



2021 Additive Group Study

Randy West

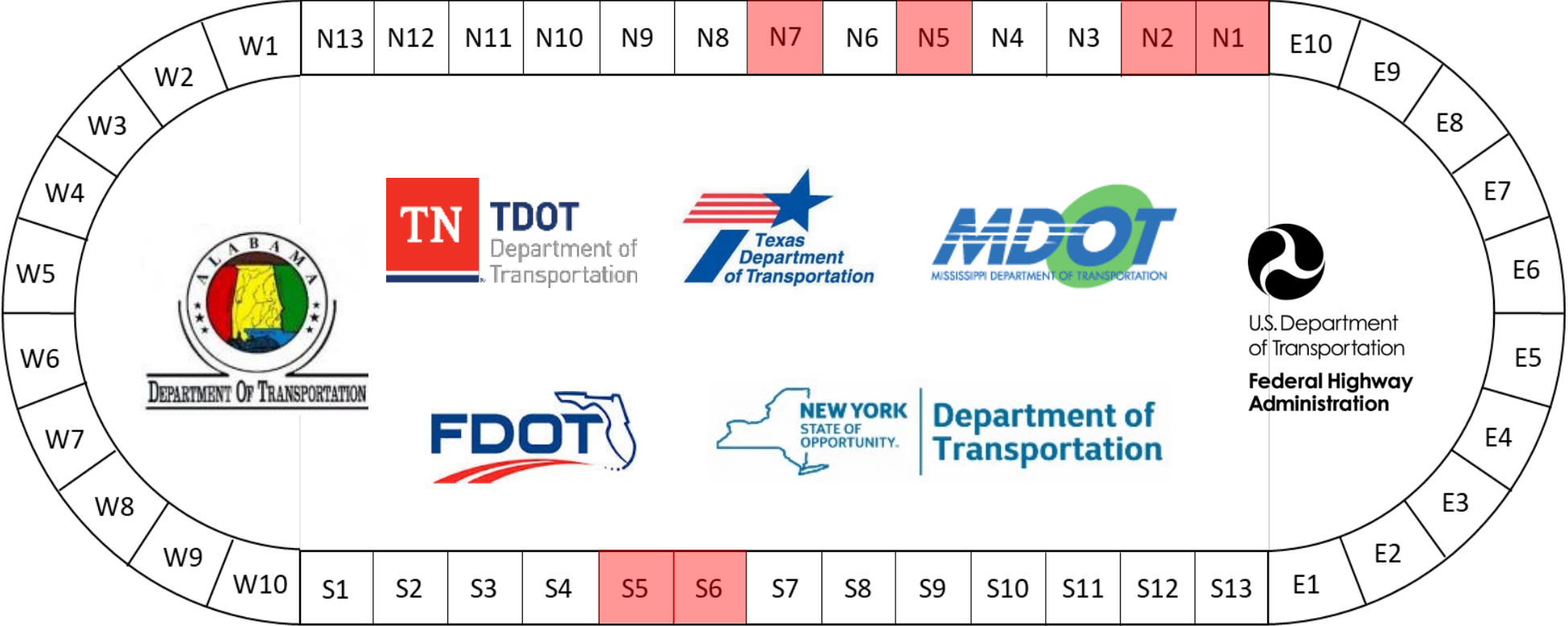
SEVENTH
RESEARCH CYCLE

NCAT TEST TRACK CONFERENCE

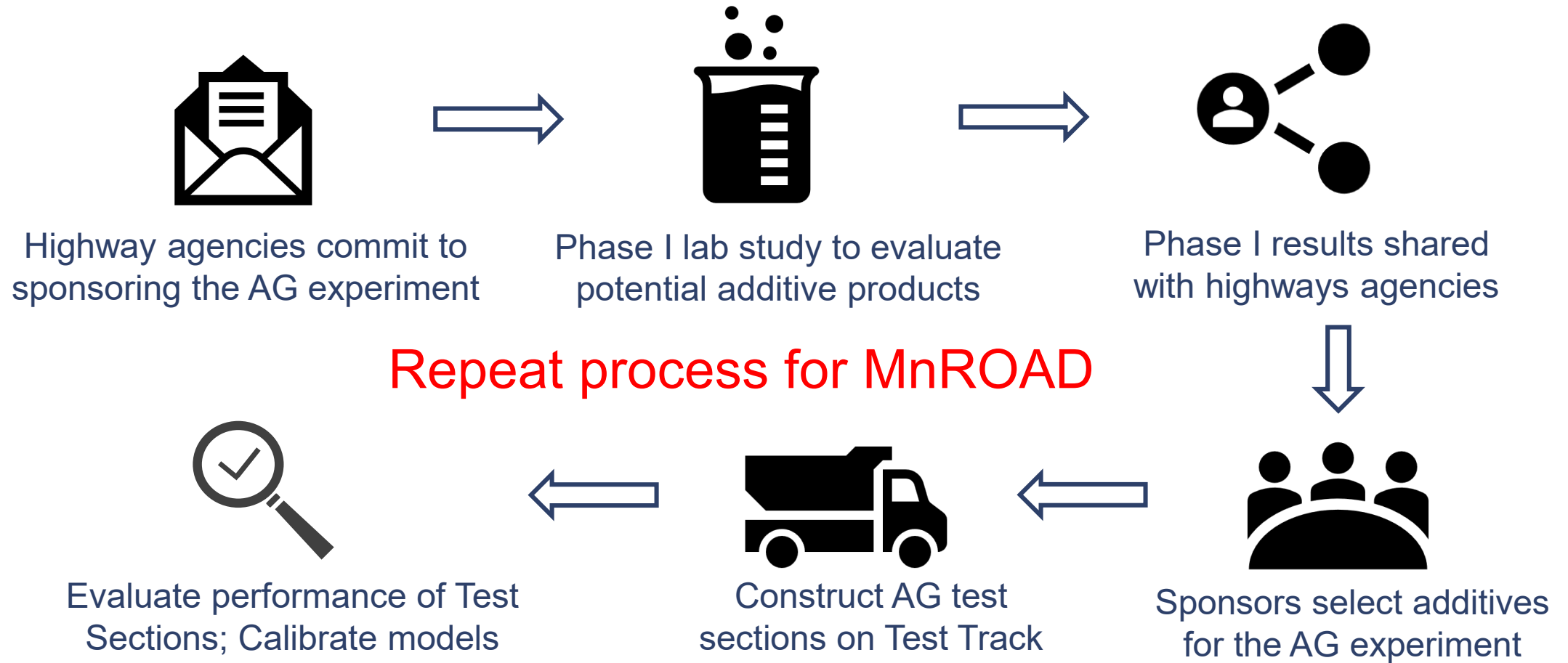
Additive Group Experiment - Objectives

- **Comprehensively evaluate the performance impact of multiple mix additives at the same time**
- **Establish a process to evaluate future additives without having to build test sections**
- **Support the goal to provide sustainable and resilient technologies that outperform current materials**

