RESEARCH PROJECT CAPSULE
24-1ST
June 2024
TECHNOLOGY TRANSFER PROGRAM

Ultra-High Performance Concrete (UHPC) Application in Link Slabs for Crack Mitigation

JUST THE FACTS:

Start Date:
January 15, 2024

Duration:
24 months

End Date:
January 14, 2026

Funding:
TT-Fed/TT-Reg-5

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used / Implementation Potential

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PROBLEM

Connecting adjacent spans by jointless decks that provide continuity only through a link slab is gaining acceptance as an alternative to establishing full continuity through positive moment reinforcement embedded in continuity diaphragms. In addition to eliminating both the costs of joints and their associated maintenance, jointless decks also mitigate the deterioration of girder ends and bent caps by draining road wash and debris away from these areas.

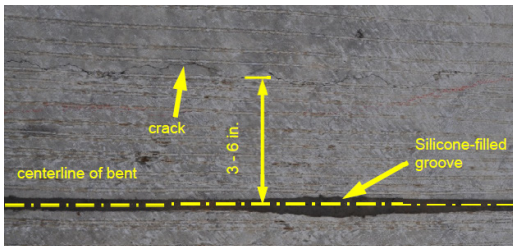

Figure 1. (at left) Ouachita River bridge view from east side looking at river crossing segment
Figure 2. (at right) Typical link slab crack location

The performance of link slabs under different scenarios was investigated in a field study of the Ouachita River bridge *(pictured above at left)* through LTRC Project 14-1ST (https://www.ltrc.lsu.edu/pdf/2020/FR_626.pdf). It was found that link slabs perform well in a floating span configuration up to a segment length of 540 ft. Due to the tension experienced by these link slabs, transverse deck cracking along the gap between adjacent spans was observed. It was also found that notches in the deck did not arrest cracks, as was initially hypothesized. Therefore, a new crack mitigation strategy is still needed. Ultra-High Performance Concrete is a new class of cementitious composites offering high compressive strength, relatively high tensile strength, and superior resistance to liquid ingress. Furthermore, it can sustain its tensile strength even after cracking due to the mix's discontinuous internal fiber reinforcement. Using UHPC for the link slab portions of bridge decks can help mitigate link slab cracking.

OBJECTIVE

The objective of this study is to explore the feasibility of using Ultra-High Performance Concrete (UHPC) in a bridge link slab for the purpose of producing crack-free continuity detail. This new link slab detail will employ a UHPC mix design that is suitable for Louisiana. The research plan described in this proposal will achieve the following goals:

- Develop a UHPC mix suitable for Louisiana bridge applications;
- Develop an instrumentation plan for monitoring the performance of a new link slab employing the selected UHPC mix;
- Assist in the procurement and overview of the installation of the aforementioned monitoring system; and
- Evaluate the performance of the newly employed link slab detail by analyzing and interpreting field data to understand its behavior and performance.

Additionally, the ultimate goal of the project is to provide DOTD with useful information on the performance of the new link slab detail to assist in updating the Louisiana Bridge Design and Evaluation Manual (BDEM).

METHODOLOGY

To achieve the objectives of this project, the research team will address both the UHPC mix design and performance and the field performance of a new UHPC link slab detail. The work will be divided into three components:

1. Develop a UHPC mix suitable for link slabs and characterize its properties in the lab;
2. Design an instrumentation plan for monitoring the performance of the link slab in the field; and
3. Collect and analyze field data from the monitoring system.

The research team will perform multiple tasks. First, they will begin with an in-depth literature review of UHPC mix design and link slab design. The team will then divide Task 2 into two subtasks. The first subtask will focus on the UHPC mix design. Based on the data assembled in Task 1, the literature review, and taking into account the aforementioned dense packing design models, the research team will begin the design and trials of UHPC mixes. In the second subtask, all batches will utilize several standard test methods to evaluate the mechanical performance of the designed UHPC.

The third task will involve designing a link slab detail for the bridge selected by the DOTD Bridge Design Section for the project. The team will then design an instrumentation plan before collecting the necessary data, processing it, and evaluating the UHPC link slab.

Finally, the research team will prepare and present a final report to the PRC before submitting the report and technical summary for publication.

IMPLEMENTATION POTENTIAL

Extending the service life of bridges in general, and bridge decks in particular, is of great importance to bridge owners. Bridge decks are known to deteriorate faster than their supporting beams. Deck cracking plays a major role in the deterioration process, and eliminating deck cracking, especially in link slabs in the vicinity of girder ends, can have a significant impact on the longevity of the deck, and consequently on the entire bridge. This will translate into savings related to maintenance and replacement costs.