



Transportation Synthesis Report

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Research Collaboration Opportunities: Four States' Problem Statements and Related Research

Prepared for
North Central Pavement Research Coordination Partnership

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Request for Report

Members of the North Central Pavement Research Coordination Partnership pooled fund study (Illinois, Michigan, Minnesota and Wisconsin DOTs) requested an analysis of their recent research problem statements, as well as of related research they are conducting or have completed, to identify opportunities for collaboration. Collaboration could include cooperation in drafting Requests for Proposals and work plans, joint issuance of a single RFP, reciprocal membership on technical oversight committees, sharing of interim data and conclusions, sharing of test materials, and joint presentations of findings.

Problem Statements

We reviewed 53 problem statements submitted by the partner states and categorized them by state under the four main research areas of the pooled fund, and further under 38 research topics. This categorization is preliminary, subject to closer review by the study's technical experts. See a spreadsheet of all problem statements at <http://www.frozenfour.us/docs/Combined%20Problem%20Statements%20Updated.xls>.

Table 1 highlights nine research topics (bolded) in which at least two states had prepared problem statements, offering potential opportunities for collaboration.

Table 1. Collaboration Opportunities and Problem Statements

Problem Statements	Illinois	Michigan	Minnesota	Wisconsin	Collaboration Opportunities
Flexible Pavement					5
Coarse Mixes			1	1	Yes
Damage Analysis		1	2		Yes
Friction Courses	1				No
Intelligent Compaction				1	No
Materials Characterization				1	No
Mix Characterization				1	No
Non-Destructive Examination			1		No
Overlays	2			1	Yes
Recycled Materials in Base	1		1		Yes
Recycled Materials in Pavement			1	1	Yes
Repair and Restoration			2		No

Rigid Pavement					2
Bridge Deck Preservation			2		No
Concrete Pavement Road Map				1	No
Concrete Properties	1				No
Early Opening	1				No
JPCP Repair and Damage Mitigation		1	1		Yes
M-E Design and Mix Characterization				1	No
Mix Design Innovation				1	No
Mixture Testing			1		No
Overlays and Whitetopping	1			1	Yes
Permeable Pavement			1		No
Special Design Situations			1		No
Soils/Geology/Foundations					1
Aggregate Characterization			1		No
Alternative Materials			1		No
Culverts			2		No
Embankments				1	No
Mechanistic Design of Grading			1		No
M-E Design, Materials Characterization				1	No
Pile Design and Characterization	1			1	Yes
Design/Management/Maintenance					1
Alternative Intersections	1				No
Contracting			1		No
Data Collection and Integration			1		No
Faultmeter Control			1		No
Pavement Management	1				No
Position Tracking			1		No
Preventive Maintenance		2			No
Profiling	1		1		Yes
Recreational Trails			1		No
Totals	11	4	25	13	9

Completed and In-Progress Research

We reviewed completed and in-progress research projects of the four partners to identify those related to the nine research topics identified in Table 1. See spreadsheets of all projects for the main research areas at the following links:

- Flexible Pavement: <http://www.frozenfour.us/docs/Flexible%209-22-06.xls>
- Rigid Pavement: <http://www.frozenfour.us/docs/Rigid%209-22-06.xls>
- Soils, Geology and Foundations: <http://www.frozenfour.us/docs/Soils%209-22-06.xls>
- Pavement Design, Management and Maintenance: <http://www.frozenfour.us/docs/Design%209-22-06.xls>

We found 58 projects related to seven of the nine research topics. Table 2 highlights five research topics (bolded) that have been addressed by three or four partners and are the subject of problem statements from two of the four. These five topics could be considered priority opportunities for collaboration.

Table 2. Collaboration Opportunities, Problem Statements and Related Research

Research Topics With Collaboration Opportunities	Problem Statements From Two or More States				Related Research Projects			
	Ill.	Mich.	Minn.	Wis.	Ill.	Mich.	Minn.	Wis.
Flexible – Coarse Mixes			1	1				
Flexible – Damage Analysis		1	2		1	1	7	1
Flexible – Overlays	2			1	1	2	3	3
Flexible – Recycled Materials in Base	1		1		1	2	2	4
Flexible – Recycled Materials in Pavement			1	1	3		8	
Rigid – JPCP Repair & Damage Mitigation		1	1			2	1	1
Rigid – Overlays and Whitetopping	1			1	5		8	1
Soils – Pile Design and Characterization	1			1				
Design – Profiling	1		1				1	
Totals	6	2	7	5	11	7	30	10