2021 Additive Group Sponsors



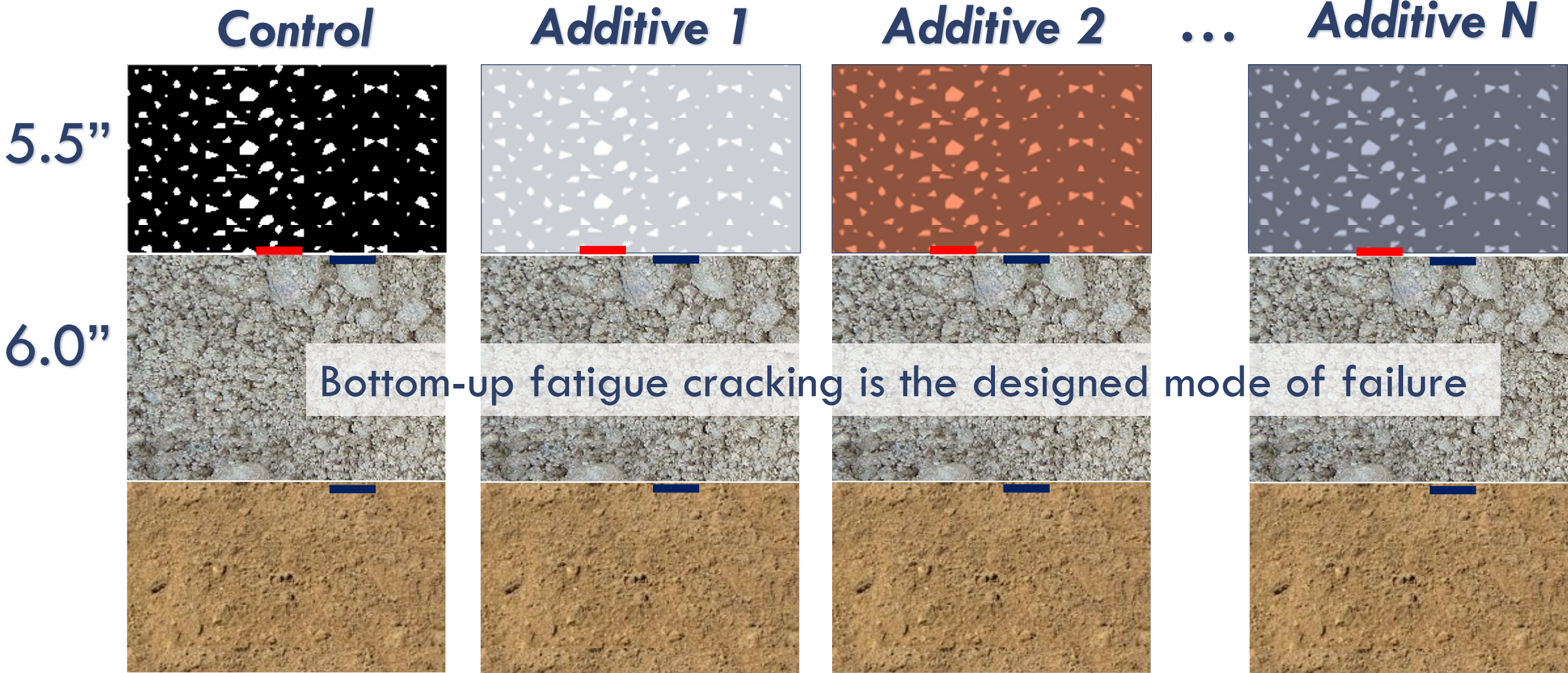
Overall Additive Group Plan



Additives Evaluated in Phase I

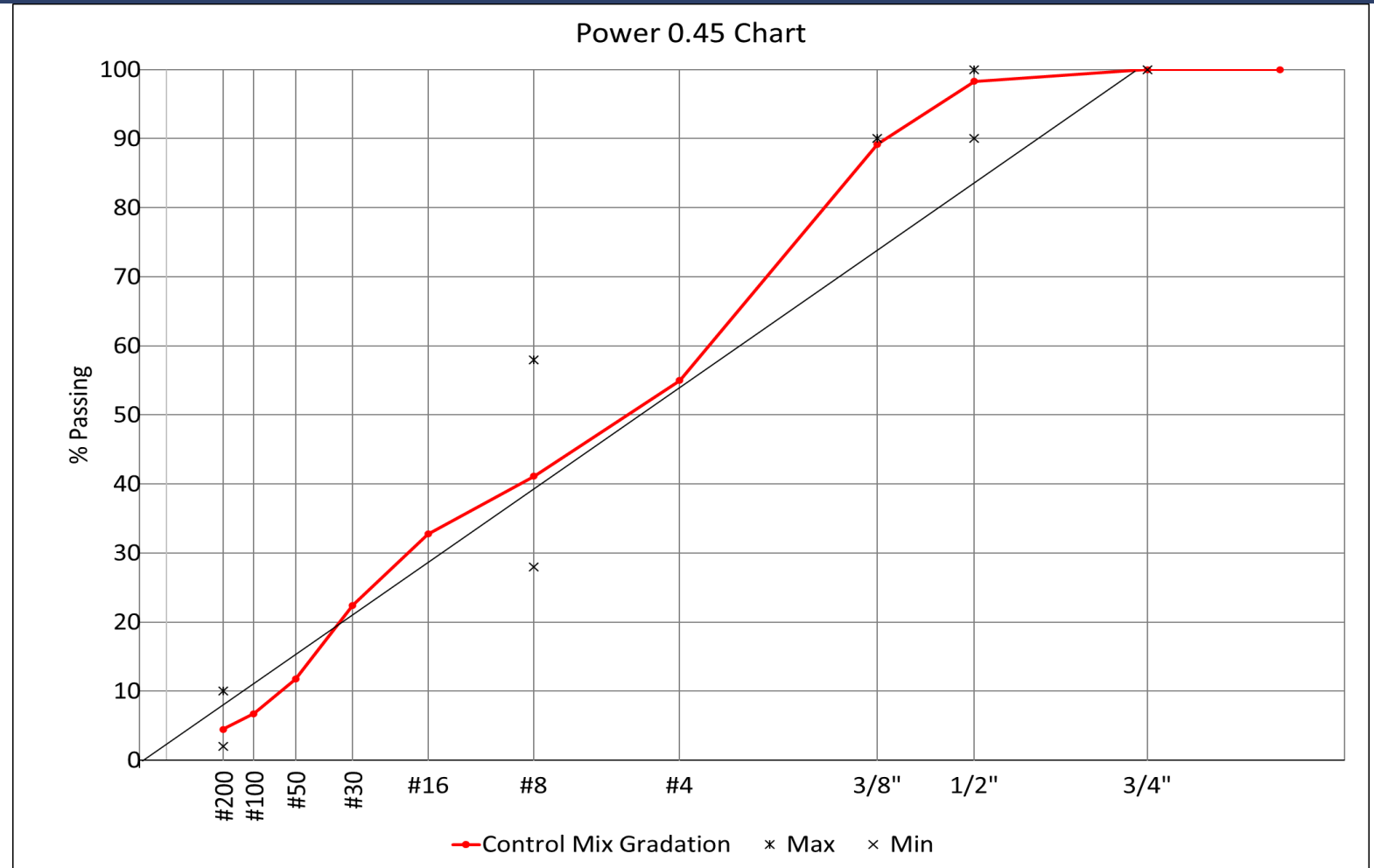
- Six Recycled Plastic Additives
- Six Recycled Tire Rubber Additives
- Two Aramid Fiber Additives

NCAT Additive Group Test Section Design

