



**Wisconsin Department of Transportation
Wisconsin Highway Research Program**

Request for Proposals

Investigation of Reflective Cracking in Wisconsin

Questions submitted to research@dot.wi.gov regarding the content of this RFP are due no later than 04:30 PM (CST) on January 4, 2024

Responses to questions will be posted to the WisDOT Research and Library website <http://wisdotresearch.wi.gov/rfps-and-proposals> by 04:30 PM (CST) on January 19, 2024

Proposers must submit a PDF version of their proposal by 4:30 PM (CST) on February 9, 2024 to research@dot.wi.gov.

Proposal Preparation Guidelines can be found at the Proposal Preparation Guidelines at <https://wisconsin.dot.gov/Pages/about-wisdot/research/researchers.aspx>

Proposers will be notified by April 26, 2024

For more information regarding this RFP, contact the WisDOT Research Program at research@dot.wi.gov.

This RFP has been posted to the Internet at: <http://wisdotresearch.wi.gov/rfps-and-proposals>

Wisconsin Highway Research Program (WHRP)
Flexible Pavement Technical Oversight Committee (TOC)
Request for Proposals

Investigation of Reflective Cracking in Wisconsin

I. Background and Problem Statement

Asphalt overlays are an efficient rehabilitation tool used by the Wisconsin Department of Transportation (WisDOT) to increase structural capacity and restore the functionality of pavements. WisDOT utilizes overlays in several distinct design scenarios, including over existing Portland Cement Concrete (PCC) pavement, existing asphaltic surfaces, and composite pavements that may have been overlaid previously. All overlay mixtures in Wisconsin are designed according to the standard hot mix asphalt design process outlined in the WisDOT Construction and Materials Manual, Section 866: Asphalt Mixture Design. Despite their widespread use and utility, reflective cracking of overlays, in all design scenarios, is a significant challenge for WisDOT engineers.

Recent efforts by WisDOT and WHRP to pilot a “Balanced Mixture Design (BMD)” approach for standard paving practice have resulted in a special provision that specifies minimum mixture performance requirements during the design phase to ensure field performance. Different performance thresholds are suggested in the special provision for standard dense-graded mixtures and Stone Mastic Asphalt (SMA) mixtures (Table 1); however, mixtures designed for asphalt overlays are not directly addressed. Therefore, a performance-driven approach is needed to determine mixture design requirements that optimize and improve the performance of asphalt overlay mixtures in Wisconsin. In particular, WisDOT is concerned with addressing issues related to reflective cracking resistance while not sacrificing other important performance or constructability attributes, such as rutting resistance and smoothness.

Table 1: BMD “Approach A” Criteria Included in WisDOT’s Special Provision

Mixture Type	LT	MT	HT	SMA
HWTT* (AASHTO T 324 as modified in CMM 836.6.10.1)				
Corrected Rut Depth @ 20,000 Passes (mm)	≤ 12.0	≤ 7.5	≤ 5.0	≤ 4.0
Stripping Number (LC _{SN})	≥ 3,000	≥ 3,000	≥ 3,000	≥ 3,000
IDEAL-CT* (ASTM D8225 as modified in CMM 836.6.10.2)				
CT-Index	≥ 30	≥ 30	≥ 30	≥ 80

*Note: HWTT and IDEAL-CT are the abbreviated forms of, respectively, Hamburg wheel tracking test and indirect tension asphalt cracking test.

II. Research Objectives

This research aims to determine mixture performance and mix design requirements that increase the resistance of asphalt overlays to reflective cracking in Wisconsin. Recommendations must not sacrifice other critical performance or constructability

attributes, such as rutting resistance and smoothness. Research efforts should focus on mill and overlay and overlay over existing PCC design scenarios. A secondary research objective is to identify process-driven methods to increase overlay performance for consideration by WisDOT in future WHRP studies or as pilot projects. The research will address the following specific objectives at a minimum:

- Summarize existing mix design and performance requirements for asphalt overlays used by local and State Agencies in regions with similar climatic and aggregate resources as Wisconsin. The focus should be on design methods and performance requirements that have been successfully implemented and have demonstrable efficacy for reducing reflective cracking.
- Identify and recommend process-driven methods and technologies that show promise in reducing reflective cracking in Wisconsin. Examples might include the use of underseals and geotextiles, among others. These methods are not expected to be included in the laboratory testing plan; however, they must be identified for future consideration.
- Using existing WisDOT mixtures as a benchmark, modify or supplement the existing WisDOT BMD special provision focusing on BMD “Approach C”¹ for mixtures designated for asphalt overlays.
- Provide WisDOT with recommendations and requirements to establish/validate the performance criteria for asphalt overlays. These recommendations and criteria include, but are not limited to:
 - BMD “Approach C” criteria for testing the HMA mechanical performance that will be included in WisDOT’s quality assurance (QA) program.
 - A recommendation for a minimum number of projects and sampling requirements for field validation of the BMD “Approach C” criteria.

