

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

Short Research Title:	Perpetual Pavement Test Sections in Wet Freeze Climates
NRRRA Team(s):	Flexible
Research/Synthesis:	Research
Developed By:	NRRRA Flexible Team Subcommittee #2
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Research Funding Estimate:	\$150,000 WisDOT will pay construction costs for WI sections MnDOT construction funds requested for MnROAD section(s)
Research Years Expected:	4 years
Beneficial Partnerships:	WisDOT funding construction of test sections in WI
Number of Test Sections:	Two in WI; One or Two on MnROAD I-94 Mainline
Instrumentation Effort:	Extensive
MnROAD Monitoring:	WI section data collected remotely and monitored by WisDOT;

Research Outline:

The objective of this project is to provide NRRRA agency members guidance on perpetual pavement designs, a sustainable design alternative, by constructing test sections in WI and at MnROAD. Perpetual pavement (PP) design philosophy will be validated and refined with regional materials, further allowing NRRRA states to take advantage optimizing fiscal and environmental performance. This will be accomplished by instrumenting two pavement sections on I-94 near Eau Claire, Wisconsin (WI) and three sections on MnROAD I-94 mainline. It is a unique opportunity to collaborate between NRRRA agency states to share resources, further leverage WisDOT’s construction funding, and solve problems together, thus allowing for a much broader impact than working individually

WisDOT is constructing a deep strength asphalt design and a PP design section on I-94 between Northfield to Osseo, WI in 2022 or 2023. WisDOT has collaborated with MnROAD, through the NRRRA Flexible Team, to design an instrumentation array that will be embedded in the pavement structure to measure in-situ PP responses to validate and refine the latest version of PerRoad, PP Design Program.

\$60,000 of NRRRA funding is being requested for to provide instrumentation for WI and MnROAD sites. No additional construction funding is being requested for the WI sections and MnROAD’s data collection/ storage infrastructure will be used for both sites. Additionally, a \$150,000 research contract is requested to provide:

- Analysis of the instrumentation data collected from the perpetual pavement sections to validate existing (update transfer functions) and new PerRoad PP design philosophy (cumulative strain distribution).
- Laboratory testing to properly characterize HMA layers for PP design
- Comparison of conventional PP sections / PP sections built at MnROAD using recycling/reclamation techniques.

Pavement Test Cell Outline:

It is proposed that 2 test sections be built in WI and 1 section on MnROAD. *Deep Strength Asphalt* and *Perpetual Pavement (Using PerRoad)* sections will be built in WI. MnROAD cell 1 will be reconstructed using conventional construction and PerRoad PP design.

Through collaboration with the NRRRA Geotech Team, it is proposed that two MnROAD sections utilize recycling/reclamation techniques to achieve a PPs. MnROAD cells 4 and 15 will be reconstructed using recycling/reclamation techniques. There have been numerous successful PPs built using these techniques, especially in the southeastern US.

NRRRA Sustainability/Resiliency and or Intelligent Construction:

This project falls directly into the current NRRRA scope of Sustainability and Resiliency by researching pavement structures that maximize the life of the pavement materials. The link between PP and sustainability has been thoroughly investigated as the concept of PP has developed over the last 15 years (Timm 2006, Al-Qadi 2008, El-Hakim 2012, FHWA 2020).

Of particular relevance to this proposed research, is the recent work done in Iowa "*Improved Asphalt Pavement Sustainability Through Perpetual Pavement Design.*" In the report linked below, the authors use LCCA and LCA to show that perpetual pavement sections built in Iowa have better environmental performance and a lower cost than a typical HMA pavement structure. The authors also directly addressed the link between PP and resiliency: "...asphalt pavements design offers a level of resiliency for the roadway facilities on which they are used. The thicker asphalt pavement structure is resistant to moisture damage and more likely to remain serviceable after a flooding event"(FHWA-HIF-19-080) https://www.fhwa.dot.gov/pavement/sustainability/case_studies/hif19080.pdf

Referenes:

El-Hakim, Mohab Y., and Susan L. Tighe. "Sustainability of Perpetual Pavement Designs: Canadian Perspective." *Transportation research record* 2304.1 (2012): 10-16.

FHWA-HIF-19-080 Flintsch, Gerardo, Joep Meijer, and Kurt Smith. *Improved Asphalt Pavement Sustainability through Perpetual Pavement Design*. No.. United States. Federal Highway Administration. Office of Preconstruction, Construction, and Pavements, 2020.

Timm, David H., and David E. Newcomb. "Perpetual pavement design for flexible pavements in the US." *International Journal of Pavement Engineering* 7.2 (2006): 111-119.

Al-Qadi, Imad L., et al. "Dynamic analysis and in situ validation of perpetual pavement response to vehicular loading." *Transportation Research Record* 2087.1 (2008): 29-39.

Implementation Plan:

In addition to providing locally-calibrated, modern transfer functions for deep strength asphalt and perpetual pavements, the researcher will be tasked with summarizing the existing PP design procedure of each NRRRA agency member and providing each with customized improvements that could be made based off of this study.