OFFICE OF RESEARCH & BEST PRACTICES
Michigan Department of Transportation

Research Spotlight

Testing epoxy-coated rebar helps refine bridge maintenance strategies

MDOT has long recognized the advantages of epoxy-coated reinforcement bar (ECR) for constructing new bridges. ECR offers improved corrosion resistance and longer life compared with black steel rebar, and over the past several years the agency has adopted ECR as the standard for concrete bridge decks. However, the agency can take full advantage of this technology only if it can attach real numbers to the improved performance of ECR and update its bridge maintenance strategies and schedules accordingly.

Project Information

REPORT NAME: ECR Bridge Decks: Damage Detection and Assessment of Remaining Service Life for Various Overlay Repair Options, Part II

START DATE: September 2006

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RESEARCH REPORT NUMBER: RC-1549

TOTAL COST: $334,908, includes Part II (this research) and Part I (see separate Research Spotlight)

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

MDOT Project Manager

Steve Kahl, P.E.

Construction and Technology Division
Michigan Department of Transportation
8885 Ricks Road
Lansing, MI 48917
kahls@michigan.gov
517-322-5707

Problem

While anecdotal evidence in Michigan suggests that bridge decks built with ECR significantly outlast those reinforced with black steel, there remains some question among engineers on the quantifiable benefits of ECR. Documented performance values vary among the different case studies and research projects carried out nationwide, and many of these do not share Michigan's traffic and weather conditions.

ECR resists corrosion and is the standard for Michigan bridge decks, but MDOT needed to quantify its performance. (Courtesy of iStockphoto.)

MDOT needed to better understand how bridge decks constructed with ECR perform in order to update the state's bridge deck preservation matrix used to guide decisions on how and when to undertake a range of maintenance options.

Approach

Through this research project, investigators sought to establish ECR performance values through laboratory testing of bridge

(continued)

> *"This research will aid in the development of an improved preservation strategy for ECR bridge decks."*
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> **Steve Kahl, P.E.**
> Project Manager

deck specimens reinforced both with ECR and with black steel. To simulate the natural mechanical and environmental impacts on Michigan bridge decks, test protocols called for accelerated laboratory aging of the specimens, including traffic loading, freeze-thaw cycling and continuous accelerated corrosion.

With the end goal of updating the MDOT bridge deck preservation matrix, investigators also aimed to test specimens repaired with a variety of rehabilitation options provided on that decision matrix: epoxy overlays, shallow and deep concrete overlays and hot-mix asphalt overlays.

Research

Researchers monitored the test specimens while exposing them to artificial weathering and simulated traffic, measuring three properties:

- **Stiffness.** Investigators measured changes in stiffness of the test specimens at predetermined times throughout the artificial aging process to determine trends in the severity of deterioration.
- **Corrosion.** Electrical measurements provided the cumulative corrosion in the reinforcing bar and allowed calculation of corrosion rates.
- **Cracking.** X-ray tomography provided images of the internal cracking in specimens before and after the aging process.

Results

While the results of the stiffness tests were ultimately inconclusive, the tests for corrosion and cracking provided compelling data on the life of ECR bridge deck specimens compared with black steel. Researchers found that the damage growth rate for ECR was between 2.6 and 4.0 times slower than for black steel. Using the more conservative value, which is based on the results of corrosion testing, they established the estimated life expectancy for bridge decks reinforced with ECR as 2.6 times longer than decks reinforced with black steel. With this number in hand, MDOT will be able to adjust its bridge deck preservation matrix to allow for longer expected service life of bridge decks constructed with ECR.

These results also support a possible change to future rehabilitation options for ECR bridge decks. Deep overlay repairs, which typically follow shallow overlays and precede full deck replacement, are part of the traditional approach to bridge deck maintenance. With ECR bridge decks, such repairs could result in the exposure of ECR and accidental damage to the epoxy coating. The established longer life of ECR supports the feasibility of an alternative maintenance strategy of postponing or skipping the deep overlay rehabilitation to take full advantage of ECR's long life.

Value

Bridge deck maintenance decision-making is a sophisticated process that requires a complete understanding of a number of factors: the condition of the bridge deck, the condition of adjacent decks and the anticipated costs and benefits of different repair options. By having reasonable research-based expectations on how bridge decks constructed with ECR will perform, MDOT can fine-tune its repair strategies and make the most efficient use of its maintenance budget. Changes now under consideration for the MDOT bridge deck preservation matrix will help the state realize the full intended benefits of ECR.

RBP

Principal Investigator

Ronald Harichandran, Ph.D., P.E.

Department of Civil and Environmental Engineering
Michigan State University
East Lansing, MI 48824
harichan@egr.msu.edu
517-355-5107

Contact Us

PHONE: 517-241-2780

E-MAIL: mdot-research@michigan.gov

WEB SITE: www.michigan.gov/mdotresearch

This final report is available online at

https://mdotjboss.state.mi.us/SpecProv/getDocumentById.htm?docGuid=c6bdc983-b9c8-46ae-9b76-083f1608ae8b.

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