Research Brief

Wisconsin Highway Research Program
Project 0092-12-06
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Thin Polymer Overlays for Bridge Decks

Research Objectives

- Explore the effectiveness and durability of thin polymer overlays in restoring and protecting bridge decks, improving safety and extending service life
- Assess and compare performance of selected thin polymer overlay systems under laboratory test conditions
- Suggest appropriate bridge deck maintenance strategies related to this research

Research Benefits

Thin polymer overlays:

- Impose less deadweight than concrete overlays
- Can be rapidly applied, resulting in lane closure of eight hours or less
- Have life expectancies of seven to 15 years when properly installed
- Better preserve surface friction and skid resistance compared to concrete with no overlay

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Background

Deterioration of concrete bridge decks is a major maintenance concern, particularly in the northern snow-belt regions where deicing salt is used to treat roads and bridges during winter months. The salt that helps keep traffic moving safely in winter can also accelerate deterioration of bridge decks and corrode embedded steel components. Sealers and overlays are used to prevent corrosive chlorides from penetrating the concrete and improve skid resistance by mitigating the damaging effects caused by vehicles, deicing salts and freeze-thaw cycles. These practices have resulted in varying levels of success in preserving affected bridge decks in a cost-efficient manner. Application can be expensive, time consuming and result in traffic disruptions. Additionally, corrosion activity may continue unabated even after application if chloride contamination already exists. This research was performed to explore cost-efficient solutions to these prevailing problems.

Methodology

Based on the evaluation of available literature, surveys, and discussions with state DOTs and manufacturers, the research team proposed nine sets of different treatment systems for testing of polymer overlays. Laboratory tests were performed to compare the performance of the selected systems against each other and a control group of uncoated specimens. Reinforced 15 in. x 15 in. x 4 in. concrete slab specimens matching conventional WisDOT mix designs were subjected to accelerated corrosion, freeze-thaw cycling, heat/ultraviolet/rain cycles and tire wear tests, including “snow plow” application. Application of overlays on previously chloride-contaminated concrete was also studied through exposure of two sets of specimens to increasing chloride levels prior to application of overlays. Chloride testing was done using the rapid chloride test (RCT) procedures. Pull-out strength, friction, deformation due to tire passage and corrosion mass loss were also measured.

Rapid chloride exposure testing in progress.

"The addition of polymer overlays does not significantly reduce corrosion mass loss in bridge decks with high levels of chloride contamination prior to application."

– Habib Tabatabai, UW-Milwaukee

Interested in finding out more?

Final report is available at: WisDOT Research website.

Results

The overlay system with an epoxy resin and flint rock aggregate provided the best overall performance based on performance indices determined for friction coefficient, corrosion mass loss, pull-out strength and surface deformation due to tire passage. The polyester multi-lift overlay system delaminated from the concrete surface in all nine specimens utilizing that overlay type. The addition of polymer overlays does not significantly reduce corrosion mass loss in bridge decks with high levels of chloride contamination prior to application. Applying overlays may slightly reduce the initial friction of concrete surfaces, but retain surface friction longer than tined concrete with no overlay. Freeze-thaw testing resulted in gradual loss of aggregates that protect the polymer against deterioration due to ultraviolet (UV) radiation, suggesting that, in practice, there may be longer-term UV damage after loss of aggregate.

Recommendations for Implementation

Proper application of a 2-lift thin polymer overlay on decks that are in good repair (no significant chloride contamination, corrosion and/or deck surface defects) have a life expectancy of seven to 15 years. The main advantage of thin polymer overlays is the long-term preservation of friction coefficients as the deck ages. Therefore, for applications where friction enhancements are needed, the thin polymer overlays are recommended unless deck conditions preclude it.

If the purpose for the installation of the thin polymer overlay is to protect an uncontaminated deck against corrosion, a more cost effective approach may be to apply penetrating sealer instead shortly after construction, and repeating the sealer application every three to five years, depending on average daily traffic. On heavily-travelled roads, where routine reapplication can be particularly disruptive to traffic, the application of thin polymer overlays may be considered as an acceptable corrosion protection strategy when chloride contamination is not significant.

Timing is key to ensure that penetrating sealers are effective and have a long service life. All new bridge decks should receive their first application shortly after construction, to maximize benefits and guarantee harmful chlorides have not already migrated into the concrete beneath. If the first application of sealer is not done within the first five years of a deck's life, there may be little to no benefit.

The time of year that sealing should be performed matters as well; late spring and summer are ideal, especially in areas where deicers are used over the winter. Allowing rain to help wash the accumulated chloride off the deck will help to preserve the service life of the sealer or overlay.

This brief summarizes Project 0092-12-06,
"Evaluation of Thin Polymer Deck Overlays and Deck Sealers"
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