Researchers are expected to use a combination of laboratory-reproduced mix designs and construction/in-service performance data to complete this study. Researchers are encouraged to consider the cost of design change recommendations, but the development of a life cycle cost analysis is outside the scope of this study. In addition, researchers should not focus on mechanistic analysis or modeling of overlays.

Based on the outcomes of this research, proposed changes to the criteria of existing WisDOT BMD special provision will be suggested for overlay mixtures. It is worth emphasizing that the criteria provided in Table 1 are based on BMD “Approach A,” but the future recommendations will be based on BMD “Approach C.” The research team will provide requirements for validating the modified BMD provision for long-term evaluation.

III. Scope of Work

Task 1: Synthesis of Agency Practice and Landmark Research

¹ <https://www.asphaltpavement.org/expertise/engineering/resources/bmd-resource-guide/balanced-mix-design-approaches>

Researchers will summarize relevant local and State practices concerning asphalt overlays and reflective cracking resistance, focusing on regions with similar climate, traffic, and aggregate resources as Wisconsin. The research team is also encouraged to review advancements made by other countries, including Canada. Ongoing and published academic research should be considered, but primary consideration must be given to (a) feasibility of implementation and (b) proven effectiveness of proposed approaches. Review and consideration of outcomes from prior WHRP projects should be considered when formulating this work plan. Researchers are advised that WisDOT is a member of the National Road Research Alliance (NRR) pooled fund with two ongoing activities focused on reflective cracking. Overlap with the scope of these projects should be avoided.

- “Continued Monitoring of Original I-94 Westbound Asphalt Overlay Sections and Use of Cracking and Performance Data MRCC Project”
(<https://www.dot.state.mn.us/mnroad/nrra/structure-teams/flexible/i94-monitoring-mrcc-data.html>)
- “MnROAD HMA Reflective Cracking Challenge”
(<https://www.dot.state.mn.us/mnroad/nrra/structure-teams/flexible/reflective-cracking-challenge.html>)

Task 2: Identification of Process-Driven Methods to Reduce Reflective Cracking

Identify potential process-driven methods and technologies to improve reflective cracking resistance for recommendation as future WisDOT research. Researchers are encouraged to review international practice and literature focusing on cold regions subjected to freeze-thaw to identify prospective methods. When applicable, researchers should include general costs and potential barriers to implementation in Wisconsin for each method identified. Examples of process-driven methods include underseals (e.g., “Texas underseal”) and use of geotextiles or geofabrics.

Task 3: Develop BMD Approach C Framework for Asphalt Overlays

The research team will propose a comprehensive work plan to the Project Oversight Committee (POC). This plan will include sampling raw mixture design materials, sampling field/plant loose mixtures, and/or delivery of performance databases as approved. Using the existing WisDOT BMD special provision as guidance (Table 1), researchers will preferentially modify or supplement the provision using BMD “Approach C” to reduce the reflective cracking of asphalt overlays.

Researchers will coordinate the sampling of materials with WisDOT staff and contractors. POC members will help with the logistics of sample collection and shipment of materials. However, the research team must include costs associated with shipping in the research budget.

Mixture performance testing methods not currently used in the BMD framework could be considered to assess performance. However, the research team should consider WisDOT’s ability to conduct the selected tests for verification purposes. One example of such a test is the Texas Overlay Tester. An alternative approach is to use the currently specified methods (e.g., IDEAL-CT) as a surrogate for reflective cracking via correlation to more predictive

methods such as the overlay tester. Researchers are tasked with identifying which, if any, current WisDOT mixture design requirements (e.g., volumetric parameters, aggregate consensus property, etc.) may be relaxed to allow for higher-performing overlay mixtures following BMD “Approach C.” Researchers will also consider variables that impact reflective cracking performance, such as thermal loading, overlay thickness, layer density, virgin asphalt binder properties, and use of recycled materials. Consideration must be given to Wisconsin's general climate and aggregate resources.

The outcome of this task is a proposed mix design and BMD “Approach C” framework for asphalt overlays in Wisconsin to resist reflective cracking.

Task 4: Develop Recommendations for Validation of Proposed BMD Framework

The research team is expected to develop recommendations and requirements to validate the BMD framework developed in prior tasks. Recommendations should consider a minimum number of projects, mix design designations (such as traffic level), project scope and size, and requirements for mixture sampling and data acquisition, among other variables. Researchers are advised to review prior and ongoing efforts to pilot and implement BMD processes in Wisconsin and use the findings of those efforts to develop recommendations. Researchers are not expected to support or conduct field testing for validation; this task aims to provide a framework and “roadmap” for implementing the proposed BMD specification.

Task 5: Final Report and Deliverables

A final report is expected to be submitted that includes the agency and literature review, experimental design, analysis of test results, recommendations for pilot project construction, and suggestions for WisDOT BMD provisional specification improvement, including relevant changes to CMM Section 866 and Standard Specification (SS) Section 460. Any significant changes to standard practice should be clearly articulated so that contractors, mix designers, and agency personnel can use this information for implementation.

Task 6: Closeout Presentation

The WHRP will schedule a closeout presentation (COP) summarizing the principal findings of the research within three months before the end of the contract. The research team's Principal Investigator is expected to present the results and recommendations from the project.

