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RESEARCH PROJECT TITLE

Investigation and Evaluation of Iowa Department of Transportation Bridge Deck Epoxy Injection Process

SPONSORS

Iowa Department of Transportation (InTrans Project 10-381)

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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.

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Investigation and Evaluation of Iowa Department of Transportation Bridge Deck Epoxy Injection Process

tech transfer summary

This project resulted in draft specifications for concrete bridge deck epoxy injections, which can also be used in contracting this work to others.

Problem Statement

Iowa Department of Transportation (DOT) maintenance staff have implemented a successful solution to repair concrete bridge decks by bonding the delaminated concrete overlays to their original surfaces using epoxy resin. However, there has not been a comprehensive study to learn the length of the additional service life or the most effective methods and materials for the injection process.

There is a need to perform this treatment on 120 to 180 Iowa DOT structures each year. Currently, this work is only performed by Iowa DOT bridge crews given the lack of adequate specifications for contractors.

Objectives

- Determine the effectiveness, durability, and typical service life of epoxy-injected delaminated bridge decks
- Evaluate the current state-of-the-practice with these epoxy injections
- Develop procedures and specifications for bridge deck epoxy injection

Background

The Iowa DOT has been using concrete overlays on its bridge decks since the 1970s to restore the concrete deck surface and lengthen the service life of the bridge deck. The overlays inhibit chloride and water intrusion into the bridge deck and have proven effective as a maintenance treatment on Iowa bridges.

Bridge deck overlays typically last 15 to 20 years before delamination at the bond interface requires repairs to or replacement of the overlay. The delamination of the overlay is often repaired by Iowa DOT maintenance crews that inject the deck overlay cracks and voids with epoxy.



District epoxy injection crews varied in size from one to five people

Anecdotal observations by Iowa DOT field staff suggest that the epoxy injection process can delay repair of overlays by another 5 to 10 years, but there is no current documentation to substantiate this. In addition, the process for injecting epoxy into bridge deck cracks and delaminations has not been formally documented, so Iowa DOT districts have developed differing procedures and utilize a variety of materials and equipment.



Some injection pumps were trailer mounted and drew epoxy material directly from 50-gallon drums, while others were portable and required filling reservoirs with epoxy material from 5-gallon buckets

Project Description

The research team identified 26 bridges as being injected between 2003 and 2006 as part of a preliminary performance evaluation. The researchers visited each bridge to visually inspect the deck surfaces, as well as to sound the concrete overlays for delaminations.

Based on these preliminary performance evaluations across Iowa, the research team looked at whether there were any factors (such as injection temperature, crew size, equipment, delamination rate before injection, etc.) that significantly affected delamination development after injection.

The team distributed both state and national surveys to gain further insight into the procedures and applicability of bridge deck epoxy injections. The survey responses were used to gain insight and set a benchmark used to compare and contrast the practices within each Iowa DOT district. Also, they formed the basis for the content of individual interviews.

The researchers interviewed bridge crew leaders from each Iowa DOT district to learn about their respective procedures, materials, and equipment, and to document the state-of-the-practice in Iowa.

Beginning in summer 2011, numerous bridges around Iowa were scheduled for epoxy injection. As part of the injection field investigation, these bridges, were sounded (if possible) in advance to determine the pre-injection level of detectable delamination. In many cases, the injection procedure was then observed and documented.

Subsequently, each of the selected 24 bridges was re-sounded once a year each summer from 2012 through 2016 to track the condition of the deck, with the objective of identifying a rate of deterioration and/or the development of new deck delaminations.

Finally, the team developed draft specifications for epoxy injection of bridge deck delaminations based on the insights and results from this research effort.

Key Findings

- Overall, the injections collectively appear to be performing well through eight years of service. The data collected indicated that epoxy injection can extend the service life of a bridge deck by at least four years. These observations agree with those of the DOT bridge crews, which have suggested the epoxy injection can delay repair of the overlays by 5 to 10 years.
- Epoxy deck injections were not beneficial once a certain threshold of deterioration was present. One bridge that was part of the field investigation exhibited a very high delamination rate prior to injection, and also subsequently had poor long-term performance as bridge deck replacement was necessary after three years. However, further work is necessary to investigate this finding, as the sample size was not large enough to reach verifiable conclusions.
- The results of the survey responses showed that a uniform procedure for the implementation of epoxy deck injections was not present and that the method was not widely implemented on a national scale. The injection procedure, as well as its quality, were highly dependent upon the experience of the crew.

More detailed observations, particularly from the injection field investigation, are included in the final report for this project.

Implementation Readiness and Benefits

After evaluating injections in the field, the results from a state and national survey, and interview responses from Iowa DOT bridge crew leaders, the research team developed draft specifications for bridge deck epoxy injections. These specifications provide guidance for DOT staff across the state.

In addition, the specifications give Iowa DOT staff the ability to contract for epoxy injection work, alleviating demand on their own installation and maintenance crews as needed. With Iowa's seasonal roadwork demands, this is particularly beneficial.