

# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 20-413 (project 581) | June 2020

## Structural Fiber Reinforcement to Reduce Deck Reinforcement and Improve Long-Term Performance



### the **ISSUE**

The use of deicing salts on highway bridges has decreased the service life of bridge decks due to the accelerated corrosion of the steel reinforcement. The use of glass fiber reinforced polymer (GFRP) in bridge decks as a means of corrosion-mitigation has been met with some success. However, GFRP is a linear-elastic material that does not exhibit any plastic behavior prior to rupture, making it brittle and prone to possible failure.

### the **RESEARCH**

This current work provides a description of an experiment conducted on 14 full-scale 4'x12' flexural bridge deck specimens and six full-scale 14'x12' punching shear specimens. The decks contained steel-reinforcement, GFRP-reinforcement, or discrete GFRP-reinforcement combined with alkali-resistant fiberglass composite macrofibers. The addition of the macrofibers with GFRP bars, or hybrid reinforced concrete (HRC), was an attempt at improving ductility in the otherwise brittle GFRP-reinforced decks. Preliminary cost analysis suggests that the HRC decks are cost neutral to epoxy coated rebar decks.

The investigation consisted of two parts: the static testing and the cyclic and post-cyclic testing. The cyclic specimens experienced either 1 or 2 million cycles at the service level. The HRC decks exhibited more flexural ductility prior to the rupture of the concrete than both the steel- and GFRP-reinforced deck panels. Under fatigue loading, all of the decks performed within the AASHTO criteria for service level crack width and deflections. Therefore, based on the results, the HRC reinforcement strategy is viable for both ultimate and service limit states.



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### Lead Investigator(s)

Marc Maguire  
Utah State University  
marc.maguire@unl.edu

### Research Assistant(s)

Jared McRory, GRA, MS  
Fray F. Pozo-Lora, GRA, PhD  
Zachary Benson, Undergrad

### Project Title

Structural Fiber  
Reinforcement to Reduce  
Deck Reinforcement  
and Improve Long-Term  
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### the FINDINGS

By combining GFRP macrofibers with GFRP rebar, ductility and bond performance increased and all decks (steel, GFRP and hybrid schemes) performed acceptably under harsh cyclic loading conditions. Behavior was predictable and safe for all reinforcing schemes. The HRC decks, which are shown to be cost-neutral with traditional epoxy coated decks, provide acceptable structural performance and cost and may greatly reduce long term maintenance costs through elimination of corrosion.

### the IMPACT

The HRC decks, which are shown to be cost-neutral with traditional epoxy coated decks, provide acceptable structural performance and cost and may greatly reduce long term maintenance costs through elimination of corrosion.

For more information on this project, download the entire report at <https://www.ugpti.org/resources/reports/details.php?id=989>

For more information or additional copies, visit the Web site at [www.mountain-plains.org](http://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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