiring and wire entrance shall be provided for the top of the pole.

A grounding connection shall be provided adjoining the base.

When painting of the supporting structure is specified by the plans or proposal, the supporting structure shall have two primer coats applied at the factory or point of fabrication and two additional coats of high-grade exterior grade enamel applied in the field.

Paints shall conform to the applicable portions of Section 855.

(c) TIMBER POLES.

Timber poles shall be southern yellow pine treated in accordance with the latest American Wood-Persever's Association (AWPA) standards and conform to the requirements of Section 833, Table 1.

Unless otherwise noted on the plans, timber poles used for supporting traffic signals shall be Class 5 and shall conform to the requirements of ANSI Standards Publication No. 05.1-1992. The poles shall not have more than 180 degrees of twist in grain over the full length and the sweep shall be no more than 4 inches {100 mm}.

When required, guy wires shall be provided of adequate strength and shall meet the requirements of ASTM A 475-89. Guy wire anchors shall be expanding or screw type with a minimum guy tension of 8000 pounds {35 kN}.

890.18 Luminaire Extension Assembly.

(a) DESCRIPTION.

Luminaire extension assembly shall consist of an extension arm, housing, reflector, a refractor or lens, a lamp socket, an integral ballast, a terminal strip, and a lamp shall conform to the requirements of this specification unless otherwise specified on the plans, in the proposal, and on the details in the Special and Standard Highway Drawings.

(b) GENERAL.

The luminaire shall be of the horizontal type for IES Type III medium cut off distributing an asymmetrical light pattern.

(c) MATERIALS.

1. LUMINAIRE EXTENSION ARM.

Unless otherwise shown on the plans, the extension arm shall be 12 feet {3.7 m} in length. Stud mounting bolts and brackets shall be provided.

2. PHOTOELECTRIC CONTROL UNIT.

A photoelectric control unit shall be provided and conform to the requirements of the Institute of Electrical and Electronic Engineers (IEEE) and NEMA.

3. HOUSING.

The housing shall be fabricated from die-cast aluminum.

If the housing is provided with a hole for the receptacle, the hole shall be closed, covered, and sealed with weatherproof material, in a permanent manner.

The housing shall be weather-tight and shall be gasketed.

All hinges, bolts, nuts, washers, screws and miscellaneous hardware shall be stainless steel.

4. LENS.

The lens shall be a pressed borosilicate glass refractor to provide the IES lighting pattern indicated.

5. BALLAST.

The ballast shall be a CWA Type.

6. LAMP.

Each luminaire shall have clear high-pressure sodium (HPS) lamp of the required wattage. Average lamp life shall be 24,000 hours. Initial lumen output shall be 27,500 lumens for 250 W and 50,000 lumens for 400 W.

7. FIELD WIRES.

Field wires connected to the luminaire shall terminate on a barrier type terminal block secured to the housing.

An ultra violet resistant No. 10 AWG cable shall be provided. Phase or current carrying conductors shall be of the Type RHH, RHW, USE, or XHHW and shall be identified by a continuous black color or colors other than white, gray, or green. If colors are used, they shall be consistent for circuit and phase.

8. SURGE ARRESTOR.

The surge arrestor shall be enclosed in a watertight case with mounting ears so that no additional hardware will be required except attachment screws. There will be no limitation as to proper orientation for mounting to insure that the unit is 100 percent functional.

The surge protection elements shall be metal-oxide varistors with a total peak surge current rating (8x20 microseconds) of 45 kA for the 120 V mode. Certified response time shall be 5 nanoseconds max at 700 A and 440 V. Certified test reports from an independent laboratory shall be submitted when requested by the Engineer.

The arrestor shall provide protection from line to ground and neutral to ground. It shall have a calculated surge life of greater than 40,000 occurrences at 700 A or 1000 occurrences at 1000 A. There shall be no follow current and current drain shall be less than 100 μA.

890.19 Concrete Foundations.

All concrete foundations or footings shall conform to the requirements of Section 718.

A ground rod of a non-ferrous coating material, 5/8 inch {16 mm} in diameter by 8 feet {2.4 m} in length, shall be provided. The ground rod shall be provided with a bonding copper wire or strip equivalent to the cross sectional area of a No. 6 AWG {4.25 mm} wire.

