

# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 17-329 (project 402) | September 2017

## Seismic Performance of Self-Consolidating Concrete Bridge Columns



### the **ISSUE**

Rectangular bridge columns in high seismic areas require high amounts of confining steel. Self consolidating concrete is ideal for the construction of concrete members with high steel congestion. However, there is lack of data on the seismic performance of rectangular self consolidating concrete bridge columns.

### the **RESEARCH**

The study had two main objectives: 1) assess stress-strain relationships of self consolidating concrete (SCC), and 2) evaluate the seismic performance of rectangular SCC bridge columns. To accomplish the first objective, three SCC and four conventional concrete (CC) mixtures were designed, batched, and tested under uniaxial compression. Fresh and hardened properties were measured, and typical stress-strain parameters were evaluated to compare SCC to CC mixes. To fulfil the second objective, two SCC and two control CC rectangular column specimens were designed, fabricated, instrumented, and tested under combined axial load and quasi-static cyclic lateral loading.



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)

Nadim Wehbe  
nadim.wehbe@sdstate.edu  
South Dakota State University

### Project Title

Seismic Performance of  
Self-Consolidating Concrete  
Bridge Columns

### Research Assistant(s)

Ahmad Ghadban  
Post-Doctorate Scholar  
Todd Pauly  
Graduate Research Assistant

### Sponsors | Partners

USDOT, Research and  
Innovative Technology  
Administration

## the FINDINGS

The experimental results of the material tests showed that for the same concrete strength, SCC has higher strain at strength and ultimate strain, lower material ductility, and lower elastic modulus than conventional concrete. The results of the column specimens showed that SCC bridge columns provide adequate performance under high inelastic lateral load reversals. Compared to CC columns, SCC columns exhibited lower displacement ductility, higher drift ratio, and lower energy dissipation.

## the IMPACT

Self consolidating concrete can be specified for the construction of bridge columns in seismic areas. The use of self consolidating concrete will expedite the construction process and will eliminate construction deficiencies arising from steel congestion in bridge columns.

For more information on this project, download the entire report at <http://www.ugpti.org/resources/reports/details.php?id=883>

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 for Title IX/ADA Coordinator, Old Main 201, NDSU Main Campus, 701-231-7708, [ndsu.eoaa@ndsu.edu](mailto:ndsu.eoaa@ndsu.edu).