2018 MnROAD Research Efforts
Spring NCAT Test Track Conference - March 2018
Ben Worel – MnROAD Operations Engineer
2018 MnROAD Research Efforts Outline

MnROAD Activities

National Road Research Alliance

Future Needs

How to get involved
MnROAD

• MnROAD Owned and Operated by Minnesota DOT
• 23-Years of Long Term Customer Service

• HMA and PCC Pavements
• New and Rehabilitation

• Major Experiments
  • Phase I (1994-2006)
  • Phase II (2007-2016)
  • Phase III (2017- )
MnROAD and Minnesota Test Sections

MnROAD Overall Studies
- 35 unique ongoing studies
- 141 unique test sections

Low Volume Road
- Local Road Research Board
- (MN - City and Counties)
- 19 Studies / 49 test sections

Interstate 94 Westbound
- Mainline (3.5 miles)
  - 12 ongoing studies / 44 test sections
- Old Westbound (3.5 miles)
  - 4 ongoing studies / 48 test sections

Additional Offsite Test Sections
- Partnership - National Center Asphalt Technology (NCAT)
- 50 Test Sections south of Milaca – US-169 and CSAH-8
MnROAD Operations Support

• Research Development / Partnerships
• Coordination of Construction

• Traffic Loadings
• Performance Monitoring
  • Pathways Van
  • Cracking / Rutting / Ride / FWD, ..... 

• Sensors
  • Static (Environmental)
  • Dynamic (Traffic Loading)

• MnROAD Database
• Technology Transfer
Autonomous Bus Testing at MnROAD
What are the Challenges?

Salt

Snow / Ice
Safe Automated Vehicle Testing Demonstration

Project Goals

• Snow and Ice Testing
• Identify Infrastructure Needs
• Identify Traffic Operations Impacts
• Improve Future Mobility Options
• Develop Partnerships
• Public Feedback/Perception
Project Observations

• Cold Weather Operations
  • Battery Life
    • Heaters
    • ADA Pedestrian Ramp
  • Snowing / Blowing Snow / Slush / Snow Pack / Ice
• Salt Build-up on Sensors
Pavement Design & Autonomous Vehicles
Where is the future / What is needed?

• Current Roadway System
  • Millions of miles / Billions of dollars invested

• Highway Engineers Need
  • Currently designed with wheel wander and loading conditions
    • HVS and Test Track
    • Past Experiences
    • Future Designs
  • Infrastructure Investment Required

• Autonomous Industry
  • Wheel Wander and Axle/Vehicle Spacing

Communication is going to be the key to the future
Strategic Implementation Through Cooperative Pavement Research
What is NRRA?

• Pooled fund (2016-2021)
• Fulfill regional and national road research needs
• Foster innovation with states, academia, industry
  • Each Members Research Efforts
  • MnROAD Test Track
    – Direct Phase-III of MnROAD Construction
    – $3 million in MnDOT funding
• Develop innovative technologies
• Focus on implementation, technology transfer, and training into research projects from the ground up
Technical Teams/Budget

• 6 States and 40+ Associate Members
• Executive Committee (states)
• 5 Technical Teams (states /associates)
  — Meeting Schedules
• Investment in Research
  — 65% Research ~$1,825,200
  — 30% Tech Transfer ~$842,400
  — 5% Administration ~$140,400
<table>
<thead>
<tr>
<th>NRRA Team</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible</td>
<td>Tack Coats</td>
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<tr>
<td></td>
<td>Longitudinal Joint Construction Performance</td>
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<tr>
<td>Rigid</td>
<td>Design and Performance of Concrete Unbonded Overlays</td>
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<td>Repair of Joint Associated Distress Pavements</td>
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<tr>
<td>Geotechnical</td>
<td>Larger Subbase Materials</td>
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<td>Subgrade Design for New and Reconstructed Roadways</td>
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<tr>
<td>Pavement Maintenance</td>
<td>Surface Characteristics of Diamond Ground PCC Surfaces</td>
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<td></td>
<td>Pavement Preservation Approaches for Lightly Surface Roadways</td>
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</table>
The purpose of this tech transfer project is to compile a synthesis of best practices being used by NRRA members in the area of tack coats and to identify any gaps in the research.
The goal of this Tech Transfer would be to compile research and specifications from the NRRA states and others into a synthesis for publication.
<table>
<thead>
<tr>
<th>Team</th>
<th>Project</th>
<th>Contractor</th>
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<tbody>
<tr>
<td>Flexible</td>
<td><strong>HMA Overlay of PC and Methods of Enhancing Compaction</strong></td>
<td>University of New Hampshire</td>
</tr>
<tr>
<td></td>
<td><strong>Cold Central Plant Recycling</strong></td>
<td>American Engineering and Testing</td>
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<tr>
<td>Rigid</td>
<td><strong>Fiber Reinforced Concrete</strong></td>
<td>University of Minnesota Duluth</td>
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<tr>
<td></td>
<td><strong>Early Opening Strength to Traffic</strong></td>
<td>University of Pittsburg</td>
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<td></td>
<td><strong>Optimizing Concrete Mix Components</strong></td>
<td>Iowa State</td>
</tr>
</tbody>
</table>
Flexible Team

HMA Overlay of Concrete

Asphalt overlay mixes placed on deteriorated concrete. How do different mixtures aid in enhancing compaction and how they may reduce reflective cracking?

