



# WHRP

## Wisconsin Department of Transportation Wisconsin Highway Research Program

### Request for Proposals

### ***Benchmarking Delta Tc ( $\Delta T_c$ ) for Wisconsin Materials***

Questions submitted to [research@dot.wi.gov](mailto:research@dot.wi.gov) regarding the content of this RFP are due no later than 4:30 PM (CST) on January 3, 2022

Responses to questions will be posted to the WisDOT Research and Library website <https://wisconsindot.gov/Pages/about-wisdot/research/researchers.aspx> by 4:30 PM (CST) on January 14, 2022

Proposers must submit a PDF version of their proposal by 4:30 PM (CST) on February 4, 2022 to [research@dot.wi.gov](mailto:research@dot.wi.gov).

Proposal Preparation Guidelines can be found at [Proposal Preparation Guidelines](#)

Proposers will be notified by April 29, 2022

For more information regarding this RFP contact the WisDOT Research Program at [research@dot.wi.gov](mailto:research@dot.wi.gov).

This RFP has been posted to the Internet at: <https://wisconsindot.gov/Pages/about-wisdot/research/researchers.aspx>

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

***Benchmarking Delta Tc ( $\Delta T_c$ ) for Wisconsin Materials***

**I. Background and Problem Statement**

The use of rejuvenating oils and recycled materials in asphalt mixtures continues to increase. Using rejuvenating oils and recycled materials helps in adding pavement life while also improving sustainability. However, improper usage of these materials can lead to early onset of non-load-related cracking; caused by accelerated aging of asphalt pavement surface layers. In response to this problem, asphalt technologists developed the  $\Delta T_c$  parameter to help predict the non-load-related cracking susceptibility of asphalt binders. The  $\Delta T_c$  parameter is determined using the Bending Beam Rheometer (BBR) test that measures two parameters: creep stiffness (S) and stress relaxation (m). The critical low temperatures are determined using these two parameters at 60 seconds of loading time, and the difference between these temperatures is the  $\Delta T_c$  parameter. National and local researchers showed the efficacy of  $\Delta T_c$  and suggested its implementation into transportation agencies' specifications. The proposed research project would apply the past research concepts to Wisconsin materials.

A recently completed WHRP project (0092-19-04) titled *Recycled Asphalt Binder Study* successfully used the  $\Delta T_c$  parameter to evaluate the cracking susceptibility of high recycle mixtures. Researchers were able to correlate  $\Delta T_c$  with chemical properties after aging, show that mixtures with high recycle contents tend to have lower  $\Delta T_c$  values, and provided a step-by-step procedure to offset the negative impacts of high recycle mixtures using recycling agents. Despite the encouraging results, the researchers in that study tested just a limited set of materials. Measurement of a range of Wisconsin asphalt binder (recycled and virgin) properties is desirable before implementation in State specifications.

The proposed benchmarking study is needed to characterize a range of Wisconsin asphalt binders using  $\Delta T_c$ , where mixtures containing different levels of recycled materials should be included. In addition, the study should compare results of the benchmarking against national thresholds for non-load-related cracking and past WisDOT research. If this study verifies the past research recommendations, WisDOT would confidently implement  $\Delta T_c$  into State specifications for accepting asphalt materials.

**II. Research Objectives**

- A. Evaluate the use of the  $\Delta T_c$  parameter to help predict the non-load-related cracking susceptibility of Wisconsin asphalt mixtures, including recycled asphalt binders and rejuvenators.
- B. Use past research to standardize, validate, and recommend an aging procedure prior to measurement of  $\Delta T_c$ .

- C. Compare the benchmarking study results against  $\Delta T_c$  thresholds recommended by past researchers to determine the risk of early non-load related cracking in Wisconsin.
- D. If needed, recommend a plan for implementing  $\Delta T_c$  as a preferred performance measure for cracking susceptibility into WisDOT specifications.

### III. Scope of Work

#### Task 1: Extensive Literature Review and State of Practice

Perform a critical literature review of asphalt binder testing research related to non-load related cracking such as  $\Delta T_c$ ,  $\Delta T_f$ , Glover-Rowe, 4-mm plate dynamic shear rheometer (DSR) testing, and other relevant tests for evaluating the non-load-related cracking susceptibility. The literature review should also consider how the sample preparation process impacts the outcome of resultant binder testing. In particular, WisDOT is interested in documenting how extraction and recovery procedures introduce variability to asphalt binder results.

