# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 17-321 (project 405) | March 2017

## Seismic Retrofit of Spliced Sleeve Connections for Precast Bridge Piers

## the **ISSUE**

The rehabilitation method described in this paper concerns connections between precast columns and footings, and precast columns and pier caps. This research uses high-performance materials, including headed reinforcing bar, epoxy, nonshrink or expansive concrete, and carbon fiber sheets to repair damaged columns constructed using accelerated bridge construction (ABC) techniques.

## the **RESEARCH**

The joints or connections between a precast concrete columns, pier caps, and footings play an important role in the seismic performance of a bridge. This research investigates the retrofit of joints for ABC components of bridges located in seismic regions. Grouted Splice Sleeve (GSS) connectors were used to construct column-to-footing and column-to-pier cap joints. Half-scale models were designed and constructed based on typical reinforced concrete bridges. Cyclic quasi-static loading was applied to the half-scale specimens. The precast column-to-footing joint incorporated one type of GSS where the bars were grouted at both ends (GGSS); the precast column-to-pier cap joint used a different GSS type where one bar was threaded into one end and the other bar was grouted into the opposite end (FGSS). After the as-built tests, the GGSS column-to-footing joint and FGSS column-to-pier cap joint were repaired and tested again. The repair utilized prefabricated Carbon Fiber-Reinforced Polymer (CFRP) shells, epoxy anchored headed mild steel rebar, and non-shrink concrete to relocate the column plastic hinge. Experimental results show that performance of the repaired precast test specimens was satisfactory. The method is simple and rapid and could be used to repair bridges constructed with joints utilizing GSS connectors.

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## Project Title

Seismic Retrofit of Spliced Sleeve Connections for Precast Bridge Piers

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## the FINDINGS

The plastic hinge was successfully relocated to the column section adjacent to the repair. The method is simple and rapid and could be used to repair bridges constructed with joints utilizing GSS connectors. Although the repair was developed for precast concrete elements connected with grouted splice sleeves, it could be extended to seismically retrofit and repair existing columns as well. It has the potential to be used in the retrofit of column connections before an earthquake as well as a rapid repair method for such column connections after an earthquake. The method successfully restored the performance of the damaged specimens in terms of displacement capacity, load capacity, energy dissipation and stiffness.

## the IMPACT

The project has a great impact in the rapid seismic retrofit or repair of bridges that are substandard according to current seismic codes. The methods developed can speed the repair of such bridges significantly. Society can benefit from reduced delays in repairing bridges after an earthquake. Several DOTs are interested in adopting the repair method developed in this research.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=865

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7938 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.