2021 Initial Idea Development

2021-2022 NRRA Research and MnROAD Construction Development

Initial Proposal is for NRRA Executive Team to Approve for further development (keep to two pages)

Short Research Title:	MnROAD Reflective Cracking Challenge
NRRA Team(s):	Flexible
Research/Synthesis:	Research
Developed By:	NRRA Flexible Team Subcommittee #1
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Expected Construction Costs:	$0 (construction funded by MnDOT)
Expected Research Cost:	**$225,000 NRRA Research**
Research Years Expected:	**4 years**
Partnerships:	**NCAT Additive Group, MCTI Sections in Missouri**

Number of Test Sections:	**10 on MnROAD I-94 Mainline, Companion sections at NCAT Test Track and Missouri**
Instrumentation Effort:	**Extensive on MnROAD**
MnROAD Monitoring:	**Each of the three group will be collecting and providing data to the university/consultant that NRRA hires to do this work**

Research Outline:

The overall objective of this research is to evaluate the field performance of hot mix asphalt (HMA) surface mixes in new construction and in reflective cracking scenarios with test sections on MnROAD I-94 Mainline. A portion of each section will have transverse saw-cuts in the lower HMA layers to simulate an asphalt over asphalt overlay that is applied to an HMA pavement with existing thermal transverse cracking. The vast majority of state agency asphalt construction is placed as an overlay or mill and inlay, thus these MnROAD sections will represent the demands placed on the HMA mixes.

An integral component of the MnROAD Reflective Cracking Challenge is the continuation of the NCAT/MnROAD partnership with the Additive Group (AG) Experiment (see separate AG 2-pager). The AG will evaluate emerging additive products that are introduced into HMA such as recycled plastics, recycled rubber, and fibers with test sections in the NRRA's reflective cracking challenge at MnROAD. The remainder of the test sections will include HMA surface mixtures that have shown good performance in previous NRRA and MnROAD studies or have high interest. Additionally, the Missouri Department of Transportation and MCTI Missouri Center for Transportation Innovation have committed funding to develop companion test sections in Missouri (see separate MCTI 2-pager).

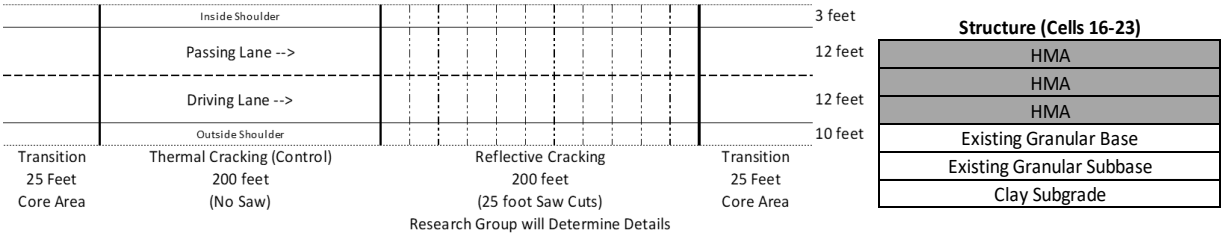
NRRA funding is being requested for a research contract to:

1. Analyze the performance of HMA mixes in new construction and overlay applications at MnROAD. Does using a polymer-modified asphalt improve overlay performance?
2. Develop a decision tool for overlay selection considering LCA.
3. Provide a better mechanistic understanding of HMA/HMA overlays for improved modeling and testing.

Additionally, at no extra cost to the NRRA, the NCAT and MCTI collaborations will provide an assessment of the impact of including recycled additives on HMA design, testing, aging, and performance.
(see accompanying 2-pagers)

Pavement Test Cell Outline:

Existing MnROAD test cells 16-23 comprise 4,700' of I-94 Mainline and will be used for the reflective cracking challenge. The length of each test section will depend on the total number of HMA mixtures in the study, but each cell will be a minimum of 400'. As shown in the figure below, 200' of the 400' will be used to evaluate reflective cracking of the surface mixture by saw-cutting the underlying HMA layers to create consistent HMA/HMA overlay scenarios to evenly evaluate the different HMA surface mixtures. "Sympathy Cracking" or transverse cracks in the shoulder may be included in the reflective cracking portion of each section.



Companion AG sections will be constructed at the NCAT Test Track and NCAT will design the HMA for the five AG sections at MnROAD. The companion sections built by MoDOT in Missouri will also investigate the performance of various HMA overlays with additives. The exact mixes included in the study and design details on each section will be researched and selected by the NRRA project Technical Advisory Panel.

NRRA Sustainability/Resiliency and or Intelligent Construction:

To improve the long-term sustainability and resiliency of national pavement systems, an effort must be made to use resources in an effective and efficient manner. A decision tree tool can achieve exactly that by providing designers and material engineers with a cost-effectiveness tool for selecting the most suitable asphalt concrete overlay given a range of initial design considerations and desired level of service. The proposed reflective cracking challenge will develop a decision tree tool for asphalt overlays on asphalt pavements that will include innovative overlay material options (especially those coming from additive group experiment), different traffic loading levels (between driving and passing lanes) and different reflective cracking mechanisms (traditional versus sympathy cracking). This project will provide a means to evaluate the viability of traditional and innovative asphalt mixtures for rehabilitation of deteriorated pavement systems while considering the life cycle cost of each option through use of the decision tree tool. Further, this study will undertake efforts to document environmental impacts (carbon footprint, cumulative energy demand) by incorporating life cycle assessment (LCA) based benchmarks to encourage sustainable practices. All MnROAD construction from this study will provide an opportunity for the intelligent construction group to utilize innovative technologies for monitoring of pavement construction, thus leveraging the effort. This project also builds upon current NRRA project on asphalt overlays over PCC pavement and plans to adopt superior performing asphalt mixtures in proposed MnROAD experiment.

Implementation Plan:

Findings, recommendations, and conclusions from this study are expected to generate an overlay decision tree tool for rehabilitation of deteriorated asphalt pavements. It is anticipated that implementation of the tool by NRRA members along with recommendations from this study will lead to savings in time, cost and resources needed to rehabilitate existing pavement systems with AC overlays while improving the serviceability of roadways for users. Further, through liaison with the additive group experiment, this study will also help in developing performance driven material selection and specifications. All mixtures for additive group will undergo a balanced mix design (BMD) evaluation.