Refer to the following projects:

- WHRP Study 0092-10-06 Effect of Recovered Binders from Recycled Shingles and Increased RAP Percentages on Resultant Binder PG  
(<https://www.wistatedocuments.org/digital/collection/p267601coll4/search/searchterm/785834554/field/dmoclcn0>)
- WHRP Study 0092-16-02 Asphalt Binder Extraction Protocol for Determining Amount & PG Characteristics of Binders Recovered from Asphalt Mixtures  
(<https://wisconsin.gov/documents2/research/0092-16-02-final-report.pdf>)
- WHRP study 0092-19-04 Recycled Asphalt Binder Study  
(<https://wisconsin.gov/documents2/research/0092-19-04-final-report.pdf>)
- NCHRP 09-58 The Effects of Recycling Agents on Asphalt Mixtures with High RAS and RAP Binder Ratios  
(<https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3645>)
- NCHRP 09-59 Relating Asphalt Binder Fatigue Properties to Asphalt Mixture Fatigue Performance  
(<https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3862>)
- NCHRP 09-60 Addressing Impacts of Changes in Asphalt Binder Formulation and Manufacture on Pavement Performance through Changes in Asphalt Binder Specifications  
(<https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4036>)

#### Task 2: Selection of Materials and Design of Experiment

Propose a sampling and testing method for a range of asphalt binder materials used on Wisconsin construction projects. Materials and test methods should be selected to target non-load-related cracking susceptibility of asphalt binders. Consider the following factors when selecting material to be tested:

- Virgin asphalt binder suppliers – there are multiple approved asphalt binder suppliers in the state. See Wisconsin approved suppliers on the combined state binder group's latest Method of Acceptance document:

<https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrcs/tools/qmp/csbq-policy-2020.pdf>

- Recycled asphalt binder source – part 460 of WisDOT standard specifications describe the current policies on asphalt binder recycling. Any contractor can include a prescribed amount of recycled asphalt depending on the mixture type. Both recycled asphalt pavement and shingles are allowed (<https://wisconsindot.gov/rdwy/stnds/spec/ss-04-60.pdf>).
- Recycled asphalt binder processing – asphalt is recycled as millings from an existing roadway or stockpiled and blended at the plant location.
- Project location – Wisconsin has two climactic zones for PG grading. The Northern half of the state requires PG58-34 binders, while the Southern half of the state requires PG58-28.

An ideal experimental plan would test enough materials to represent possible asphalt materials used in Wisconsin. WisDOT is primarily interested in the measurement of  $\Delta T_c$ , but understands that other test methods may be needed to characterize non-load-related cracking properties of asphalt materials adequately. Therefore, the experimental plan will be reviewed and approved by the Project Oversight Committee (POC).

### **Task 3: Sampling of Materials**

Coordinate the sampling of materials with WisDOT staff and contractors. POC members will help researchers with the logistics of sample collection and shipment of materials. Include costs associated with shipping in the research budget.

### **Task 4: Conduct Approved Experimental Plan**

Carry out experiment reviewed and approved by POC.

### **Task 5: Final Report**

Submit a final report that includes a literature review, experimental design, analysis of test results, and suggestions for WisDOT specification improvement. Recommendations that include the procurement of new equipment or additional labor should summarize how the additional effort will impact testing laboratories.

### **Task 6: Closeout Presentation**

The WHP will schedule a closeout presentation (COP) in Madison, WI, within three months before the end of the contract. The principal investigator is expected to present the results and recommendations from the project.

## **IV. Required Testing/Equipment**

1. Bending Beam Rheometer (BBR)
2. Pressure Aging Vessel (PAV)
3. Rolling Thin Film Oven (RTFO)
4. Equipment to extract and recover asphalt binder
5. *Optional but may be needed:* Dynamic Shear Rheometer (DSR)

## **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 on the shipment of 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 Technical Oversight Committee (TOC) and POC will coordinate access to WisDOT aggregates used in laboratory test programs. In addition, the research team must arrange and cover the transport of aggregates and materials to their laboratory test facilities as needed.
- 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**

The principal investigator will deliver the final presentation during the last three months of the project.

## **VII. Deliverables**

- A. Quarterly Progress Reports
  - a. WHP contracts require quarterly technical progress reports that serve both 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 is required to be submitted three months before the contract end date to allow time for review and revision of 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 \$175,000
- B. Proposed project duration is 24 months, starting around 10/01/2022
- C. Deadline for submittal of the BCOP is three months before the contract end date to allow for report review activities.

#### **IX. Implementation**

- A. Summarize the expected range of non-load-related cracking potential for a representative set of asphalt binders used on Wisconsin construction projects (recycled and virgin asphalt binders).
- B. Build on past research to recommend/refine specifications for acceptance of asphalt binders to prevent non-load-related cracking, if needed.