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Polymer Concrete Overlay Evaluation

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Polymer Concrete Overlay Evaluation

tech transfer summary

This project documents the state-of-the-practice with respect to polymer concrete overlays, as well as the placement of two overlays on bridge decks in Iowa, and then their field performance over a two-year period.

June 2016

RESEARCH PROJECT TITLE
Polymer Concrete Overlay Evaluation

SPONSORS
Federal Highway Administration
Iowa Department of Transportation
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Background

For the past 13 years or so, the Kansas Department of Transportation (KDOT) has been using polymer-based overlays on primary highway bridge decks. Since the first trial application, more than 200 decks have been overlaid with primarily epoxy-based materials. Recently, however, KDOT has begun trials with overlays based on methracrylates and polyesters.

In general, anecdotal evidence suggests that the KDOT experience has been good. However, implementation has not been without problems and a commonly encountered learning curve. Despite these problems, KDOT has started using polymer overlays on new structures in place of their more conventional silica-fume overlays.

Problem Statement

While most problems that have been encountered were not attributed to material problems, there has been no concerted effort to track or document polymer overlay performance with time or to relate performance to material usage and/or workmanship.

Objectives

The objectives of this work were to document the state-of-the-practice with respect to polymer concrete overlays, document the placement of two overlays in Iowa, monitor the field performance of the overlays over a two-year period, and relate their performance to material usage and/or workmanship.

First polymer layer complete on the Johnson County bridge

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The Bridge Engineering Center (BEC) is part of the Institute for Transportation (InTrans) at Iowa State University. The mission of the BEC is to conduct research on bridge technologies to help bridge designers/owners design, build, and maintain long-lasting bridges.

The sponsors of this research are not responsible for the accuracy of the information presented herein. The conclusions expressed in this publication are not necessarily those of the sponsors.

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Research Description

Prior to placement of the overlays, the researchers reviewed national and international literature on the use of polymer concrete overlays with a particular focus on long-term performance, degradation mechanisms, and case studies. In addition, they conducted a brief survey of state DOTs to seek out specifications for the use of polymer concrete overlays, information on general performance, and results of any research completed.

The two bridges—a Johnson County, Iowa bridge over I-80 on 12th Avenue in Coralville, and the Keg Creek Bridge on Hwy 6 in western Iowa, 10 miles east of Council Bluffs—were overlaid during the summer/fall of 2013. The process by which each bridge was overlaid was similar in many ways, although a few slight differences existed.

The deck preparation was completed similarly by shot blasting the deck to an approved surface roughness and blowing the deck free of debris. The blowing process differed slightly, but it appeared that the same result was achieved.

The way by which the epoxy polymer was measured and mixed and how the cast aggregate was placed was likely the greatest difference observed. The polymer material used at each location differed, but met specifications at both.

The epoxy polymer for the Keg Creek Bridge deck was precisely measured using automated controls; whereas, the material used on the Johnson County bridge deck was closely approximated by dispensing each part into equally sized muck tubs.

Shot blasting (and vacuuming) the Keg Creek Bridge deck to achieve deck surface relief as part of initial preparation

Two-part epoxy polymer mixing for the Johnson County bridge deck

Semi-truck and trailer carrying hopper of flint chips, vats of epoxy polymer, and a blower on the Keg Creek Bridge

Hand-broadcasting flint chips on the first polymer layer of the Johnson County bridge deck

Spreading polymer and blowing flint chips on the Keg Creek Bridge deck

Second layer deck preparation on the Johnson County bridge deck

At Keg Creek, the aggregate was cast via a vacuum and blower; whereas, at the Johnson County bridge, the aggregate was cast via a more labor-intensive hand broadcasting method.

Aside from these differences, the process by which the polymer was mixed and spread onto each deck was nearly identical (Jiffy paddles and notched squeegees). In the end, the final product was quite similar with neither one appearing to be better than the other.

Key Findings

The researchers found that the success or failure of any overlay project can often be attributed to three things: existing condition of the deck, preparation of the deck surface, and proper mixing of the epoxy polymer.

Prior to the determination of epoxy polymer overlay use, the deck condition must be assessed and found to be in a satisfactory state. That is to say, the epoxy polymer is not intended to fix existing deficiencies in the deck, but, rather, to prevent the elements from acting on the deck and expediting deterioration.

The preparation of the deck surface prior to the application of the overlay is paramount to the success of the project. A certain level of surface roughness must be attained and the deck must be free of foreign material and moisture. If these requirements are not met, the bond between the overlay and the deck surface will be greatly compromised and likely apt to fail in short order.

Any epoxy polymer used will have a specified method of measurement and mixing. These methods are backed by the manufacturers' own research and should be strictly followed to ensure the polymer is properly prepared for deck application. Without proper mixing, the polymer effectiveness could be compromised, resulting in a premature failure of the overlay.

Spreading second layer of polymer on the Johnson County bridge deck

Over time, each overlay has generally performed quite well with only a few areas of exception. It is believed that these localized areas likely underperformed due to poor deck preparation, improper polymer mixing, snowplow impact, or a combination thereof.

Implementation Readiness and Benefits

The results from this project provide a more complete understanding of the use of polymer concrete overlays and of the common deterioration mechanisms. The field performance evaluations for the two bridge decks provide an early-life record of overlay performance.