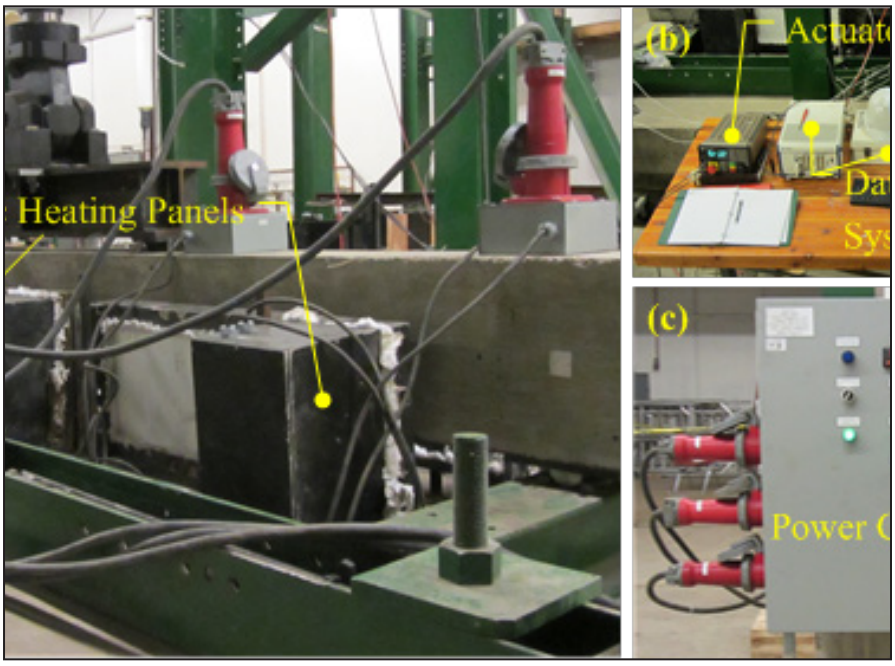
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 18-362 (project 412) | August 2018

Experimental Fatigue Assessment of CFRP-Retrofitted Reinforced Concrete Beams Subjected to Service Temperatures



the ISSUE

Federal, state and local road agencies are in need of cost effective ways to extend the safe working life of bridges and bridge components. Cyclic loading of bridges caused by passing traffic can lead to eventual fatigue failure of structural members. Fatigue is caused by cyclic stress ranges, which are below the material's ultimate strength, but which cause initial microscopic flaws in the material to accumulate and grow. To date most research on the use of carbon fiber reinforced polymers (CFRP) for the repair of infrastructure elements has been on its use to increase the stiffness and strength of reinforced concrete beams or columns. This study focuses on the steel reinforcing bars found in the reinforced concrete of bridges and which have been shown to be the limiting fatigue component reinforced concrete bridge structures.

the RESEARCH

Researchers studied the effect of externally bonded CFRP on slowing or arresting fatigue crack growth in the steel rebar in a reinforced concrete beam subjected to cyclic loading and service temperature. A unique experimental test was devised to directly measure fatigue crack propagation rates in the tensile steel reinforcement of full-scale reinforced concrete beams with and without CFRP repairs. The results of the tests were then used to determine the material constants in the Paris Law equation.

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

Fatigue Strength of CFRP-Repaired Reinforced Concrete Bridge Girders Under Service Temperature

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Civil and Environmental Engineering at CSU

USDOT, Research and Innovative Technology Administration

the **FINDINGS**

In general, the results show the benefit of adding CFRP for slowing down crack growth. Furthermore, the applied service temperature, within the tested range, appears to provide beneficial effect for increasing the fatigue life.

the **IMPACT**

Use of this retrofit approach will prolong the service life of reinforced concrete bridges that are subjected to deterioration and fatigue cycles. The added fatigue life could be doubled or tripled, which would result in significant cost savings for federal, state and local agencies and taxpayers.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=949

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.