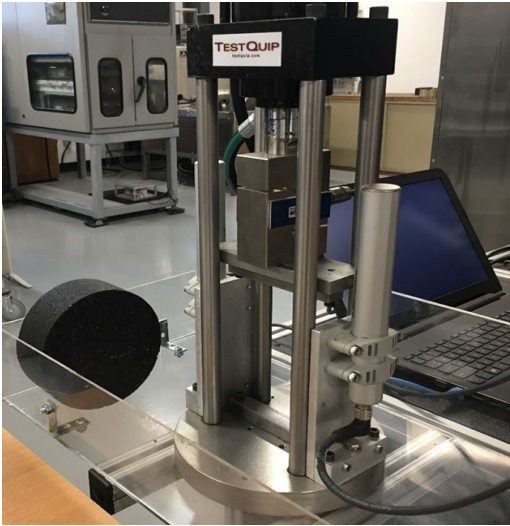


Mix Design Information

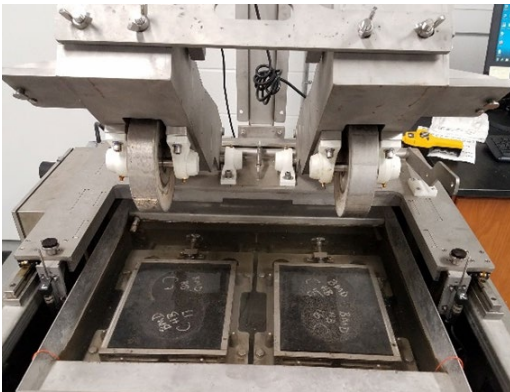
- 12.5 mm NMAS
- 20% RAP
- $N_{des} = 60$ gyrations
- 76-22 Binder
- Aggregates:
 - ▣ Granite 78 - 26%
 - ▣ Granite 89 - 25%
 - ▣ Sand - 28%
 - ▣ BHF - 1%
 - ▣ RAP - 20%



