MOUNTAIN-PLAINS CONSORTIUM

PROJECT BRIEF | MPC 15-303 | December 2015

Fire Performance of Bridge Members Retrofitted with Near-surface-mounted Carbon Fiber Reinforced Polymer Composites

the ISSUE

Carbon fiber reinforced polymer (CFRP) composites are a promising material for upgrading or repairing existing bridge members. Like other structural components, CFRP-retrofitted bridge members are exposed to potential fire hazards. Repaired members must, therefore, demonstrate acceptable fire resistance to ensure adequate structural integrity until travelling vehicles are evacuated.

the RESEARCH

This research presents a two-phase experimental program studying 1) the interfacial response of NSM CFRP strips embedded along a concrete substrate at elevated temperatures and 2) the behavior of NSM CFRP strips for strengthening concrete members subjected to thermomechanical distress (thermal and mechanical loads are applied simultaneously).

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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

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the **FINDINGS**

Although he residual strength of concrete and CFRP is not influenced by thermal exposure, effects were seen in the adhesives used. The performance of the CFRP-concrete interface bonded with an ordinary epoxy is better thanthe performance of a high-temperature adhesive without thermal distress, while the latter becomes superior to the former with an increase in temperature. The interaction between the adhesive and concrete controls the interfacial capacity and corresponding failure mode. The thermal relaxation of a polymeric bonding agent influences the transfer of interfacial stresses, including the stress-decrease response time of the interface with temperature. Transient heat flow is apparent across the interface until the strengthening system fails due to the thermomechanical load. The failure plane of the interface is governed by the progression of heat energy in conjunction with the phase transition of the adhesive. The slip of the interface articulates a thermal hysteresis mechanism when loaded cyclically.

the **IMPACT**

The research program has examined the behavior of NSM CFRP-concrete interface subjected to elevated temperatures. Experimental findings are useful for understanding the thermal response of constructed bridges strengthened with NSM CFRP composites, while analytical results assist practicing engineers who are interested in applying such strengthening technologies on-site.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=840

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7938 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.