890.20 Signs.

The R10-10 sign, R10-12 sign, R10-4B sign, and any sign as indicated o the plans, as a part of the signal installation shall conform to the requirements of Section 880.

SECTION 891
STRUCTURAL MATERIALS FOR TRAFFIC CONTROL DEVICES AND HIGHWAY LIGHTING

891.01 General.

All materials used in the fabrication of overhead roadway sign, traffic signal, luminaire and traffic surveillance structural supports shall meet the requirements of the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 1994 Edition* (hereinafter referred to as the AASHTO Sign Specifications*)*. AASHTO material specifications shall govern in lieu of ASTM material specifications when an AASHTO equivalent specification exists for all references within any referenced specification.

891.02 Steel.

(a) GENERAL.

All grades of steel listed in the AASHTO *Standard Specifications for Highway Bridges* are applicable for welded structural supports for overhead roadway signs, luminaries, traffic signals and traffic surveillance and shall have a specified yield strength not less than 35 ksi {241 MPa}, unless otherwise specified on the contract plans, or within this Section. The specifications for steels other than ASTM and AASHTO shall be submitted to the Bridge Engineer for approval, prior to design. The contractor shall supply the Bridge Engineer with a copy of the steel specification corresponding to the steel that is being used if the steel is not covered by ASTM or AASHTO specifications.

(b) FABRICATION.

Within 30 days after the award of the contract, the Contractor shall notify the ALDOT Bridge Engineer in writing of the name and address of the fabricator of the structural steel. The notification shall include the fabricator's proposed fabrication schedule. Evidence of the fabricator's qualifications and experience shall be furnished if requested by the ALDOT Bridge Engineer.

No material shall be fabricated before the Department has been notified where the fabrication order has been placed. The Fabricator is responsible for notifying the Bridge Engineer of any fabrication work to be done outside of their facility, the name and address of the outside fabricator, and the proposed fabrication schedule.

The Contractor shall give the ALDOT Bridge Engineer a two week notice prior to the beginning of fabrication to allow time for arrangements to be made for an ALDOT inspector to be present during fabrication.

All steel structures shall be fabricated in a plant certified by the American Institute for Steel Construction for Conventional Structures.

Welding of steel members shall be in accordance with the *American Welding Society Structural Welding Code D1.1, 1996 Edition* (hereinafter referred to as the AWS Steel Welding Code). Welders shall be certified in accordance with the AWS Steel Welding Code. All welds shall be visually inspected and be free of cracking and undercutting. High Mast lighting assembly pole to base plate welds shall be magnetic particle or ultrasonically tested. Circumferential butt welds shall not be allowed on overhead roadway sign structure uprights. All circumferential welds on steel poles shall be tested by ultrasonic for wall thickness of 5/16 inch {8 mm} or greater, or radiographic testing for wall thickness less than of 5/16 inch {8 mm}. All requirements of Section 1.4.2 of the AASHTO Sign Specifications shall be observed when welding and testing the poles. The longitudinal weld on the female section of lap splices shall be either one hundred percent full penetration, with quality assurance by ultrasonic inspection per the AWS Steel Welding Code, or shall be reinforced externally to ensure the development the full yield stress of the pole.

The handling and storing of materials, during and after fabrication, shall be done in such a manner that the metal or galvanized finish is not damaged. Material that is damaged may be rejected. Material shall be stored off the ground and properly drained. Loose members and fasteners shall be stored in boxes, crates, kegs or barrels.

Support structures shall be free from sharp edges and irregularities, and any misfits or structural deficiencies. All members must fit together well and make for an easy and quick erection. All components shall be protected from damage during fabrication, handling and transportation to the site. None of the components shall be delivered to the site until such time as the entire structure (less sign faces) can be erected.

(c) OVERHEAD ROADWAY SIGN STRUCTURES.

Material for overhead roadway steel sign structures shall be structural carbon steel or structural low alloy steel meeting the requirements of the AASHTO *Specifications for Highway Bridges*, latest edition. Steel pipe shall be in accordance with ASTM A 53, Grade B, Schedule 40 or stronger. Nuts, bolts, and washers used in structural joints shall be in accordance with ASTM A 325 and shall be installed in accordance with Item 508.03(d)6. Nuts and bolts used in non-structural joints shall be in accordance with ASTM A 307. Washers used in non-structural joints shall comply with the requirements of ASTM F 844.