Task 7: Data Management Plan

The research team will include a Data Management Plan (DMP) documenting all field/laboratory data and analyses to ensure accessibility and transparency of research data as required by the USDOT per the Public Access Plan (<https://ntl.bts.gov/ntl/public-access/creating-data-management-plans-extramural-research>). The DMP will include the following items:

- The final research data produced during the project.

- The standards to be used for data and metadata format and content.
- Policies for accessing and sharing the final research data, including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, and other rights or requirements.
- Policies and provisions for re-use, re-distribution, and the production of derivatives.
- Plans for archiving final research data and other research products and preserving access to them.

IV. Required Testing/Equipment

This study will include the fabrication and testing of laboratory-produced asphalt mixtures and loose HMA sampled from the field/plant. *Minimum* mixture performance testing must consist of the following:

1. HWTT
2. IDEAL-CT

Any additional cracking test methods proposed by the research team should prioritize the availability of testing devices/apparatuses, availability of a standard process (e.g., AASHTO/ASTM), and implementation status in other regions (preference given to methods that have been successfully implemented). Although existing mix designs may be provided, the research team is expected to have the necessary equipment and competency to produce HMA mixture designs according to WisDOT Construction and Materials Manual (CMM) Section 866 and comply with WisDOT SS Section 460.

AASHTO R18 or similar laboratory accreditation is desirable but not required.

V. WisDOT/TOC Contribution

WisDOT will provide the following support through the POC to support the successful completion of the project.

- A. The POC will work with the research team to ship materials. Please budget to cover shipment costs.
- B. The research team will not assume the availability of WisDOT staff or equipment in the proposal. If WisDOT or another entity donates equipment or staff time, a commitment letter must be included in the proposal.
- C. The TOC and POC will coordinate access to WisDOT aggregates used in laboratory test programs. The research team must arrange and cover the transport of aggregates and materials to their laboratory test facilities as needed. The TOC and POC will also coordinate access to WisDOT databases as requested and approved, including performance testing, field density, and in-service performance databases.
- D. If fieldwork on or around in-service facilities is anticipated, the proposal will describe the nature and extent of traffic control and support assistance required. The research team will coordinate with WisDOT regional personnel and possibly the county personnel where project fieldwork is being conducted. For WisDOT planning purposes, the research team shall specify in the proposal, as practical, traffic control measures for this

project, including traffic flagging, signage, barricades, etc., and the duration (hours/day/location). WisDOT will not fund the traffic control apart from the research project budget.

VI. Required for Travel to Fulfill TOC Obligations

None; however, the principal investigator will deliver the final presentation during the last three months of the project.

VII. Deliverables

- A. Quarterly Progress Reports
 - a. WHRP contracts require quarterly technical progress reports for technical and administrative functions.
 - b. Detailed information regarding the content of the progress report can be found at [Quarterly Progress Reports Guidelines](#)
- B. Invoices
 - a. Invoices shall be submitted quarterly for partial payments on the project for authorized services completed to date. Four invoices per year are expected, one partial invoice for each specified quarter.
 - b. Detailed information regarding invoicing can be found at [Invoicing Requirements](#)
- C. Before Close-Out Presentation (BCOP) Report
 - a. A BCOP report must be submitted three months before the contract end date to allow time to review and revise the BCOP before the presentation.
 - b. Reports are expected to have quality technical writing and proper grammar. It is acceptable to dedicate funds in the project budget for the services of a technical editor to ensure these requirements are met.
 - c. The required elements of the BCOP report can be found at [Before Closeout Presentation Requirements](#)
- D. Project Closeout Presentation (COP)
 - a. The Principal Investigator on the research team is required to give a presentation to the TOC.
 - b. Presentation and formatting requirements can be found at [Closeout Presentation Requirements](#)
- E. After Closeout Presentation (ACOP) Report
 - a. The ACOP report is due within three weeks of the Closeout Presentation for review and comments.
 - b. This report details the results of the research project. The final report should be as concise as possible (e.g., a maximum of 50 pages plus supporting appendices) and follow the report guidelines and submission requirements: [After Close-Out Presentation Report Requirements](#)
 - c. After revision(s) and oversight committee chair approval, an electronic copy of the Publication-Ready Report must be delivered to WisDOT by the contract end date.

VIII. Schedule and Budget

- A. Project budget shall not exceed \$250,000
- B. Proposed project duration is 24 months, starting around 10/01/2024
- C. The deadline for submittal of the BCOP is three months before the contract end date to allow for report review activities.

IX. Implementation

The research proposal must include an implementation plan based on the study's findings. At a minimum, the implementation plan must include:

- A. Summarize proposed changes to the WisDOT BMD special provision and any relevant changes to the WisDOT Standard Specification Section 460 and CMM Section 866. These changes should be summarized either in tabular or red-line format for ease of review and comparison.
- B. All relevant project data must be summarized in a user-friendly database that supports the proposed changes to the specification. Excel is an acceptable format for such information.
- C. If applicable, produce a technical memo or similar intended for mix designers that concisely summarizes the proposed changes to the mix design standard process.