Titles of Problem Statements and Related Research Projects

Flexible – Coarse Mixes

- Problem Statements – 2
 - MN: Permeable Pavements in Cold Regions Longevity and Best Maintenance Practices
 - WI: Coarse Graded Mix Design

Flexible – Damage Analysis

- Problem Statements – 3
 - MI: Development of a General Forensic Process for Finding Causes for Pavement Distress
 - MN: Ultrasonic Evaluation of Top-Down Cracks in Asphalt Pavements
 - MN: Development and Field Validation of Energy-Based Criterion for the Cracking Performance of HMA
- Research Projects – 10
 - IL: Nondestructive Pavement Evaluation Using ILLI-PAVE Based Artificial Neural Network Models
 - MI: Identification of the Causes of Top-Down Cracking of Flexible Pavements
 - MN: Low Temperature Cracking of Asphalt Concrete Pavements
 - MN: Report to Mn/DOT Investigation Into the Low Temperature and Fatigue Properties of Three MnROAD Bituminous Mixtures
 - MN: INV 816: Low Temperature Cracking of Flexible Pavement Due to Thermal Fatigue and Combined Effects Temp/Load
 - MN: INV 739: Low Temperature Cracking of Asphalt Concrete Pavements
 - MN: INV 764: Investigation of Factors Related to Surface-Initiated Cracks in Flexible Pavements
 - MN: Investigation of Low Temperature Cracking in Asphalt Pavements - Pooled Fund Study (TPF-5(080)) & MNRD TWR26
 - MN: Low Temp Cracking in Asphalt Phase II
 - WI: Non-Nuclear Density Testing Devices and System to Measure In-Place Asphalt Pavement Density

Flexible – Overlays

- Problem Statements – 3
 - IL: Performance of HMA Overlays in Illinois
 - IL: Development of Artificial Neural Network Based Structural Analysis and Nondestructive Evaluation Tools for Asphalt Overlays Constructed Over Rubblized Concrete Pavements
 - WI: Pre Overlay Repair of Existing Asphaltic Pavements

- Research Projects – 8
 - IL: Overlay/Evaluation of Tack and Bond of HMA Overlays of PCC
 - MI: Identify Causes for Under Performing Rubblized Concrete Pavement, Phase II (listed on the Design/Management/Maintenance spreadsheet on the Frozen Four Web site; see page 2 of this TSR for links to all project spreadsheets)
 - MI: Identify Causes for Under Performing Rubblized Concrete Pavement, Phase I (on the Design/Management/Maintenance project list)
 - MN: INV 703: Surface Preparation Prior to Overlay
 - MN: INV 802: Performance of Pavement Crack Sealants Beneath Bituminous Overlays
 - MN: INV 843: Predicting the Occurrence of Bumps in Overlays
 - WI: Guidelines for the Surface Preparation/Rehab of Existing Concrete and Asphaltic Pavements Prior to an Asphaltic Concrete Overlay
 - WI: Development of Rational Overlay Design Procedures for Flexible Pavements
 - WI: Guidance, Parameters and Recommendations for Rubblized Pavements

Flexible – Recycled Materials in Base

- Problem Statements – 2
 - IL: Expansive Characteristics of Recycled Materials Used as Pavement Base Materials
 - MN: Use of Foamed Asphalt Base Reclamation in Urban Areas of Minnesota
- Research Projects – 9
 - IL: Utilization of Recycled Materials in Illinois Highway Construction (on the Design/Management/Maintenance project list)
 - MI: Identify Causes for Under Performing Rubblized Concrete Pavement, Phase II (on the Design/Management/Maintenance project list)
 - MI: Identify Causes for Under Performing Rubblized Concrete Pavement, Phase I (on the Design/Management/Maintenance project list)
 - MN: Resilient Modulus Development for Materials Containing Recycled Bituminous and Concrete for 2002 Design Guide and Mn/PAVE Pavement Design (on the Design/Management/Maintenance project list)
 - MN: Recycled Unbound Pavement Materials (on the Soils project list)
 - WI: Guidance, Parameters and Recommendations for Rubblized Pavements
 - WI: Field Performance of Subbases Constructed with Industrial Byproducts (on the Soils project list)
 - WI: Development of Methodology to Include Strength Contribution of Select Subgrade Materials in Pavement Structures (on the Soils project list)
 - WI: Implementation of Research on Development of Methodology to Include Strength Contribution of Select Subgrade Materials in Pavement Structures (on the Soils project list)

