



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

Request for Proposals

***Development of Design Procedures for
Concrete Adhesive Anchors***

Questions submitted to research@dot.wi.gov regarding the
Content of this RFP are due no later than
4:30 PM (CST) on January 3, 2020

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) by January 11, 2020

Researchers must submit a PDF version of their proposal by
4:30 PM (CST) by February 3, 2020
to: research@dot.wi.gov

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

Researchers will be notified of the proposal review decision by May 1, 2020

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:
<https://wisconsindot.gov/Pages/about-wisdot/research/researchers.aspx>



**Wisconsin Highway Research Program
Structures Technical Oversight Committee
Request for Proposals**

***Development of Design Procedures for
Concrete Adhesive Anchors***

I. Background and Problem Statement

Adhesive anchors are used in the construction of transportation structures in Wisconsin. Pedestrian railing/fencing attachment is done using anchors during new construction. Retrofits include abutment and pier extensions, as well as abutment wingwall, backwall and paving block replacements. However, primarily due to the Boston Tunnel ceiling panel failure and a subsequent FHWA moratorium for certain uses of adhesive anchors, WisDOT banned the use of concrete adhesive anchors for parapet placements and replacements (WisDOT Bridge Manual 30.3(2)). This ban limits construction options and there is the potential for significantly higher costs in situations where the edge of deck or slab needs to be removed far enough to develop the existing deck bars and new parapet bars into the replacement work.

WisDOT adhesive anchor design is currently controlled by the American Concrete Institute (ACI) 318-14 procedure, cited in section 40.16 of the WisDOT Bridge Manual and recently added as section 5.13 – Anchors to the AASHTO 8th Edition. ACI can be difficult to follow and does not provide tangible solutions for WisDOT applications.

This project should determine cost-effective design procedures to replace and extend specific bridge elements by providing design solutions using adhesive anchors to meet or exceed the capacity of a section originally based on cast-in-place reinforcement.

This comprehensive study will evaluate current FHWA policy and other states' policies and develop testing to determine if WisDOT can use concrete adhesive anchors for parapet placement and replacement.

II. Research Objectives

- A. Provide simplified design guidance for adhesive anchor use on WisDOT projects, commensurate with the current WisDOT approved products. Currently, such applications include backwall, paving block and wing replacements (upper and lower sections), as well as abutment and pier extensions.
- B. Provide design guidance for adhesive anchor use for concrete parapet replacement on WisDOT projects, which is currently not allowed.

III. Scope of Work

Task 1:

Conduct a comprehensive literature review and assessment of current practices at other state DOTs, FHWA, industries and manufacturers. WHRP has an initial Literature Search that will be provided to researchers. Provide a summary of the reviewed information.



Task 2:

Examine and summarize WisDOT and other state DOTs' policies and guidelines for using adhesive anchors. Include design assumptions such as minimum characteristic bond strength, environmental conditions (e.g., dry-uncracked, wet-uncracked, etc.) and other key parameters.

Evaluate WisDOT's bond strength policy and determine if a higher value(s) would be better for certain applications (e.g., attaching concrete barriers to existing decks).

Task 3:

Develop recommendations and guidelines that simplify the replacement or extension of WisDOT typical detail applications with adhesive anchors in lieu of the cast-in-place details.

Task 4:

Provide design examples using adhesive anchors for typical WisDOT details. At a minimum, include the following typical details for inclusion in the WisDOT Bridge Manual Standards: wing replacement (upper sections), abutment extension, concrete parapet replacement utilizing the 42SS parapet, and temporary concrete barrier anchorage to bridge decks. The design should be based on WisDOT's current policy and/or follow an alternative policy based on Task 3 outcomes. Uncoated and epoxy coated reinforcement should be evaluated based on the application (e.g., epoxy coated for parapet replacement).

Task 5:

Design and conduct laboratory tests that provide information relating to concrete adhesive anchor capacities to assist in validating Task 4 findings for the replacement of an upper wing, replacement of a 42SS concrete parapet, and extension of an abutment. See "Required Testing" for additional information.

Task 6:

Develop recommendations and guidelines in a format consistent with the WisDOT Bridge Manual (Chapter 40), including text, examples, and standard drawings.

IV. Required Testing

- A. Anchor installation shall follow Section 502 of the WisDOT Standard Specifications for Highway and Structure Construction for all lab tests.
- B. Lab tests – For each application, test two adhesive products on the Wisconsin Approved Products List, preferably products with the lowest reported minimum characteristic bond strengths, and test one adhesive product with a minimum characteristic bond strength of at least 1500 psi. Each product should be tested a minimum of three times for each application.
- C. Upper Wing Replacement Application – Determine the pullout capacity of #5 epoxy coated bars. Embed (based on Task 4) into reinforced concrete with the centerline of hole 4-inches from the edge of concrete, drilled vertically in the downward direction. Depth of concrete to be 1'-6" minimum. Reinforcement of concrete specimen to be coated #4 bars spaced at 8" in both directions. Use $f'c = 3500$ psi concrete.
- D. Concrete Barrier on Bridge Deck Application – Determine the pullout capacity of #5 epoxy coated bars. Embed 5.5" into reinforced concrete with the centerline of hole 12-inches from the edge of concrete, drilled vertically in the downward direction. Depth of concrete to be 8". Reinforcement of concrete specimen to be one layer of coated #4 bars at spaced at 8" in both directions with 2.5" clear cover. Use $f'c = 4000$ psi concrete.



- E. Abutment Extension Application – Determine the pullout capacity of #8 epoxy coated bars. Embed as needed (based on Task 4) into reinforced concrete with the centerline of hole 4-inches from the edge of concrete, drilled horizontally. Thickness of concrete to be 2'-0" minimum in the direction of the hole. Reinforcement of concrete specimen to be coated #4 bars at spaced at 8" in both directions.

V. WisDOT/TOC Contribution

- A. Work will be conducted with project oversight by the WisDOT Bureau of Structures and WHRP Structures Technical Oversight Committee (TOC). The TOC members will appoint a Project Oversight Committee (POC) to support the successful completion of the project.
- 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 letter of commitment must be included in the proposal.
- C. WisDOT staff/TOC members can be expected to contribute a maximum of 40 hours over the duration of the project.

VI. Required Travel

The Principal Investigator is required to travel to Madison to deliver the Close-Out Presentation in person.

VII. Deliverables

Submission of a PDF of the final report is required.

VIII. Schedule and Budget

- A. Project budget shall not exceed **\$150,000**. Matching funds will not be considered in the proposal evaluation process.
- B. Proposed project duration is **24 months** and is expected to start around October 1, 2020.

IX. Implementation

- A. Lab test results, with recommendations to clarify AASHTO 8th Edition Section 5.13 – Anchors/American Concrete Institute (ACI) 318-14.
- B. Provide guidance for adhesive anchor use for concrete parapet replacement on WisDOT projects, which is currently not allowed.
- C. Develop recommendations and guidelines in a format consistent with the WisDOT Bridge Manual, including text and standard drawings.