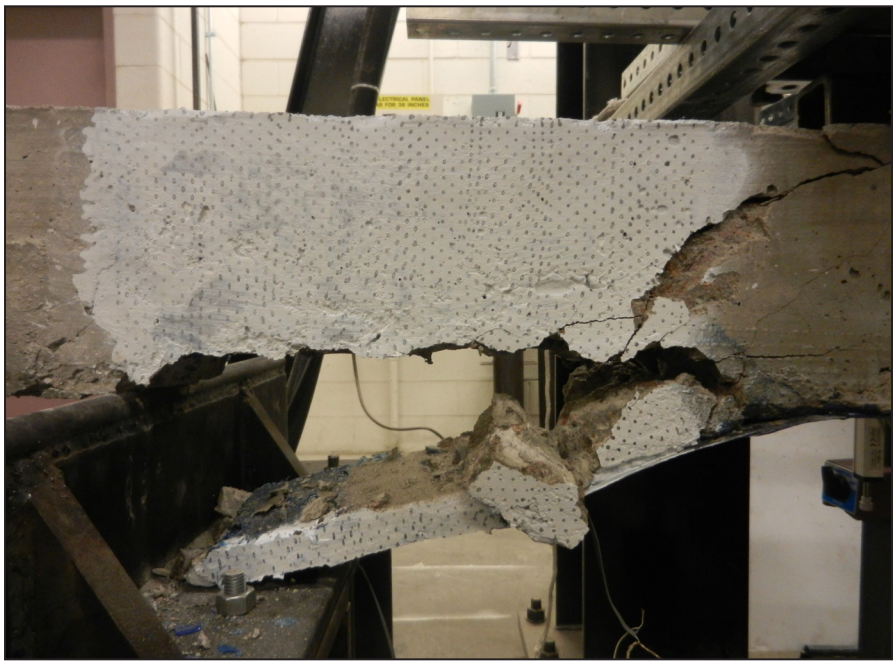
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 19-409 (project 516) | December 2019

Innovative Strengthening for Deteriorated Concrete Bridges Using Embedded Composite Sheets Bonded with Polyester-Silica



the ISSUE

The bond within a carbon fiber reinforced polymer (CFRP) concrete interface is instrumental in enabling the intended functionality of strengthened members. End-peeling concerns arise near the CFRP termination. A new anchoring technique is proposed to reduce the risk of end-peeling and stress singularities in CFRP-strengthened beams.

the RESEARCH

This research explores the feasibility of a novel anchor system with an emphasis on impeding end-peeling failure. The proposed anchorage is embedded inside a pre-grooved beam and protected by a durable polyester-silica composite matrix. To substantiate the practicality of the embedded CFRP anchors, an experimental program was conducted at material-, interface- and structure-levels. The primary parameters of the investigation were embedment angle and partial debonding, which are crucial to understand the load-bearing mechanism and failure characteristics of the beams with embedded CFRP.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

Colorado State University
North Dakota State University
South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
University of Wyoming

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Project Title

Innovative Strengthening for Deteriorated Concrete Bridges Using Embedded Composite Sheets Bonded with Polyester-Silica

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the **FINDINGS**

This research proposed a novel anchor system for CFRP-strengthened beams in order to address the unfavorable consequences of end-peeling. The proposed system was composed of angled CFRP sheets embedded in the anchorage, which were overlayed and covered by a durable polyester-silica composite. Multi-phase tests were conducted to investigate the material, interfacial, and flexural responses of the element- and structure-level specimens. Analytical approaches (correlation and sensitivity) characterized the effects of CFRP embedment angles and local debonding on the capacity of the strengthened beams.

The novel anchoring method will warrant the sustainable performance of CFRP-strengthening systems for bridge rehabilitation, particularly for mitigating the occurrence of premature bond failure that is a major concern in the subject area.

the **IMPACT**

The research contributes to the understanding of embedded-CFRP systems and will enhance the durability of strengthened concrete members and provide new techniques for bridge engineers who want to adopt state-of-the-art repair techniques to strengthen bridges and extend their lifespans.

For more information on this project, download the entire report at https://www.ugpti.org/resources/reports/details.php?id=983

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.

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