Flexible – Recycled Materials in Pavement

- Problem Statements – 2
 - MN: Incorporation of Roofing Shingles into HMA Mixes
 - WI: Increased use of RAP/Other Recycled Materials in Asphalt Mixtures
- Research Projects – 11
 - IL: Determination of Usable Residual Asphalt Binder in RAP
 - IL: Detection of Recycled Asphalt Pavement (RAP) in Bituminous Mix
 - IL: Cold-in-Place Recycling and Full-Depth Recycling
 - MN: INV 783: Development of Simple Asphalt Test for Determination of RAP Blending Chart
 - MN: INV 788: Recycled Asphalt Pavement (RAP) Effects on Binder and Mixture Quality aka Investigation of Recycled Asphalt Pavement (RAP) Mixtures
 - MN: Cold In-Place Recycling Literature Review
 - MN: Cold In-Place Recycling
 - MN: INV 766: Evaluation of Cold In Place Recycling
 - MN: INV 742: Materials Evaluation and Mix Design Procedures for Cold In-Place Recycling of Asphalt Pavements aka Cold In-Place Recycling Literature Review (on the Soils project list)
 - MN: INV 826: Appropriate Use of RAP
 - MN: Recycled Asphalt Pavements

Rigid – Jointed Plain Concrete Pavement Repair and Damage Mitigation

- Problem Statements – 2
 - MI: Rehabilitation and Preventive Maintenance Treatments for Jointed Plain Concrete Pavement
 - MN: A Study of the Susceptibility of Jointed Plain Dowelled and Undowelled Concrete Pavements and Curbs to Blow-Ups and Investigation of Practicable Mitigation
- Research Projects – 4
 - MI: Transverse Crack Propagation of JPCP as Related to PCC Toughness
 - MI: Investigation of Early Cracking on Selected JPCP Projects
 - MN: Factors Affecting Shear Capacity of Transverse Cracks in Jointed Pavement
 - WI: Analysis of Concrete Pavement Joints to Predict the Onset of Distress

Rigid – Overlays and Whitetopping

- Problem Statements – 2
 - IL: Guidelines for Design and Material Performance of Unbonded Concrete Overlay Systems
 - WI: Whitetopping Performance Assessment in Wisconsin
- Research Projects – 14
 - IL: Performance of an Unbonded Concrete Overlay on I-74 (on the Design/Management/Maintenance project list)
 - IL: Evaluation of UTW and Whitetopping Procedure (on the Design/Management/Maintenance project list)
 - IL: Whitetopping Performance in Illinois
 - IL: Whitetopping Construction and Early Performance in Illinois
 - IL: Bonded Concrete Overlay Performance in Illinois
 - MN: The Construction and Performance of Ultra-Thin Whitetopping Intersections on US-169
 - MN: The Construction and Performance of Ultra-Thin Whitetopping Intersections on US-169, Final Report State Project Report 7106-60
 - MN: The Measured Response of Ultra-Thin and Thin Whitetopping to Environmental Loads
 - MN: One Year Performance Summary of Whitetopping Test Sections at the MnROAD Test Facility
 - MN: The Construction of US-169 and I-94 Experimental Thin and Ultra-Thin Whitetopping Sections in Minnesota
 - MN: Whitetopping Construction and Instrumentation at Mn/ROAD aka Forensic Investigation Report for MnROAD Ultrathin Whitetopping Test Cells 93, 94 and 95
 - MN: Performance, Analysis and Repair of Ultra-Thin and Thin Whitetopping at MnROAD
 - MN: INV 748: Cost and Performance Evaluation of Ultrathin Pavements on High Volume Intersections
 - WI: Portland Cement Concrete (PCC) Pavement over Rubblized PCC

Soils – Pile Design and Characteristics

- Problem Statements – 2
 - IL: Evaluation and Modification of IDOT Foundation Piling Design and Construction Policy
 - WI: Downdrag on Piles

Design – Profiling

- Problem Statements – 2
 - IL: Annual Profile Equipment Verification (PEV) Program
 - MN: FWD and GPR Evaluation of Pavement Profiles
- Research Projects – 1
 - MN: APA Rut Testing Evaluation aka Asphalt Pavement Analyzer (APA) Evaluation