- University of New Hampshire
- 12 Test Sections + 1 Control
- 7 unique Mixes
- 3/4” - 1.5” - 4” Overlays
- 1 Undersealing PCC

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>CELL</th>
<th>DEPTH (inch)</th>
<th>MIX DESCRIPTION (NMAS, mm)</th>
<th>BINDER</th>
<th>DESIGN Voids</th>
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<tbody>
<tr>
<td>Control Section</td>
<td>983</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>HMA over PCC (1 lift)</td>
<td>984</td>
<td>1.50</td>
<td>Superpave (9.5)</td>
<td>58H-28</td>
<td>4.0</td>
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<tr>
<td>HMA over PCC (1 lift)</td>
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<td>HMA over PCC (1 lift)</td>
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<td>HMA over PCC (2 lifts)</td>
<td>987</td>
<td>1.50</td>
<td>Superpave (9.5)</td>
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<td>4.0</td>
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<tr>
<td>HMA over PCC (2 lifts)</td>
<td>988</td>
<td>2.50</td>
<td>Superpave (19.0)</td>
<td>58H-28</td>
<td>4.0</td>
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<tr>
<td>HMA over PCC (2 lifts)</td>
<td>989</td>
<td>2.25</td>
<td>Superpave (19.0)</td>
<td>58H-28</td>
<td>4.0</td>
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<tr>
<td>HMA over PCC (2 lifts)</td>
<td>990</td>
<td>2.25</td>
<td>Superpave 95/5 (12.5)</td>
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<tr>
<td>HMA over PCC (2 lifts)</td>
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<td>Regressed voids design (12.5)</td>
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<tr>
<td>HMA over PCC w/interlayer</td>
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<td>1.50</td>
<td>Superpave (9.5)</td>
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<td>4.0</td>
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<tr>
<td>HMA over PCC w/interlayer</td>
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<td>1.00</td>
<td>Crack inhibiting interlayer (4.75)</td>
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<td>2.0-3.0</td>
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<td>HMA over PCC w/PASSRC</td>
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<td>Superpave (9.5)</td>
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<td>4.0</td>
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<td>HMA over PCC w/PASSRC</td>
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<td>Permeable interlayer mix</td>
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<td>HMA over PCC (1 lift)</td>
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<td>1.50</td>
<td>Ultra-Thin Bonded Wearing Course with PCC/Soil Stabilization</td>
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<tr>
<td>HMA over PCC (1 lift)</td>
<td>995</td>
<td>0.75</td>
<td>Superpave (9.5)</td>
<td>58H-28</td>
<td>4.0</td>
</tr>
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Flexible Team

Cold Central Plant Recycling

Goal - Demonstrating the use of cold central plant mix recycling technology to best utilize RAP stockpiles into new roadway layers.

- American Engineering and Testing
- 4 Test Sections
  - Foam vs Emulsion
  - 2X Chip vs 1.5” HMA Overlay
Flexible Team

Cold Central Plant Recycling

Low Volume Road

133 2X Chip
4" CCPR Emulsion
12" Class 6
Clay

233 2X Chip
4" CCPR Foam
12" Class 6
Clay

135 1.5" HMA
4" CCPR Foam
12" Class 6
Clay

235 1.5" HMA
4" CCPR Emulsion
12" Class 6
Clay

Double Chip Section

This week
Goals - What is the long term effects? Are the fibers cost beneficial? Design thinner pavements or expect the concrete to hold together?
Thin Fiber-reinforced PCC (139 and 239)
Early Fiber Reinforced Concrete Performance

Cell 139 -- 3” FRC
After several weeks of MnROAD truck passes
True test of FRC!
Goals - How early can concrete be loaded when it is curing? How early can you put traffic on roadways and what is the loss in long-term performance/life of the pavement? Can it be measured?
Early loading
Cells 124-424 (524 no loading)

4,000 lb axle vs 14,000 lb axle loads
(1st cell loaded @ 3hrs)
Early loading of Cells 624
Iowa State University
2 Test Sections
- 470 lbs Cement
- 500 lbs Cement

Goal - How can we optimize the amount of cement without impacting the workability and long-term pavement performance?
<table>
<thead>
<tr>
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<tr>
<td>Geotechnical</td>
<td>Recycled Aggregates</td>
<td>Iowa State</td>
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<tr>
<td></td>
<td>Large Stone Subbase</td>
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<tr>
<td>Pavement Maintenance</td>
<td>Maintaining Poor Pavements</td>
<td>SRF Consulting</td>
</tr>
<tr>
<td></td>
<td>Partial Depth Repair</td>
<td>Braun Intertec</td>
</tr>
</tbody>
</table>
Goals - Best use of recycled unbound aggregate bases

Iowa State
- 4 Recycled Bases
- Subbase Thickness
- Geogrid and Sep. Fabric

Goals - Best use large stone subbase layers that require less crushing? What are the benefits over soft soils?
Large-sized Subbase (X27 and X28)

