



**Wisconsin Department of Transportation  
Wisconsin Highway Research Program  
Request for Proposals**

***Proactive Prevention of Pavement Buckling***

Questions submitted to [research@dot.wi.gov](mailto:research@dot.wi.gov) regarding the content of this RFP are due no later than 04:30 PM (CST) on January 3, 2023

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 18, 2023

Proposers must submit a PDF version of their proposal by 4:30 PM (CST) on February 8, 2023 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 28, 2023

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: <http://wisdotresearch.wi.gov/rfps-and-proposals>

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

***Proactive Prevention of Pavement Buckling***

**I. Background and Problem Statement**

In recent years, Wisconsin has experienced a significant increase in concrete pavement buckling. Some of the causes for this distress were identified and investigated in the WHRP [0093-20-02](#) “Evaluation of Concrete Pavement Buckling in Wisconsin” study that provided recommendations for reducing buckling risk. Wisconsin Department of Transportation (WisDOT) expects the proposing research team to incorporate the findings obtained from that study and consider the loss of climate stationarity for developing a mechanistic model for predicting concrete pavement buckling. Extreme heat is one of the climate variables that has been suggested as a non-stationary environmental variable. Extreme temperatures, associated with heat waves, have created a steady increase in annual mean and high temperatures. These conditions trigger more significant slab expansions, influencing the occurrences of buckling.

The research team will develop a model that will be used to (1) evaluate buckling vulnerability throughout the WisDOT’s roadway network considering different climatic scenarios and on-the-ground conditions, (2) investigate scenarios to understand and quantify the consequences of buckling, and (3) assess the characteristics that contribute to significant and non-significant consequences resulting from buckling. The results obtained from different scenarios and conditions will help with risk assessment and prioritizing buckling-affected sites throughout the State of Wisconsin. With this tool, WisDOT intends to prevent the occurrence of buckling proactively. First, the results of the scenarios will be integrated using risk assessments to rank and prioritize sites in Wisconsin for potential interventions, so these findings will be used to recommend mitigation or proactive repair strategies at the most critical sites. In addition, the model should be flexible to be updated with future research results. Finally, the model can be integrated into design verification tools to quantify the potential for buckling issues in new designs and, if issues potentially exist, to recommend alternative design options.

**II. Research Objectives**

The research plan includes five main objectives:

1. Develop an updatable mechanistic model to predict buckling.
2. Identify the characteristics that contribute to significant and non-significant consequences resulting from buckling.
3. Assess buckling vulnerability through the WisDOT’s network using the developed mechanistic model.
4. Recommend a set of mitigating and proactive repair strategies at the most critical sites in Wisconsin.

5. Integrate the mechanistic model developed for buckling into a design verification tool to quantify the buckling potential or recommend alternative design options, including integration of maintenance-and asset management-related decisions.

### **III. Scope of Work**

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

Conduct a comprehensive literature review on domestic and international studies on concrete pavement buckling and develop an annotated bibliography. The literature review should include, at a minimum, the topics in this list:

- The significance of non-stationarity climate variables on the design and resiliency of concrete pavements
- The influence of loss of climate stationarity (e.g., heatwaves) on concrete pavement buckling
- The modeling methods that can be potentially suitable for the prediction of such distress, and how they can be implemented in the current standard design methods to mitigate or even prevent pavement buckling based on non-stationary climate conditions, e.g., extreme heat, etc.
- The type of data required for the development of buckling models to predict this distress type accurately.
- The proactive measures that can be taken to mitigate or even prevent the occurrence of safety-related pavement distresses, e.g., buckling, at project and network levels.

#### **Task 2: Data Utilization/Collection and Scenario Determination**

Utilize the data/findings from the WHRP [0093-20-02](#) study and consult with Project Oversight Committee (POC) members to obtain pavement management system (PMS) and/or other appropriate data necessary for developing a mechanistic model for the prediction of buckling. The research team will also have to hold meetings with POC members to define appropriate scenarios/conditions required for the modeling and buckling prediction.

#### **Task 3: Model Development and Evaluations**

Develop a mechanistic model capable of predicting concrete pavement buckling. This model – developed based on realistic conditions, e.g., considering an infinite length for the slab and non-linear temperature distributions – must be able to evaluate buckling vulnerability across the WisDOT's network given:

- Evolving climate change scenarios
- On-the-ground conditions (e.g., baseline climate, material properties, geometrical design).

#### **Task 4: Conduction of Scenario-Based Investigations**

Conduct scenario-based investigations considering the recommendations from the research team and the inputs from POC members. Such investigation will enable the research team to understand buckling events and quantify safety and economic consequences.

#### **Task 5: Integration of the Model into a Design Verification Tool**

Integrate the model into a design verification tool, quantify the potential for buckling issues in new designs, and recommend alternative design options if issues exist. This task aims at increasing the resilience of concrete pavements to buckling from both functional and structural perspectives.

#### **Task 6: Implementation of Appropriate Methods for Rendering the Model Developed Updateable**

Consider updating the developed model based on future field observations. Such observations will be used as further verifying methods to increase the accuracy of buckling predictions.

#### **Task 7: Recommendation of Proactive Measures to Mitigate or Prevent Buckling**

Utilize the findings from the WHRP [0093-20-02](#) study to recommend a set of mitigation or proactive repair strategies at the most critical sites determined from running analysis using the mechanistic model developed for the prediction of pavement buckling.

#### **Task 8: Final Report**

Prepare and submit a draft final report that includes information and findings from all previous tasks. As part of this report, the research team is required to provide the organized/collected data used for the model development in Microsoft Excel spreadsheets or Google Sheets. Also, the research team is required to submit a design verification tool with the addition of the buckling model.

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

No field testing is required for this project.

#### **WisDOT TOC Contribution**

WisDOT will provide the following support through the Project Oversight Committee (POC) to support the successful completion of the project.

- A. The POC will work with the research team on (1) providing pavement management PMS data and other data types required for the development of the mechanistic model, and (2) defining scenarios for identifying consequences and characteristics of buckling.
- 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 PMS and other data sources.
- D. While not expected, 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.

### **V. Required for Travel to Fulfill TOC Obligations**

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

### **VI. Deliverables**

- A. Quarterly Progress Reports
  - a. WHRP 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 Closeout 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 after 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 presented at [After Closeout 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.

## **VII. Schedule and Budget**

- A. The project budget shall not exceed \$130,000
- B. The proposed project duration is 24 months, starting around 10/01/2023
- C. The deadline for submittal of the BCOP is three months before the contract end date to allow for report review activities.

## **VIII. Implementation**

Successful implementation of this research will be achieved through the development of the following items:

- A. Identify sites prone to pavement buckling and provide a proactive maintenance strategy for the mitigation of pavement buckling in a timely manner.
- B. Incorporate pavement buckling consideration into a design verification tool for increasing the resiliency of concrete pavements prone to buckling.