Phase I - Balanced Mix Design Tests

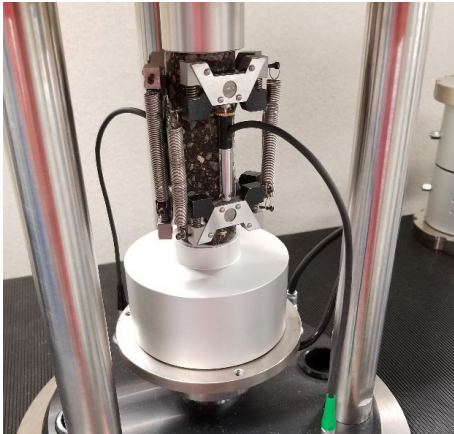


- IDEAL-CT (CT_{Index})
 - LMLC-STOA at 4hrs & 135°C
 - Test at 25°C
 - Control mix criterion: Min. $CT_{Index} = 50$

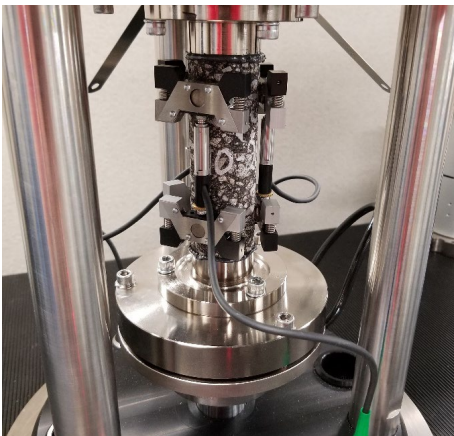


- HWTT
 - LMLC-STOA at 4hrs & 135°C
 - Test at 50°C
 - Control mix criterion: Max. rut = 12.5 mm at 20,000 passes

Phase I - Tests for Structural Evaluation



- Dynamic Modulus (E^*)
 - Small Specimen - AASHTO TP 132-19
 - Generate E^* master curves



- Cyclic Fatigue
 - Small Specimen - AASHTO TP 133-19
 - 21°C and 10 Hz
 - Generate S_{app} and FlexPAVE Inputs

Structural Analyses

- **WESLEA Layered Elastic Analyses**
 - Bottom Up Fatigue Analysis of Control Mix and Mix Containing Each Additive
 - Estimated Layer Coefficient and Equivalent Thickness
- **FlexPAVE™ Analysis**
 - Bottom Up Fatigue Analysis of Control Mix and Mix Containing Each Additive
 - Estimated Layer Coefficient and Equivalent Thickness

Selected Additives

Additive Type	Product Name or Desc.	Supplier
Control Mix	N/A	N/A
Aramid Fiber	ACE XP	SurfaceTech
Recycled Tire Rubber (Wet Process)	TB Rubber Binder	Entech
Recycled Tire Rubber (Dry Process)	SmartMIX	Liberty
Recycled Plastic (Wet Process)	LLDPE+ELVALOY RET	Dow
Recycled Plastic (Dry Process)	generic LDPE	N/A

Nest Step: Build & Evaluate Additive Group Test Sections at NCAT



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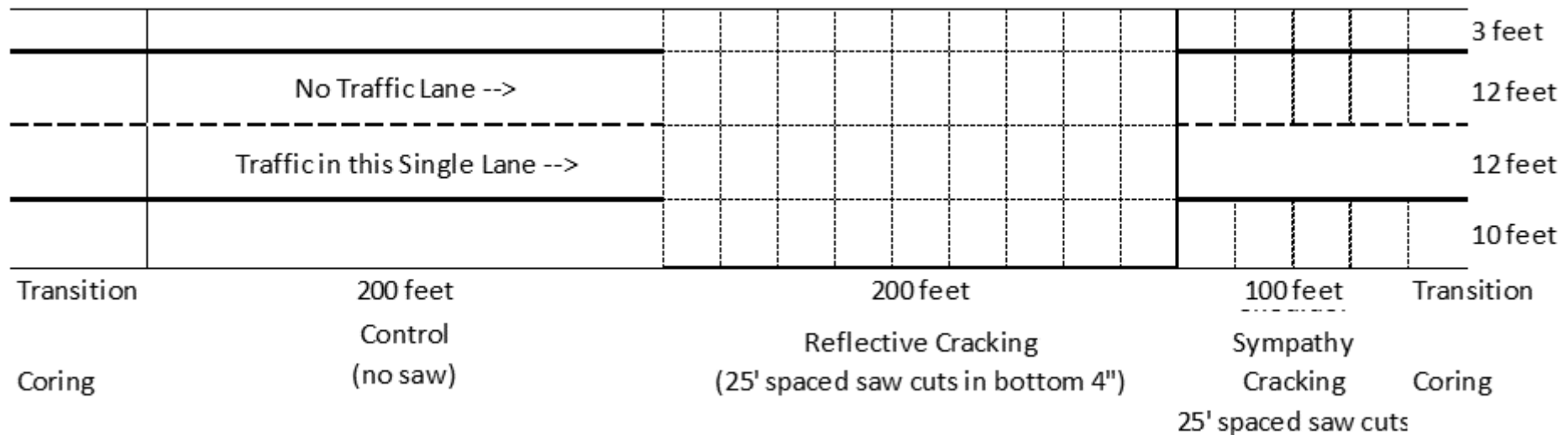
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MnROAD Additive Group Experiment Reflective Cracking (HMA/HMA) Challenge

