Michigan Department of Transportation
RESEARCH Administration

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Repair of Bridge Deck Fascias

START DATE: October 2021

REPORT DATE: September 2023

RESEARCH REPORT NUMBER: SPR-1730

PROJECT COST: $248,000

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

MDOT Project Manager

Matthew Beatty, P.E.

Transportation Engineer Licensed Specialist
MDOT Structure Design

BeattyM2@Michigan.gov
517-290-7659

RESEARCH ADVISORY PANEL MEMBERS:

John Belcher, Craig Eby, Chris Idusuyi, Chris Johnson, Dean Kanitz, Melissa Knauff, Tim Stallard, and Jeff Triezenberg.

New methods for preventing and repairing bridge deck fascia damage

The concrete fascias along the exterior sides of bridge decks and connected to crash barriers along the driving surface can deteriorate even when the bridge deck is in good condition. An improved understanding of the causes of deterioration and knowledge of new repair materials, repair techniques and bridge designs can help engineers at the Michigan Department of Transportation (MDOT) build and maintain safe, sustainable bridges. A new software tool can evaluate a fascia condition and any impact on the effectiveness of the connected crash barrier to identify where repairs may be warranted.

PROBLEM

The concrete fascias along the exterior sides of bridge decks provide structural integrity and support the driving lane crash barriers. Through inspection and monitoring, MDOT discovered that while a bridge deck may be in good condition, the concrete fascia on one or both sides may be deteriorating.

Bridge deck fascias that are exposed to excessive amounts of moisture are susceptible to deterioration caused by corrosion of steel reinforcement embedded in the concrete and freeze-thaw cycles. The concrete can crack and debond from the reinforcement, potentially falling to the area below. Additionally, a weakening of the fascia can compromise the crashworthiness of the attached barrier extending above the deck's surface.

Patching the concrete only causes the same risk of debonding, so MDOT's practice has been to remove the delaminated concrete. This method, however, leaves the reinforcement exposed, subjects the fascia to further deterioration and decreases support for the crash barrier above. Repairs might otherwise require removing the barrier and a large portion of the bridge

New tools, repair methods and bridge designs support MDOT efforts to repair existing bridge deck fascias and prevent deterioration in new bridges.

(continued)

"We have a deeper understanding of bridge deck fascia deterioration, including when repair is warranted and what new design and materials options are available. This project enhances our ability to keep bridges safe and in service."

Matthew Beatty, P.E.
Project Manager

deck. MDOT wanted to understand the main causes of bridge deck concrete fascia deterioration and explore methods to prevent, assess and repair the damage.

RESEARCH

A comprehensive literature review and a nationwide survey of state departments of transportation (DOTs) explored deck fascia deterioration and practices for design, construction, maintenance, and repair.

To examine bridge fascia deterioration in the field, MDOT staff and researchers identified 40 bridges from around the state in various stages of deterioration. Information about these bridges was gathered to create a database that could then be used to identify trends and correlations of fascia deterioration. Parameters in the database included bridge age, number of spans, degree of deterioration, drainage direction, deck overhang thickness, and reinforcement coatings.

Nondestructive testing on six geographically varied bridges provided further evidence and informed lab testing parameters. Visual inspections, examination of coatings and surface hardness, and measurements of moisture content and corrosion validated and supplemented the findings indicated in the database. Standard test methodology and equipment identified corrosion potential on bridge deck areas. Reinforcement section loss was also measured on two bridges. Lab testing on concrete fragments and nine cores from areas with varying levels of deterioration on one bridge identified compressive strength and other concrete properties.

Researchers explored ways to assess fascia damage and the resulting impacts to the crashworthiness of the connected barriers. An investigation of proposed new repair methods included the incorporation of alternative concrete mixes and assessment through both small- and large-scale testing. Lastly, researchers identified design characteristics that would reduce moisture in concrete deck fascias for new bridges.

RESULTS

Field investigations and testing revealed that the main causes of bridge deck fascia deterioration included low-grade concrete and excessive moisture, which causes steel reinforcement corrosion leading to concrete debonding. Traffic volumes and open railings on crash barriers correlated with fascia damage. The slope of the deck exacerbated moisture issues, often creating greater deterioration on one side of a bridge.

Results from the nationwide survey of state DOTs found that none of the participating states have conducted research into bridge deck fascia deterioration. Instead, these agencies have focused on overall deck performance and durability.

Advances in concrete mixes allowed researchers to develop a fiber-reinforced, self-consolidating concrete mix that performed well and had an increased resistance to weathering. The new concrete mix along with protective coatings and other repair measures involving dowels and hooks epoxied into the bridge deck formed the basis for detailed fascia repair alternatives.

MDOT Barrier, a new software tool developed as part of this project, evaluates fascia condition based on inspection data characterizing any deterioration. Results identify the attached barrier's capacity and determine its crashworthiness to indicate if repair is needed.

Recommendations for designing new bridges incorporated the causes of deck fascia deterioration revealed in this project. New design specifications included options for the configuration of deck-to-barrier connections, specification of concrete mix for the bridge deck and protective coatings.

VALUE

MDOT bridge engineers can enter data into MDOT Barrier to identify deck fascias in need of repair. Pilot projects to assess the new materials and designs in the field could inform engineers about repair and construction options.

Research Administration

Principal Investigator

Fatmir Menkulasi, Ph.D.
Associate Professor
College of Engineering
Wayne State University
5050 Anthony Wayne Drive
Detroit, MI 48202

fatmir.menkulasi@wayne.edu
313-577-9950

Contact Us

PHONE: 517-281-4004

E-MAIL: MDOT-Research@Michigan.gov

WEBSITE: Michigan.gov/MDOTResearch

The final report is available online at
MDOTjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=SPR-1730.

Research Spotlight produced by
CTC & Associates LLC, March 2024.