MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 19-372 (project 511) | February 2019

Mechanical Bar Splices for Accelerated Construction of Bridge Columns

the ISSUE

Couplers are not allowed to be used in bridge column plastic hinges in high seismic regions. This prevents their use as a precast column connection. This ban is because of a lack of systematic test data on the coupler performance, limited experimental studies on mechanically spliced columns, and engineering precautions.

the RESEARCH

The objectives of this study were to establish the behavior of mechanical bar splices suited for bridge columns, to generate an experimental database for such couplers, and to quantify the effect of such couplers on the seismic performance of bridge columns. All U.S. mechanical bar splice manufacturers were contacted, nine different coupler products were selected for testing, and more than 160 couplers were tested to failure under new monotonic and cyclic loading protocols. Three bar sizes, No. 5 (16 mm), No. 8 (25 mm), and No. 10 (32 mm), were included in the test matrix. A coupler material model and acceptance criteria were selected from the literature and then the behavior of the nine coupler products was established through experiments. The first-of-its-kind and unified database on the properties of bar couplers was developed and “seismic” and “non-seismic” couplers were identified. Furthermore, more than 240 pushover analyses were performed on mechanically spliced bridge columns to quantify the coupler effects on their seismic behavior.

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Project Title

Mechanical Bar Splices for Accelerated Construction of Bridge Columns

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the **FINDINGS**

The experimental data showed that the coupler length, size, and type significantly affect the splice performance. The general trend was that longer couplers exhibited lower strain capacities compared to shorter couplers. Couplers with higher rigid length factors showed the lowest strain capacities. Furthermore, the coupler acceptance criteria and the coupler stress-strain model proposed by Tazarv and Saiidi (2016) were found viable to identify couplers that are suited for bridge columns. These couplers were categorized as "seismic couplers." The test data also showed that consistent performance can be achieved using the proposed standard testing method for couplers. Finally, the parametric study showed that the size, type, and length of couplers can significantly affect the ductility of bridge columns. Longer couplers and couplers with higher "rigid length factors" may reduce the column displacement ductility capacity by 43%.

the **IMPACT**

1. Development of a new testing standard for mechanical bar splices,
2. Development of a comprehensive database for mechanical bar splices,
3. Integration of the experimental and analytical findings in the graduate and undergraduate level courses.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=932

Research Website:

https://sites.google.com/people.unr.edu/mostafa-tazarv/research/bar-couplers

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.