Objectives

• Test soft-soil stabilization technique used by Wisconsin, Illinois
• Two sections: 9-inch and 18-inch
• Same aggregate base and bituminous pavement section above
• Create condition with moisture, scarification, minimum compaction
• Penetration Index required ➔ 2.5-3.5 inches per blow over top 1-ft

Construction

• 9-inch section failed within one week
Large-sized Subbase (X27 and X28)
Redesigned sections

<table>
<thead>
<tr>
<th>East</th>
<th>Cell 728</th>
<th>Cell 628</th>
<th>Cell 528</th>
<th>Cell 428</th>
<th>Cell 328</th>
<th>West</th>
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</thead>
<tbody>
<tr>
<td>186+35</td>
<td>3.5” HMA</td>
<td>3.5” HMA</td>
<td>3.5” HMA</td>
<td>3.5” HMA</td>
<td>3.5” HMA</td>
<td>180+65</td>
</tr>
<tr>
<td>185+04</td>
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<tr>
<td>Revised plan</td>
<td>6” Class 5Q</td>
<td>6” Class 5Q</td>
<td>6” Class 5Q</td>
<td>6” Class 5Q</td>
<td>6” Class 5Q</td>
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<tr>
<td>9” Large-rock subbase</td>
<td></td>
<td>9” Large-rock subbase</td>
<td>9” Large-rock subbase</td>
<td>9” Large-rock subbase</td>
<td>9” Large-rock subbase</td>
<td></td>
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<tr>
<td>No grid</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remains in place</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- Tensar BX1300
- SKAPS GT116
- Tensar TX190L

Prepared subgrade

183+91

181+74
Redesigned Sections
Preventative Maintenance Team
Maintaining Poor Roadways

Original Interstate 94 (Westbound)

Mainline Interstate 94 (Westbound)

215
115
2.25" W/M 58-34
2.6" W/M 58-34
11" 64-22
1933 HMA
Clay M-Mill .75" Overlay 1.5" (2.075" lift, 4.15 mm P&L 50V-34)
M-Mill 0.75" Micro surface C06-1P 0.375"

115
Microsurface

4.75 HMA Overlay

Micromill

201
101
6" 50-28 11 blow
5.5" 50-28 11 blow

605° Class 4
605° Class 4

Clay
Clay

Microsurfacing

Goal - Best practices for maintaining existing asphalt and concrete roadways?

Develop ☛ Collaborate ☛ Research ☛ Implement ☛ Sustain.
Goal - What are some of the best partial depth repair methods used to fix concrete pavements?

Braun Intertec – 14 Repair Materials
NRRA Technology Transfer Efforts

Research Pays Off Seminar Series
• Every 3rd Tuesday
• 10-11 am
• Started in June 2015

NRRA
• Follow NRRA on Linkedin
• May 23-24 2018 Workshop

Newsletters
• Highlight Members
• Highlight NRRA Projects
• Highlight Emerging Technology

Research Partnerships
• Looking for opportunities
• Offsite pavement studies
• Sharing of Materials
2018 NRRA Pavement Workshop
May 23-24, 2018

Day 1 – Monticello
- Technical Team Updates
- Technical Team Breakout Sessions
- MnROAD Tour / Dinner

Day 2 – St Paul @University of MN
- Mike Anderson – Skok Distinguished Speaker
- Dave Rettner – Rohrbach Distinguished Speaker
- Buzz Powell – NCAT/MnROAD Partnership
- Caterpillar – Future of Paving Practices
- Technical Team Breakout Sessions

Information/Registration
http://www.dot.state.mn.us/mnroad/nrra/pavementconference/index.html
NRRA Funding
Membership Opportunities

• Membership
• Welcome more States
• Membership Rate Change?
  • 150K – Membership Agency
  • 75K – Supporting Agency?
  • 2K - Associate

(Executive Committee will be reviewing year 4-5 funding this spring)
NCAT/MnROAD Funding Membership Opportunities

National Pavement Preservation Study
Development of a National Cracking Test

MnROAD / NCAT working on contracts now

Phase – 1
- Ends 2018
- PG = $120K/yr
- CG = $210K/yr

Phase - 2
- PG – MnDOT
  - $50K/yr
- CG – Alabama
  - $100K/yr
MnDOT Legislative Efforts

MnDOT Current Efforts

• Rational / Activities

$3 million → Center of Pavement Excellence

$2 million/year → Annual Support

• National Technical Training
• Funding for Visiting Scholars
• National Research Coordination
  • Autonomous Vehicle Providing Grounds
  • Intelligent Construction
  • Pavement Performance Calibration Center
• Innovative Materials
• Industry Collaboration
• National Research Data Sharing
Future Needs

Automated Vehicles
- New Pavement Designs
- Rehabilitation Methods

Regional Test Decks
- Cold Recycling / FDR
- Rejuvenators
- East/West Test Sections?
- ?

How to push the envelope?
- Partnerships
- What are the next opportunities?
Strategic Implementation Through Cooperative Pavement Research