MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-532 (project 670 | July 2024

Numerical Simulation of Strengthening of Bridge Decks Built with Partial Depth Precast Concrete Deck Panels

the ISSUE

In several states, bridge deck delamination of reinforced concrete bridge decks built with partial-depth precast concrete panels and cast-in-place concrete has been observed. The partial-depth precast concrete panels are typically prestressed repair methods for precast concrete panels, and cast-in-place bridge decks are needed to ensure composite behavior such that deck delamination does not pose a safety risk.

the RESEARCH

The goal of the study was to develop numerical models to predict the response of structurally delaminated and repaired decks. The primary objectives of this project included: (a) forensic analysis of composite deck samples made with a partial-depth-precast concrete panel section and a cast-in-place section from the I-15 800 South Bridge; (b) replication of non-composite specimens for testing; (c) destructive testing of retrofitted non-composite deck specimens; and (d) recommended solutions for repairing bridges affected by debonding of the cast-in-place concrete section from the precast section without impacting traffic.

This report presents the results of the project during which full-scale experiments were carried out. The first series of experiments used bridge deck specimens built in the laboratory, where the precast section was located at the bottom of the deck and was reinforced with prestressing cables in the span direction. The second series of experiments evaluated the performance of two salvaged specimens obtained from the I-15 800 South Bridge. The first salvaged specimen was tested without any retrofit solution, and the second was retrofitted using the epoxy injection method. Numerical models were developed for three cases to corroborate the laboratory testing: a delaminated deck panel with no retrofit, a nonproprietary shear anchor retrofit, and an epoxy injection retrofit.

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Project Title

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the **FINDINGS**

The partial depth deck panel retrofit methods described in this report are (1) a high modulus epoxy injection between the cast-in-place and precast sections, and (2) nonproprietary shear anchors connecting the cast-in-place and precast sections. The numerical models developed include: (1) deck panel with no retrofit, (2) deck panel with epoxy injection retrofit, and (3) deck panel with nonproprietary shear anchors. Similar to laboratory testing, the numerical model concluded that the epoxy injection increases deck panel stiffness significantly, thus creating a more composite behavior. After all the testing and analysis, the research team recommends that the epoxy injection retrofit method is the most effective for similarly constructed bridge deck panels affected by this type of debonding behavior.

the **IMPACT**

The Utah Department of Transportation and other state DOTs that use partial depth precast panels can benefit from the methods developed in this research to extend the life of bridge decks. The epoxy injection method can be used to create composite action in such deck panels between the precast portion and the cast-in-place portion. This repair method can eliminate damage to such bridge decks, which will reduce maintenance costs.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1181

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.