All components of the structure assembly shall be galvanized with zinc after fabrication in accordance with AASHTO M 111 and AASHTO M 232, for fasteners. Hollow sections shall be galvanized on both exterior and interior surfaces. Closed hollow sections shall have appropriate sized galvanizing vent holes at each end of a member. Damage to galvanization or any bare areas developed before or during erection shall be painted with two coats of approved galvanizing paint in accordance with Section 855, or an approved zinc spelter paint.

A uniform camber, in accordance with Section 9 of the AASHTO Sign Specification, shall be provided for all horizontal members of the sign structure. The minimum camber shall be equal to the dead load deflection + L/1000 (L in inches {millimeters}). The maximum permissible camber shall be L/240 (L in inches{millimeters}).

1. FACILITIES FOR INSPECTION.

The Contractor shall provide ALDOT with adequate, suitable office facilities and furnishings when required for the inspection of materials and workmanship in the fabrication shop.

2. QUALITY CONTROL AND NON-DESTRUCTIVE TESTING.

A current written copy of the fabricator's quality control manual, along with a listing of qualifications of personnel qualified to perform inspections and/or non-destructive testing shall be submitted prior to any fabrication work. All nondestructive testing personnel shall meet the requirements set forth in ASNT Standard for Qualification and Certification of Nondestructive Testing

Personnel (ANSI/ASNT CP-189-1991). Additionally, current copies of ASNT NDT Level III eye examinations are required.

No materials or members will be accepted by the ALDOT Bridge Engineer's representative, or partial payments made, until the Department's BBF-1 form, the supporting mill test reports and galvanization certificates for the materials have been furnished and approved by the Department. This information shall be submitted for approval. The BBF-1 form shall be signed by a company official and notarized.

The contractor shall furnish five certified copies of mill test reports covering steel materials. These reports shall include chemical determinations and physical characteristics.

The fabrication shop shall have and maintain a master tape, calibrated by the National Institute of Science and Technology. All tapes shall be calibrated with the master tape before being used on the project. Any master tape found damaged or with a certification over two years old shall be replaced or recalibrated.

A Certified Welding Inspector (CWI) shall be present on all shifts where welding is ongoing.

3. HANDLING, TRANSPORTATION AND STORAGE OF MATERIALS

The handling and storing of materials, during and after fabrication, shall be done in such a manner that the metal or galvanized finish is not damaged. Damaged material may be a cause for rejection. Material shall be stored off the ground and properly drained. Loose members and fasteners shall be stored in boxes, crates, kegs or barrels and kept dry.

4. WORKMANSHIP, FINISH AND DETAILING.

All work shall be performed in a neat workmanlike manner.

A buffer and/or shield shall be utilized during fitting operations to protect base metals from damage caused by fitting tools or devices. Any damage incurred may be cause for rejection of the material.

Heat straightening or hot bending is allowable provided the metal is not heated above 1100 °F {590 °C}. The maximum heat applied shall be controlled by the use of heat crayons or other approved means. After straightening or bending, the metal shall not be artificially cooled until the temperature of the metal reaches 600 °F {315 °C} or less. Water or spray misting shall not be used as a means of artificial cooling. Heat cambering will only be permitted when making minor adjustments to the actual camber in a member.

Steel may be thermal cut, provided a smooth surface is secured by the use of a mechanical guide. Thermal cutting by hand shall be done only when approved. The surface shall be smoothed by planing, chipping or grinding. Other methods of cutting steel may be submitted for approval.

Sheared edges of plates more than 5/8 inch {16 mm} in thickness shall be planed to a depth of 1/4 inch {6 mm}. Plates 5/8 inch {16 mm} in thickness, or less, shall be ground to remove sharp corners and edges.

Vent holes, if required, shall be cylindrical, without ragged or torn edges or corners. If vent holes are installed with a thermal cutting process, they must be reamed.

5. ACCURACY OF REAMED OR DRILLED HOLES.

- Reamed or drilled holes shall be cylindrical and perpendicular to the member.

