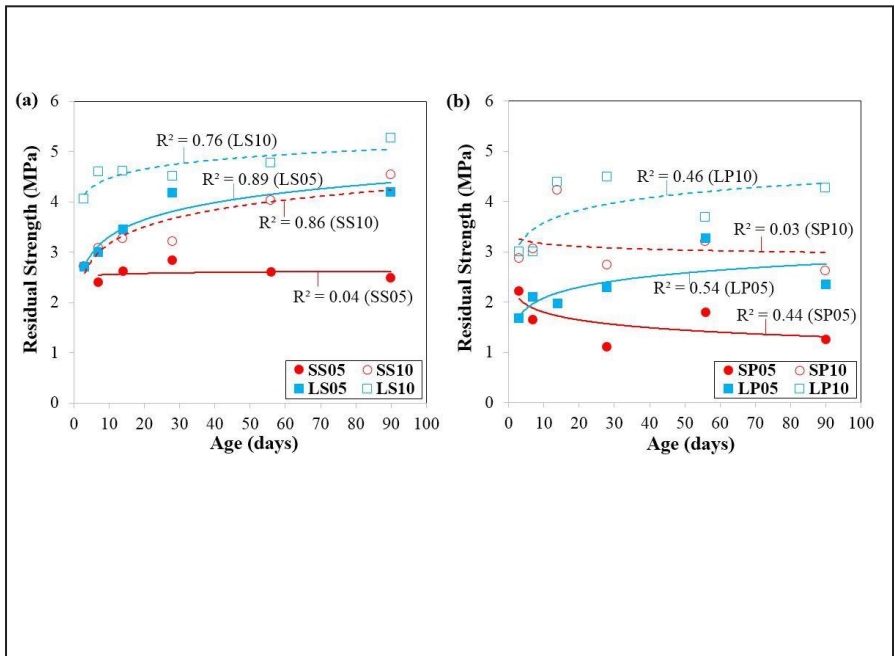


# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 18-353 (project 492) | July 2018

## Early-Age Fiber-Reinforced Concrete Properties for Overlays



### the ISSUE

Fiber-reinforced concrete (FRC) has been used for concrete pavement overlays for a few decades. It is well documented to improve performance over unreinforced plain concrete in the aspects related to crack initiation, and crack propagation. When selecting an appropriate fiber-reinforced concrete for the design of thin overlays, the flexural residual strength is the primary design criteria used. One major challenge with the FRC industry and use in pavements is that the test does not specify when (age of overlay) these tests should be performed. It was hypothesized that the FRC properties change with age and that not having a specified age for the test to be performed would result in variable performance in the field.

### the RESEARCH

Five concrete combinations were investigated including: plain unreinforced concrete against FRC with a short steel fiber, a long steel fiber, a slender synthetic fiber, or a shorter synthetic fiber. An array of tests were performed such that specimens were tested anywhere from 3 to 90 days of age. Test methods performed included compressive strength, shrinkage, coefficient of thermal expansion, wedge-splitting fracture, and flexural strength. Two or three replicates were examined. Statistical p-values and regression fits with R<sup>2</sup> values were calculated.



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



### Lead Investigator(s)

Amanda Bordelon  
bordelon@gmail.com  
University of Utah

### Project Title

Statistical Analysis and  
Sampling Standards for  
Maintenance Management  
Quality Assurance (MMQA)

### Research Assistant(s)

Min Ook Kim, GRA, PhD

### Sponsors | Partners

Utah Department of  
Transportation

USDOT, Research and  
Innovative Technology  
Administration

### the FINDINGS

Compressive strength, free drying shrinkage, coefficient of thermal expansion and modulus of rupture all demonstrated statistically negligible effects regardless of fiber addition. Post-cracking residual strength was found to increase with age for the FRCs exhibiting deflection hardening. All FRC mixtures observed a potential decrease in residual strength ratio with age, and an increase in fracture energy with age.

### the IMPACT

FRC is becoming more popular as an alternative material choice for overlay pavements. States are adding or updating their specifications every year. This research indicates to them that they should not just specify performance values measured in the lab, but also the age of the material on which testing is to be performed. For practical purposes, the authors currently recommend an age of 28 days.

For more information on this project, download the entire report at <http://www.ugpti.org/resources/reports/details.php?id=912>

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.



This publication was produced by the Mountain-Plains Consortium at North Dakota State University. The contents of this brief reflect the views of the authors, who are responsible for facts and the accuracy of the information presented herein. This document is disseminated under the program management of the USDOT, Office of Research and Innovative Technology Administration in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.



NDSU does not discriminate in its programs and activities on the basis of age, color, gender expression/identity, genetic information, marital status, national origin, participation in lawful off-campus activity, physical or mental disability, pregnancy, public assistance status, race, religion, sex, sexual orientation, spousal relationship to current employee, or veteran status, as applicable. Direct inquiries to Vice Provost, Title IX/ADA Coordinator, Old Main 201, 701-231-7708, [ndsuoaaa@ndsu.edu](mailto:ndsuoaaa@ndsu.edu).