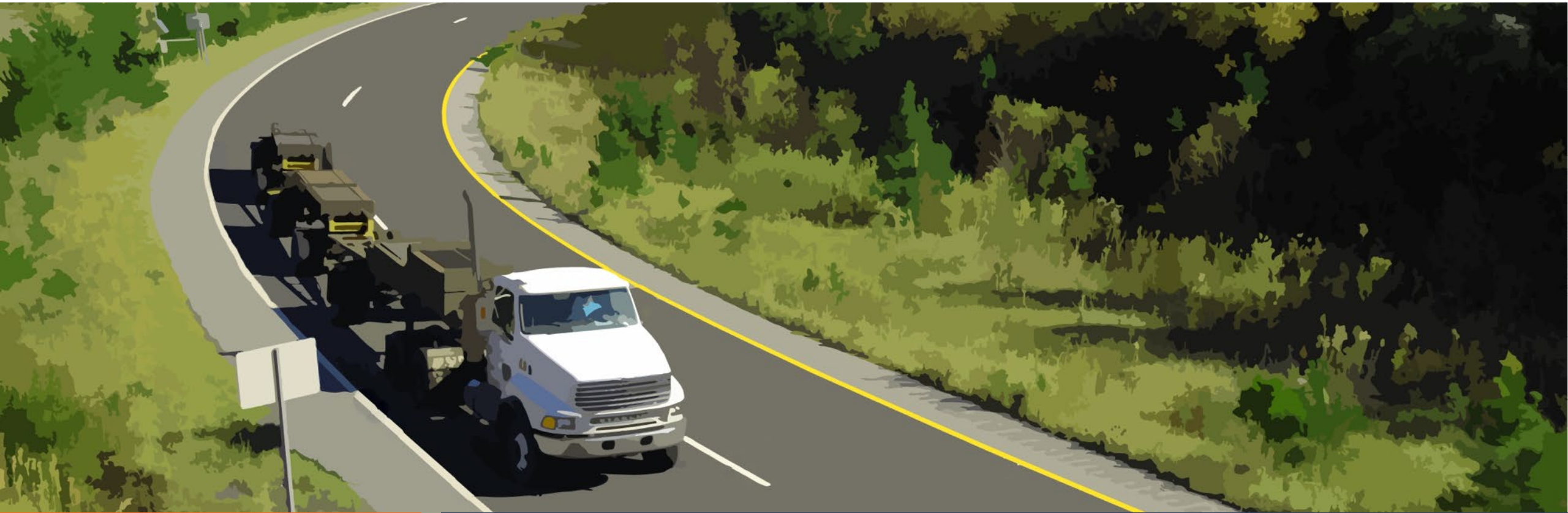
Northern Sections Layout

- Five Test Sections plus Control
- Partner with NCAT for Instrumentation, Testing and Analysis

Structure (Cells 16-23)	
2"	Mix / Treatment to test
2"	Common Mix / sawn
2"	Common Mix / sawn
12"	Existing Granular (Common Base)
12"	Existing Granular (Common Subbase)
	Clay subgrade



Questions and Answers



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