- Holes may be punched with a full-size die provided the thickness of the material is not greater than the nominal diameter of the fasteners being used nor greater than 3/4 inch {20 mm} for carbon steel, 5/8 inch {16 mm} for high strength steel, nor 1/2 inch {12 mm} for quenched and tempered alloy steel. Holes shall be clean cut and free of torn or ragged edges. Plug welding of any holes that are too large or slightly off location is prohibited. Completed holes shall be 1/16 inch {1.6 mm} larger than the nominal diameter of the fastener being used.

- All holes may be oversized or slotted by 1/32 inch {0.8 mm}, maximum. In any connection, no more than ten percent of all holes may be oversized or slotted 1/16 inch {1.6 mm}.

- Edge distances of fasteners shall be as shown below.

The minimum distance from the center of any fastener to a sheared or flame cut edge shall be: 1" Fastener: 1-3/4" {45 mm}; 7/8" Fastener: 1-1/2" {38 mm}; 3/4" Fastener: 1-1/4" {32 mm}; 5/8" Fastener: 1-1/8" {29 mm}.

The minimum distance from the center of any fastener to a rolled or planed edge, except in flanges of beams and channels, shall be: 1" Fastener: 1-1/2" {38 mm}; 7/8" Fastener: 1-1/4" {32 mm}; 3/4" Fastener: 1-1/8" {29 mm}; 5/8" Fastener: 1" {25 mm}.

In the flanges of beams and channels the minimum distance from the center of the fastener to a edge shall be: 1" Fastener: 1-1/4" {32 mm}; 7/8" Fastener: 1-1/8" {29 mm}; 3/4" Fastener: 1" {25 mm}; 5/8" Fastener: 7/8" {22 mm}.

- The distance between the edges of adjacent holes that are enlarged or slotted shall not be less than three times the diameter of the fastener minus the nominal diameter of the hole. The edge distance shall not be less than that given for Minimum Edge Distance minus one half the nominal diameter of the hole.

6. WELDING.

a. All welding shall be inspected for defects in accordance with the requirements stated herein. Any worker, welder or weld inspector who, in the opinion of the Engineer, produces inferior work, may, under the provision of Article 108.06, be disqualified from performing ALDOT work.

b. All shop welding shall be performed under cover of a permanent structure and/or building capable of protecting the material and welding operation from inclement weather.

c. Intersecting welds, unless shown on the plans or approved shop drawings, are prohibited.

d. Tack welds, not incorporated in the final weld, shall not be used. Cracked tack welds shall be removed and the area of base material examined by MT or PT.

e. Complete penetration, circumferential welded splices, in any component of an upright member is prohibited within overhead sign structures.

f. Undercut is limited to 1/32" {0.8 mm} on secondary members and to 0.01" {0.25 mm} on main members.

g. Excessive arc strikes and/or gouges will be assessed by the ALDOT representative to determine if repairs are required or if the material should be rejected.

h. Carbon arc or thermal cut boundaries and back gouged surfaces for groove welds shall be ground to a smooth, bright surface, before welding.

i. Drying and storage ovens shall be electric and of sufficient size to accommodate a one day supply of electrodes. Drying ovens shall be equipped with a recording thermometer. Storage ovens shall have a visible thermometer.

j. Each welding machine shall have its approved welding procedure posted in a conspicuous area on or near the machine

k. The Contractor shall furnish a written welding procedure specification (WPS) for each process and joint to be used in shop welding. The WPS number shall appear in the tail of the weld symbol on the shop drawings.

l. All shop welds shall be temporarily marked in such a manner that allows identification of the welder.

m. A complete list of qualified welders shall be provided by the fabricator. Welders that do not have satisfactory pre-qualification, may be required to qualify in the presence of an ALDOT representative.

(d) STEEL POLES FOR TRAFFIC SIGNAL, LUMINAIRE AND TRAFFIC SURVEILLANCE SUPPORT STRUCTURES.

The shafts shall be fabricated from basic oxygen or open hearth sheet steel, of a single ply, and having only one longitudinal seam weld. Circumferential welded splices may be used, provided none of the spliced pieces, except for the top piece, are less than ten feet in length. All circumferential welds shall be ground flush with the material surfaces. In lieu of circumferential welds, a two piece section, slip joint shaft pole (for poles without horizontal welds) will be permitted when the plans or approved shop drawings require poles longer than the manufactured length capability.

