Research Brief

Wisconsin Highway Research Program
Project 0092-18-03
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# Protocols for Concrete Bridge Deck Protections and Treatments

## Research Objectives

- Evaluate the effectiveness of current WisDOT practices and policies for preserving bridge decks
- Develop a cost-effective life-cycle treatment plan for preserving Wisconsin's bridge decks

## Research Benefits

- Developed a life-cycle guide outlining progressive strategies and treatments for preserving concrete bridge decks under various conditions and factors
- Determined the most cost-effective default strategy for preserving concrete bridge decks
- Confirmed that all examined preservation strategies are more cost-effective than taking no action

Principal Investigator

**Başak Bektaş**
Minnesota State University, Mankato
basak.bektas@mnsu.edu

Project Manager

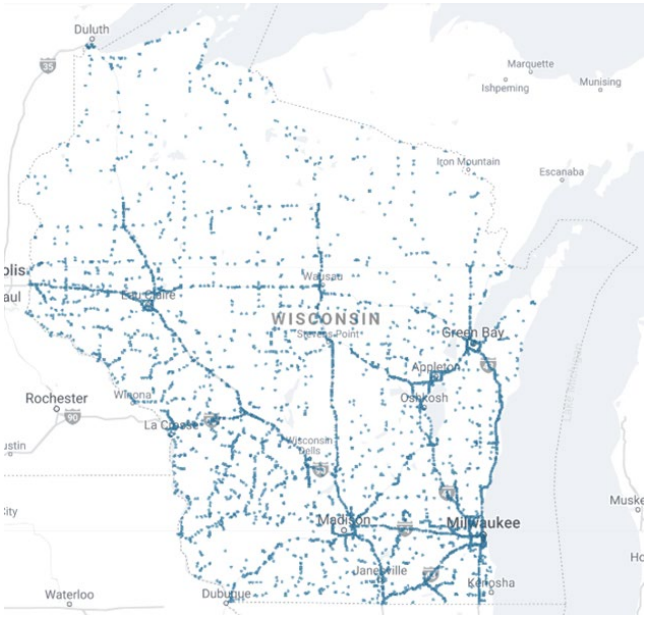
Ryan Bowers
WisDOT
ryan.bowers@dot.wi.gov

## Background

Cold-weather states like Wisconsin face challenges in preserving bridges that are subject to harsh winter conditions and chemical deicers. Depending on a bridge deck's condition, daily traffic and other factors, the state applies different preservation strategies, including: concrete overlays, asphalt concrete overlays, polymer overlays, crack repairs, deck sealers or even deck replacement. Defining optimal methods and timing of preservation treatments is critical to maximizing deck service life and reducing life-cycle costs. The objective of this research was to evaluate current WisDOT preservation practices and to improve them through the development of a cost-effective life-cycle treatment plan.

## Methodology

The research team gathered an archive of deck-preservation strategies used throughout the state and analyzed it in conjunction with historic bridge conditions and other factors, such as deicer usage and traffic data. Similar data sets from South Dakota and Minnesota were also analyzed for the same purpose. Using Monte Carlo simulation to develop life-cycle profiles and Equivalent Uniform Annual Cost (EUAC) values, the research team contrasted deck-treatment plans for performance and cost-effectiveness in order to identify the most cost-effective treatment options for different deck conditions and at different points throughout a deck's life cycle.




Wisconsin's 4,535 concrete bridge decks were mapped and archived.

*"The results of this research will augment WisDOT's approach to data-driven asset management."*
*– Ryan Bowers, WisDOT*

**Interested in finding out more?**

Final report is available at:
WisDOT Research website

## Results

The research team found that treated decks have consistently lower life-cycle costs than untreated decks, regardless which treatment strategy is applied. The team confirmed that sealing and overlaying decks early in the life cycle lead to lower life-cycle costs than if the treatment is delayed. It is also cost effective to apply multiple deck seals throughout a deck's life cycle, particularly on high-traffic corridors, as there is a significant difference in sealer performance depending on traffic volumes. Another product of the research was a series of deck performance and treatment impact models that can be utilized in WisDOT's bridge management system or decision support-tools.

## Recommendations for implementation

Simulated life-cycle plans provide insight into the most cost-effective strategies available to WisDOT and, potentially, other Midwest transportation agencies. The research team developed a life-cycle guide for addressing progressive strategies and treatments as well as transition points in bridge deck criteria. For each strategy, it details optimal application frequencies and pinpoints when in a deck's life cycle a treatment is no longer an effective or economical strategy. The team also proposed updates to the WisDOT Bridge Manual's chapters related to bridge maintenance and rehabilitation and to the WisDOT Preservation Policy on Sealing and Thin Overlays. Other recommendations include:

- Treat decks as early as possible in their life cycles to lower EUACs.
- Apply sealers more frequently on high-traffic bridge decks.
- Seal average decks at General Condition Rating (GCR) 8 and again at GCR 7.
- Seal decks every three years on bridges with annual average daily traffic of 15,000 or higher.
- Consider life-cycle costs in conjunction with WisDOT's asset performance measure targets and incorporate treatment efficiency findings into bridge management systems and other decision-support tools to facilitate bridge-level decisions.

The most cost-effective preservation strategy overall is to seal decks at GCR 8 and again at GCR 7; apply two thin-polymer overlays when GCR drops to 7; apply a concrete overlay when GCR drops to 6; and to seal it again when GCR drops to 7. Therefore, this sequence of treatments is recommended as the default deck-preservation policy.

This brief summarizes Project 0092-18-03,
"Protocols for Concrete Bridge Deck Protections and Treatments"
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