

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Effects of Concrete Cure Time on Epoxy Overlay and Sealant Performance

START DATE: July 2018

REPORT DATE: December 2020

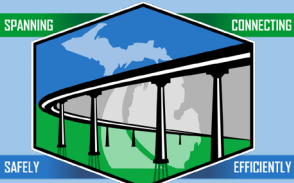
RESEARCH REPORT NUMBER: SPR-1698

PROJECT COST: \$530,000

COST SHARING: 20% MDOT, 80% FHWA through the SPR, Part II, Program

MDOT Project Manager

BUREAU of BRIDGES



and STRUCTURES

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Revised concrete cure times reduce duration of bridge closures

The Michigan Department of Transportation (MDOT) has numerous tools to keep bridges in good condition, including coatings and overlays to seal cracks and smooth surfaces. Before such a treatment can be applied, bridge crews must wait nearly a month for concrete patches and repairs to fully cure. To decrease the amount of time that bridges are closed for maintenance and reduce impacts on the traveling public, MDOT developed new procedures to determine when concrete is sufficiently cured to receive a coating.

PROBLEM

Cracks inevitably form in bridge deck concrete due to temperature changes, moisture variations and traffic loading. To improve bridge deck condition and extend service life, MDOT applies a flood coating – either a thin epoxy overlay or a healer sealer – to freshly patched or repaired concrete. Epoxy overlays protect concrete for about 15 years by creating a shield that prevents moisture from entering cracks. Healer sealers, while less costly, add about seven years of bridge life by filling cracks in a deck's surface.

After patching or repairing damaged concrete, however, current MDOT policy requires that a 28-day cure time be allowed before applying any flood coating. This policy is based on manufacturer's recommendations and traditional understandings

Experimental concrete slabs, each with an overlay applied at different times during the concrete curing process, sat in Michigan's weather for 16 months.

of concrete materials. After curing, a multi-step coating application process can add additional days to a bridge lane closure; meanwhile, traffic management and user costs mount as construction time increases.

A variety of factors determine when concrete is ready to receive a flood coating. In this study, MDOT wanted to explore whether differences in concrete mixes, epoxy overlays and sealer products affect

“This research will allow MDOT to apply flood coatings to bridge decks about one week sooner than we were before, decreasing construction and bridge closure time. Seven days can make a big difference to our road users and for traffic management.”

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how soon a flood coating can be applied on a bridge deck's fresh concrete for maximum performance.

RESEARCH

After reviewing literature on criteria related to epoxy overlays and sealers and timing of application, researchers identified the most important parameters and corresponding measures that impact when flood coatings can be successfully applied.

MDOT commonly uses two types of concrete mixes for bridge decks. After pouring specimen slabs and beams using both mixes in the laboratory, investigators applied thin overlays of two agency-approved epoxy products and two healer sealers after 14, 21 and 28 days. Various simulated environmental conditions provided initial testing variables.

The slab specimens with thin epoxy overlays then endured outdoor conditions from fall 2019 to summer 2020, including nearly 100 freezing cycles and summer temperatures up to 91 degrees Fahrenheit. Both inside the lab and outdoors, salt solutions coated the slabs for substantial periods to simulate winter road maintenance impacts. Periodic tests conducted over 17 months measured how well the overlays and sealers

prevented chlorides from permeating the concrete and corroding the embedded steel reinforcements and illustrated whether the treatments met MDOT's performance standards.

Lastly, investigators used a standard cost calculator to estimate the economic benefit of reducing the number of days a bridge is closed for maintenance.

RESULTS

This project produced two performance-based procedures to identify the minimum concrete age to receive a flood coating: one for thin epoxy overlays and the other for healer sealers. The performance of the epoxy overlay depended on several factors: concrete and bond strength, thermal compatibility between the overlay and concrete, exposure conditions, and workmanship. Factors impacting healer sealer performance included concrete moisture and workmanship.

Based on those factors, the minimum concrete age to receive a flood coating depends on many variables, including the concrete's curing duration and the age at which cracking occurs. While epoxy overlays and healer sealers can potentially delay cracking, they do not prevent it; once a coating is applied cracking is more difficult to see.

The minimum concrete age for a flood coating also depends on when the substrate moisture is acceptable. For epoxy overlays, the concrete should reach the minimum specified tensile strength. Finally, if after flood coating the product meets its performance standard, the concrete age when the coating was applied is appropriate.

Considering these parameters, MDOT was able to reduce the curing time by eight to 10 days depending on the type of concrete mix used. As the benefits calculator showed that an average bridge closure can cost the state more than \$84,000 per day, this reduced curing time can result in significant savings as well as less inconvenience for travelers.

IMPLEMENTATION

MDOT will need to make policy changes before updating the agency's guides and manuals. Until then, bridge staff will consult with suppliers of MDOT-approved epoxy overlays and healer sealers as they provide specific application requirements relating to concrete age, moisture and temperature.

Research Administration

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Final report and related materials are available online at

MDOTjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=SPR-1698.

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