Steel poles shall be anchored with a one piece cast steel anchor base or a welded steel plate anchor base that is of sufficient strength to develop the yield strength of the pole. When the anchor base is attached to the shaft it shall develop the full strength of the shaft section to resist bending action. The base shall be provided with four slotted holes for attachment to the foundation with four anchor bolts. The complete pole assembly shall be hot-dipped galvanized after fabrication in accordance with AASHTO M 111. Each assembly must be completely coated in a single dip. All miscellaneous hardware shall be galvanized per AASHTO M 232. Mill certifications shall be supplied.

891.03 Glass Fiber Reinforced Polymers (GFRP).

GFRP poles shall be heavy duty class, conforming to the American National Standard for Roadway Lighting-Fiber-Reinforced Plastic (FRP) Lighting Pole (ANSI C136.20 - latest edition). GRFP poles shall be manufactured by using a thermosetting polyester resin containing a minimum of 65% fiberglass by weight. The resin shall be ultraviolet resistant and pigmented the same color as the final coating to be applied. The resin shall not contain clay fillers. The pole color shall be uniform throughout the entire wall thickness of the pole. The finish of the pole shall be smooth. A 1-1/2 mil dry film thickness of weather resistant polyurethane shall be coated to the surface of the pole for additional ultra-violet protection.

Direct burial poles shall have a 4 inch by 6 inch {102 mm by 153 mm} hand hole with a non-aluminum cover provided at 18 inches {458 mm} above the ground line. The conductor entrance shall be two each 2 inch by 6 inch {51 mm by 51 mm} entrance holes located 2 feet {610 mm} below the ground line and one hundred and eighty degrees apart.

The poles shall be delivered pre-drilled to accommodate luminaires and lowering devices. Pole top tenons shall be permanently bonded to the shaft and shall be aluminum or hot dipped galvanized steel.

891.04 Aluminum.

Aluminum material shall meet the requirements of the AASHTO Sign Specifications, Section 5.

Welding shall be in accordance with the provisions of Section 5 of the AASHTO Sign Specifications.

The shaft of aluminum poles shall be one piece seamless round tapered tube full length heat-treated after welding on the base flange to produce the T6 temper. The base shall be one-piece cast aluminum. All nuts, bolts and washers used shall be stainless steel Grade 18-8 or stronger, and shall meet the requirements of ASTM F 593. Each pole will have an internal grounding lug. A pole vibration damper shall be provided.

The contractor shall furnish five copies of certified mill test reports attesting to the fact that the aluminum material submitted for approval meets the contract requirements. These reports shall include chemical determinations and physical characteristics.

891.05 Prestressed Concrete Poles.

Prestressed concrete shall meet the requirements of Section 513, Paragraph 513.02(c),Concrete, and shall have a minimum twenty eight day compressive strength of 5000 psi {35 MPa}.

Prestressing steel shall comply with Section 513, Paragraph 513.02(b)1., Stressing Steel, and shall have a minimum tensile strength of 250 ksi {1725 MPa}.

Poles shall be fabricated by the static-cast or spun-cast method. The maximum sweep for either type shall not exceed 1/4 inch per 10 feet {7 mm per 3 m} of length. The minimum cover for spun-cast poles shall be 3/4 inch {19 mm}. The minimum cover for static cast poles shall be 1 inch {25 mm}. Splicing may be performed by either slip joint, flange plate, bolted or welded splices. Splices shall be designed such that the full strength of the member may be developed.

The prestressed concrete pole manufacturing plant shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program. The manufacturer shall submit proof of certification prior to the start of production. The plant's certification shall be in the appropriate product group and category for the products being produced by the plant.

The Contractor shall submit to the ALDOT Bridge Engineer for approval shop drawings showing complete details of prestressed concrete poles as specified in Subarticle 105.02(c) and his proposed tensioning and de-tensioning procedure.

Within 30 days after the award of the contract, the Contractor shall notify the ALDOT Bridge Engineer in writing of the name and address of the fabricator of the poles. The notification shall include the fabricator's proposed fabrication schedule.

