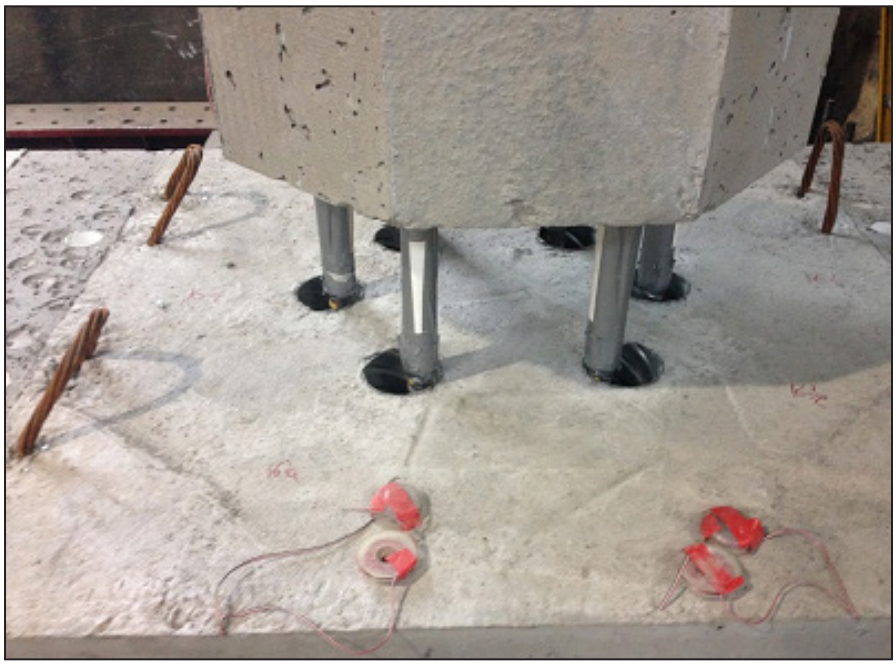
MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 22-473 (project 638) | July 2022

Analysis of ABC Bridge Column-to-Footing Joints with Recessed Splice Sleeve Connectors



the ISSUE

The use of precast concrete in bridge construction has been abundant in recent years because of its efficiency and superior quality control. Precast components are connected at the bridge site to reduce construction time and traffic disturbance. The grouted splice sleeve (GSS) connection provides good bending moment resistance between precast reinforced concrete (RC) components. This connection type has been widely employed in non-seismic areas. The use of this connection in moderate or high seismic zones has been explored and proposed for medium-size highway bridges. It is essential to propose a numerical modeling technique at the local and global level with the proposed connection type.

the RESEARCH

This research proposes a computational modeling technique that can predict the local and global response of column-to-footing joints with recessed GSS and intentional debonding. The model is focused on the local GSS response and the load path within the connection; in addition, the bond-slip response of the GSS is characterized. When intentional debonding is present, the contribution of reinforcing bars to structural response is softened, and a new model that includes this effect is needed; intentional debonding changes the extent of the strain penetration region, resulting in a different plastic hinge length. Hysteretic energy from loading cycles is compared to verify the agreement of the proposed numerical model with experimental results. Several modeling considerations are used, including plastic hinge length, bond-slip, debonding behavior, and low-cycle fatigue to match the experimental behavior of the columns tested under cyclic loading. The numerical model was prepared, and numerical results were obtained regarding local and global response of the cast-in-place column-to-footing connection, and Test 1 and Test 2 type column-to-footing connections with intentional debonding. Results showed that the hysteretic response obtained due to cyclic loading was almost identical for the proposed numerical model and the experimental results.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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
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Project Title

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the FINDINGS

The cumulative errors in hysteretic energy between the model and the experiments were found to be 6% and 2%, respectively, for the Test 1 and Test 2 type specimens. The experiments were stopped when fracture of a longitudinal bar occurred or when there was a 20% drop in the peak load during cyclic loading. After validating the computational model using the experiments, a three-column bridge bent from an actual bridge was modeled, including soil structure interaction; the results of the model were compared with the full-scale experiment of a three-column bridge bent. The seismic response of the proposed three-column bridge bent was investigated under far-field and near-field ground motions, and the performance was evaluated using the demand-capacity ratio at maximum drift and the drift ratio at maximum seismic demand.

the IMPACT

The research is expected to facilitate the use of recessed connections with intentional debonding, such as the one studied in this research for bridge bents constructed in seismic regions using accelerated bridge construction.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1114

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.