



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

Request for Proposals

Optimization of Dowel Bars in Concrete Pavements

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://wisconsindot.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)
Rigid Pavement Technical Oversight Committee (TOC)
Request for Proposals

Optimization of Dowel Bars in Concrete Pavements

I. Background and Problem Statement

Jointed plain concrete pavements (JPCP) play a crucial role in transportation infrastructure by providing a durable and reliable surface for vehicles. The Wisconsin Department of Transportation (WisDOT) has used a standard typical section of these pavements with doweled transverse joints for several years. Doweled transverse joints are a critical component in JPCP, serving to control cracking, improve load transfer, and enhance overall pavement performance. The current standard is that the first dowel is 12 inches from the pavement edge, then spaced at 12 inches at mid-depth in the slab across the pavement joints.

However, studies and design procedures across the nation indicate that many dowels across a lane do not contribute to the transferring of loads, as many of the bars are located far from where the loads are applied on the pavement. Also, the pavement performance of doweled transverse joints could have been better, and the only major change to standards has been the spacing of the joints. In addition, the cost of steel has increased over the last five years, leading to less sustainable concrete pavement.

To address these issues, the research team will aim to improve pavements' performance and sustainability while considering alternative layouts (i.e., number and spacing of dowels) for doweled transverse joints. In particular, the research team will explore if alternative dowel bar layouts can provide the same level of ride performance and distress over time while improving overall joint performance. The researchers will consider possible alternative bar layouts that may include a reduced number of dowels, different spacing between dowels, various dowel sizes consistent across the joint (based on the thickness of concrete pavements in Wisconsin), and other modifications. The type of dowel bars researched in this study shall be per WisDOT Standard Specifications (SS) 415.2.2 and WisDOT Standard Detail Drawings (SDD) 13c11 and SDD 13c13. Ultimately, the project will aim to optimize the dowel bar layout and provide a more sustainable concrete pavement in Wisconsin.

II. Research Objectives

The research plan includes these main objectives:

- Conduct a comprehensive review of the current practices related to dowel bar placement in climates similar to Wisconsin.
- Investigate the impact of dowel bar layout (i.e., number and spacing of dowels) on the performance and sustainability of concrete pavements in Wisconsin.

- Identify the most effective dowel bar layouts through modeling, laboratory, and/or accelerated testing.
- Develop strategies for implementing optimized dowel bar layouts in concrete pavements.

III. Scope of Work

Task 1: Literature Review and State of Practice

Conduct a comprehensive literature review. The aim of this task is to critically document the current state of practice in doweled transverse joint placement in concrete pavements across areas/regions with similar climates to Wisconsin. The literature review should cover the following topics at a minimum:

- Effect of reducing the number and changing the spacing of dowel bars across the lane
- Use of various dowel sizes consistent across the joint
- Identifying areas for improvement in dowel bar layout (number, size, and spacing of dowels)
- Developing and implementing optimization strategies

Task 2: Modeling Doweled Transverse Joints in Concrete Pavements

Based on the outcomes of the literature review, researchers will work with the Project Oversight Committee (POC) members to identify the most important factors that can optimize the design of doweled transverse joints in concrete pavements in Wisconsin. A modeling of doweled transverse joints can be performed using any finite element modeling software. The finite element model should address the dowel bar behavior under various pavement and loading conditions. The final model with the optimized dowel bar layout shall also investigate a minimum of three WisDOT concrete mixture designs using mixture design data provided by the POC. The researchers should focus on how the doweled transverse joints are affecting the pavement performance, such as load transfer efficiency (LTE), curling and warping stresses, and so on. The effect of removing the edge dowel should also be investigated. To complete this task, the research team must consult with the POC members to define appropriate scenarios/conditions required for modeling.

Task 3: Laboratory and/or Accelerated Testing to Validate Modeling Efforts

Using the modeled optimized dowel bar layout developed in Task 2, the research team will validate it using laboratory and/or accelerated testing. The results will be compared with the existing standard dowel bar/layout per WisDOT SS 415.2.2, SDD13c11, and SDD 13c13. The validation process will involve investigating the load transfer efficiency (LTE) and/or determining the stress/strain in the pavement layer.

Task 4: Final Report and Deliverables

The research team will compile and submit a draft final report that encompasses the information and findings from all the previous tasks. This report will include organized and collected data used for model development in Microsoft Excel spreadsheets or Google Sheets, including any data files collected from the lab and/or accelerated testing for future use, analysis, and interpretation.

Task 5: Closeout Presentation

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

Task 6: 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

No field testing is required for this project.

V. WisDOT/TOC Contribution

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

- A. 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.
- B. The TOC and POC will coordinate access to WisDOT aggregates used in the laboratory and/or accelerated laboratory test programs. The research team must arrange and pay with research funds for the cost and transport of aggregates and materials to their laboratory test facilities as needed.
- C. 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, the 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 Travel

None

VII. 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 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 report before the presentation.
 - b. Reports must 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 three weeks before 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. The project budget shall not exceed \$250,000.
- B. The 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 will include the following:

- A. Develop alternative layouts for dowelled transverse joints that will aim to optimize and/or enhance concrete pavement performance and sustainability in Wisconsin.
- B. Recommend, summarize, and refine any proposed changes to WisDOT specifications, including SS and SDD. These changes will be summarized in tabular or red-line format for ease of review and comparison.
- C. All relevant project data will be documented in a user-friendly database supporting the proposed specifications changes. Excel is an acceptable format for such information.
- D. If applicable, produce a technical memo or similar document intended for pavement designers that concisely summarizes the proposed changes to the concrete pavement standard process.