The Contractor shall give the ALDOT Materials and Tests Engineer a two week notice prior to the beginning of fabrication to allow time for arrangements to be made for an ALDOT inspector to be present during fabrication.

891.06 Breakaway Supports.

A Federal Highway Administration approved breakaway support shall be installed on each luminaire assembly when indicated on the plans. The pole shall meet the 1985 AASHTO breakaway

requirements and FHWA certification of testing must be submitted. The Contractor shall assure the compatibility of the pole base, breakaway support and foundation.

Transformer bases shall be used only as a replacement of a like item on an existing installation unless specifically shown otherwise on the plans.

891.07 Mast Arms.

Mast arms shall be fabricated from steel tubes (except for aluminum poles, which shall have aluminum mast arms) to the lengths specified on the plans and approved shop drawings. Mast arm shafts shall be of one continuous piece without intermediate splices or couplings, provided with rain-tight connections to the shaft of the pole and designed to rotate three hundred and sixty degrees in the horizontal plane.

A two piece section, slip joint shaft mast arm will be permitted when plans or proposal require mast arms longer than the manufacturer's length capability.

All hardware, except split pole clamps, shall be stainless steel or anodized aluminum. The end of the arm shall be furnished with the type of fitting required by the plans.

All connecting joints for attachments for mast arms, shaft extensions and luminaire arms shall be of the design indicated by plan details or approved by the Engineer and shall develop full strength of the joint.

891.08 Auger Base Foundation.

Steel for auger base foundations shall meet the requirements of ASTM A 635. The completed auger base shall be hot dipped galvanized.

891.09 Anchor Bolt Assemblies.

Anchor bolt assemblies (anchor bolts, nuts, and washers) shall be in accordance with AASHTO M 314, Grade 36 or Grade 50, except maximum tensile strength on all grades is waived, and capable of transferring the load safely from the structure base plate to the foundation. The exposed end of the anchor bolts shall be threaded (rolled or cut type) and provided with appropriate nuts, including lock nuts and flat washers. The anchor bolts, nuts, and washers shall be hot-dipped galvanized in accordance with AASHTO M 232, however, galvanization of the bolt below 6 inches {152 mm} from the top of the embedment line will not be required. The nuts shall be lubricated with a lubricant containing a visible dye so that a visual check can be made for proper lubrication prior to installation. Special care shall be taken when storing galvanized bolts with a water soluble lubricant.

Anchor bolts for overhead roadway sign structures and high mast lighting assembly poles only, shall meet the requirements provided in AASHTO T 244 for Charpy V-Notch testing. Notch toughness tests on specimens shall be performed in accordance with Test Frequency P (Piece Testing) of AASHTO T 243 with a minimum average value of 15 ft-lb. at 40 °F {20 J at 4.4 °C} and the notch shall be oriented perpendicular to the longitudinal axes of the anchor bolt. In order to meet the Charpy V-Notch impact requirements, the steel may require heat treatment. The Charpy V-Notch testing equipment shall be calibrated once each year using a National Institute of Standards and Technology check sample. Certification of the annual calibration shall be available to the Department when requested.

891.10 Pedestals.

If specified by the plans, pedestals shall be furnished for steel and aluminum poles according to the overall length (including cap and base) shown on the plans. Pedestal shafts shall be a one piece, continuous taper or parallel wall, circular shaft. Steel shafts shall be of not less than 1/8 inch {3 mm} wall thickness and of a size at the top designed to fit a standard 4 inch {102 mm} slip-fitter attachment. Steel shafts shall have a polished or galvanized finish, which shall be protected during storage and shipment by a suitable protective covering. The covering shall remain on the shaft until installation begins. A one piece base shall be provided which, when attached to the shaft, will develop the full strength of the shaft to resist bending action. The base shall be provided with four slotted holes for attachment to the base of the foundation. The anchor bolts shall be recessed and ornamental covers provided. A handhole with cover, approximately 4 inches by 6 inches {102 mm by 153 mm} in dimension, shall be provided in the base of the pedestal shaft. A cap for any exposed open end of a pedestal shaft shall be provided. The cap shall be of cast aluminum and of the nipple or tenon mounting type.

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