MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 19-401 (project 560) | December 2019

Calcium Sulfoaluminate Cement Concrete for Prestressed Bridge Girders:Prestressing Losses, Bond, and Strength Behavior

the ISSUE

Due to the growing need for increased turnover and production of precast/prestressed concrete, there is much need for research to speed up this process. The implementation of rapid setting concrete is one potentially sustainable alternative for use in precast/prestressed concrete. The rapid-set properties of calcium sulfoaluminate (CSA) cement can increase prestressing casting bed turnover rate and may provide a more sustainable option to Portland cement. It's estimated that the carbon dioxide emissons required to produce Portland cement concrete could be reduced by nearly 50% by using CSA cement. To be used safely used in prestressed bridge girders, it must be determined if the American Association of State Highway and Transportation Officials load and resistance factor design (AASHTO LRFD) bridge design specification can be used to predict the behavior of girders made with such cement.

the RESEARCH

This research investigates if the AASHTO LRFD bridge design specification can be used to predict the behavior of girders made with CSA cement. CSA cement was used to cast a prestressed voided deck slab bridge girder. Prestress losses were monitored long-term using vibrating wire strain gages cast into the concrete at the level of the prestressing strands and the data was compared to the AASHTO LRFD predictions for prestress losses. Material testing was performed to quantify material properties including compressive strength, tensile strength, static and dynamic elastic modulus, creep, and drying and autogenous shrinkage. The material testing results were compared to AASHTO predictions for creep and shrinkage losses.

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University of Denver
University of Utah
Utah State University
University of Wyoming

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Project Title

Calcium Sulfoaluminate Cement Concrete for Prestressed Bridge Girders:Prestressing Losses, Bond, and Strength Behavior

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Olympus Precast, SLC (provided birdge firder and transport)

USDOT, Research and Innovative Technology Administration

the **RESEARCH** (continued)

The crack reopening test for effective prestress was compared to the AASHTO prediction and AASHTO appeared to be effective in predicting losses based on the crack reopen data. The midspan failure was a shear failure, as accurately predicted by AASHTO. The 1.25d test resulted in a bond failure, which was accurately predicted by the AASHTO bond model for prestressed concrete.

the **FINDINGS**

After successfully casting a large-scale voided slab bridge girder using CSA cement, the girder was monitored for prestress losses, transfer and development length and destructively tested. In all cases, the AASHTO LRFD predictions adequately predicted behavior, indicating that bridge designers can use this type of cement for a more sustainable and possibly economical structure.

the **IMPACT**

This research will enable the use of CSA cement, a more sustainable cement that is arguably more durable and can harden rapidly. This is the first testing of a full-scale structure using CSA cement in the United States.

For more information on this project, download the entire report at https://www.ugpti.org/resources/reports/details.php?id=985

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.

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