



TECHNICAL SUMMARY

Technical Liaison:

Jim Lilly, Mn/DOT
jim.lilly@state.mn.us

Administrative Liaison:

Nelson Cruz, Mn/DOT
nelson.cruz@state.mn.us

Principal Investigators:

Arturo Schultz, University of Minnesota
Cathy French, University of Minnesota

PROJECT COST:

\$75,000



Cracks on concrete decks are a leading cause of bridge deterioration.



RESEARCH
SERVICES SECTION

Crack and Concrete Bridge Deck Sealant Performance

What Was the Need?

Sound bridge maintenance practices prolong the useful life of a bridge and increase the time between major refurbishments such as redecking. A major source of deterioration of prestressed concrete bridges is corrosion of the steel reinforcement caused by the infiltration of corrosive substances, typically chloride ions originating from deicing materials. Corrosion is caused by water seeping either through cracks or directly through the concrete, though cracks are the primary mode for corrosion of the steel reinforcement.

Minnesota's transportation agencies have been using crack and deck sealants as a preventive measure to reduce the likelihood of such bridge deterioration for some time. However, there are several types of products available and a number of application methods used. A well-researched set of best practices was needed to guide bridge engineers and maintenance personnel as they design and care for Minnesota's bridges.

What Was Our Goal?

The goal of this project was to determine the current state of the art regarding bridge deck sealants and crack sealers to extend the life of reinforced concrete bridge decks.

What Did We Do?

Researchers conducted an extensive literature review of significant studies of crack and deck sealing in concrete bridges. Subsequently, they surveyed a number of DOTs to determine common practices for the use and application of these sealants. Finally, they closely examined the results of a three-year study in Minnesota of the depth and rate of chloride penetration in concrete. The findings from these three sources were correlated and synthesized to examine trends and determine the performance characteristics, testing processes, quality assurance criteria and best application procedures for a wide range of deck and crack sealants. From this information, the research team produced a best practices guide for Minnesota's bridge deck maintenance crews on the application of deck and crack sealers on reinforced concrete bridge decks that includes specific product recommendations.

What Did We Learn?

Regarding deck sealants, the survey indicated that two tests—AASHTO T259 and ASTM C642—are commonly used to judge the acceptability of a given product. The literature indicated that the NCHRP 244 Series II test is widely used to quantify sealant performance. Research suggests that properly preparing the deck surface before the application of all types of sealant improves their effectiveness. A large scatter in the available data and the varying effectiveness of each of the considered sealants relative to a particular application prevent the identification of a single sealant that will work best in all situations. Some of the research team's significant conclusions and recommendations based on the overall trends were:

- Among the solvent-based sealers, silane products typically outperform siloxane products.
- Water-based products are not suitable for reapplication.
- Solvent-based products typically outperform water-based products.
- High solids content in the sealer typically improves performance.

Researchers found that the sealant S40Si comes closest to fitting the above criteria.

continued

“Bridge life is controlled by controlling cracks.”

—Jim Lilly,
Bridge Standards,
Research and
Information Manager,
Mn/DOT Office of Bridges
and Structures

“Crack sealing is a targeted maintenance activity for our bridges, but we needed more detailed knowledge of the properties of different products and some clear recommendations for their use in specific cases.”

—Gary Peterson,
Mn/DOT Assistant Bridge
Design Engineer (retired)
and former Technical
Liaison

Produced by CTC & Associates for:

Minnesota Department
of Transportation
Research Services Section
MS 330, First Floor
395 John Ireland Blvd.
St. Paul, MN 55155-1899
(651) 366-3780
www.research.dot.state.mn.us



Sealing cracks in concrete decks is a routine part of bridge maintenance, but practices and products vary significantly. This study established best practices guidelines for concrete deck and crack sealing on Minnesota's bridges.

Regarding crack sealers, researchers found that very little acceptance testing was done for selecting them, with many states simply relying on field experience and reviewing previous laboratory and field research. As with deck sealants, proper preparation of the surfaces and cracks themselves improved the performance of the sealer. Among the findings from the current research and the surveys were:

- High molecular weight methacrylate products provide better penetration in smaller cracks.
- Epoxy sealers typically provide higher bond strength and demonstrate good resistance to freeze-thaw effects in laboratory tests.
- Laboratory results were frequently at odds with field studies; field performance was much poorer than laboratory performance for HMWM products. Little field research has been done with epoxy sealers.

Researchers recommended that further research be conducted to clarify the (sometimes contradictory) findings in the existing studies of crack sealants, especially to coordinate laboratory and field testing of products and application techniques.

What's Next?

A new project implementing and expanding upon these findings is currently in the scoping phase. In this project, 10 concrete crack sealant products will be field-tested and evaluated for performance; the previous studies synthesized in the current project focused largely on laboratory testing. This new project will serve to validate and optimize practices that Minnesota field crews already use and will result in final recommendations of the best products and methods regarding crack sealants in Minnesota.

This Technical Summary pertains to Report 2009-13, "Crack and Concrete Deck Sealant Performance," published March 2009. The full report can be accessed at <http://www.lrrb.org/PDF/200913.pdf>. The implementation project mentioned is 2009-159, "Implementation of Best Performing Concrete Bridge Deck Crack Sealants." For more information, contact research@dot.state.mn.us.