MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 17-342 (project 437) | December 2017

Fiber-Reinforced Concrete for Structure Components

the ISSUE

Fiber reinforced concrete (FRC) helps control micro cracks and potential risks of chemical intrusion which cause early deterioration of the concrete. There are many fiber products for use in FRC, but the applicability and cost-effectiveness of the different products have not been evaluated systematically for bridge applications in South Dakota.

the RESEARCH

This research involved three main tasks: performing a comprehensive literature review, assessing current use of FRC by SDDOT and other state DOTs, and conducting experimental work on FRC mixtures having different fiber types and dosages. The literature review and interviews looked at past FRC experiences and existing design and construction practices, in addition to the most recent studies about the effect of different factors on the properties of FRC. A total of 20 FRC mixes were tested. The mixes had the same basic design but incorporated four different synthetic and one steel fiber types. For each fiber type, four different fiber dosages were used. One additional mix with no fibers served as a control mix. Several fresh and hardened concrete properties were measured to examine the effect of fiber type and dosage. These included air content, slump, compressive strength, average residual strength, flexural strength, and impact resistance. Statistical analyses were carried out to examine the significance of the effect of fiber type and dosage on each of the measured properties.

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Fiber-Reinforced Concrete for Structure Components

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the **FINDINGS**

Fibers enhance the ductility, toughness, impact resistance, tensile strength, flexural strength, and post-crack load-carrying capacity of the concrete. The addition of fibers reduce compressive strength and modulus of elasticity of concrete by an average of 18 % and 13%, respectively. Steel FRC has superior flexural properties compared to synthetic fibers. However, steel FRC is susceptible to corrosion and its use should be limited to Jersey barriers since they are not exposed directly to deicer salts. The type of synthetic fiber has no significant effect on any of the fresh and hardened concrete properties that were measured in this study. Slump decreases nonlinearly with the increase in fiber dosage. The average maximum slump drop was about 2.75 inches at the highest dosage rate of 0.69%. Of the four synthetic fiber types investigated in this study, two were found to be more cost effective than the other two.

the **IMPACT**

The experimental results and the findings from the literature review and interviews with officials from several departments of transportation were used to draft FRC design, construction, and testing guidelines for South Dakota Department of Transportation.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=899

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.