CENTER FOR TRANSPORTATION INFRASTRUCTURE AND SAFETY

Repair of Earthquake Damaged Bridge Columns with Fractured Bars

by

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16. Abstract

The objective of this study is to repair three, half-scale RC bridge columns that will be tested to failure under slow cyclic loading. These columns will have fractured longitudinal and transverse steel. The ultimate goal is to develop repair methods for these columns using different techniques. In the first two columns, different Caltrans approved ultimate splices will be used, and in the third column, an enlarged section will be built in the plastic hinge area. The target performance for the repaired columns is to restore the lateral load and ductility capacity to the level that is comparable to that of the original columns.

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Dr. Sneed's Ph.D. student, Ruili He, was supported in part by NUTC funds from August 20, 2012 to May 31, 2013. During this period, Ms. He assisted with the experimental work for this project. Two large-scale (1:2) reinforced concrete columns were successfully tested in the High Bay Structural Engineering Research Laboratory at Missouri S&T. The results of these experiments were disseminated in a presentation at the American Concrete Institute Spring 2013 Convention in the Research in Progress session. This final report includes the abstract of this activity. Information on the presentation is included below:

Yang, Y., Sneed, L.H., Saiidi, M., and Belarbi, A., April 15, 2013, ACI Spring 2013 Convention, Minneapolis, MN, "Repair of Earthquake-damaged Reinforced Concrete Bridge Columns with Interlocking Spirals and Fractured Longitudinal Bars."

Repair of Earthquake-damaged Reinforced Concrete Bridge Columns with Interlocking Spirals and Fractured Longitudinal Bars

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This presentation will describe results of ongoing research conducted to study the performance and effectiveness of a repair technique to restore the capacity of bridge columns severely damaged by earthquakes. The study includes three half-scale, oval-shaped reinforced concrete columns with interlocking spirals that were previously tested to failure under combined bending, shear, axial, and torsion with slow cyclic loading. Fractured longitudinal bars and crushed core concrete were observed at failure. Within the plastic hinge region, the repair procedure included removal of concrete and spirals, replacement of longitudinal bars using mechanical couplers, replacement of concrete, and application of an externally bonded carbon fiber reinforced polymer (CFRP) jacket. Outside the plastic hinge region, the repair included replacement of spalled concrete and application of an externally bonded CFRP jacket. The repaired columns were tested under the same loading protocol used in previous test. Test results show that the repair technique is successful in restoring both the flexural and torsional strength as well as displacement and rotational ductility. Repair design guidelines and procedures will be provided based on the test results and further analytical studies.

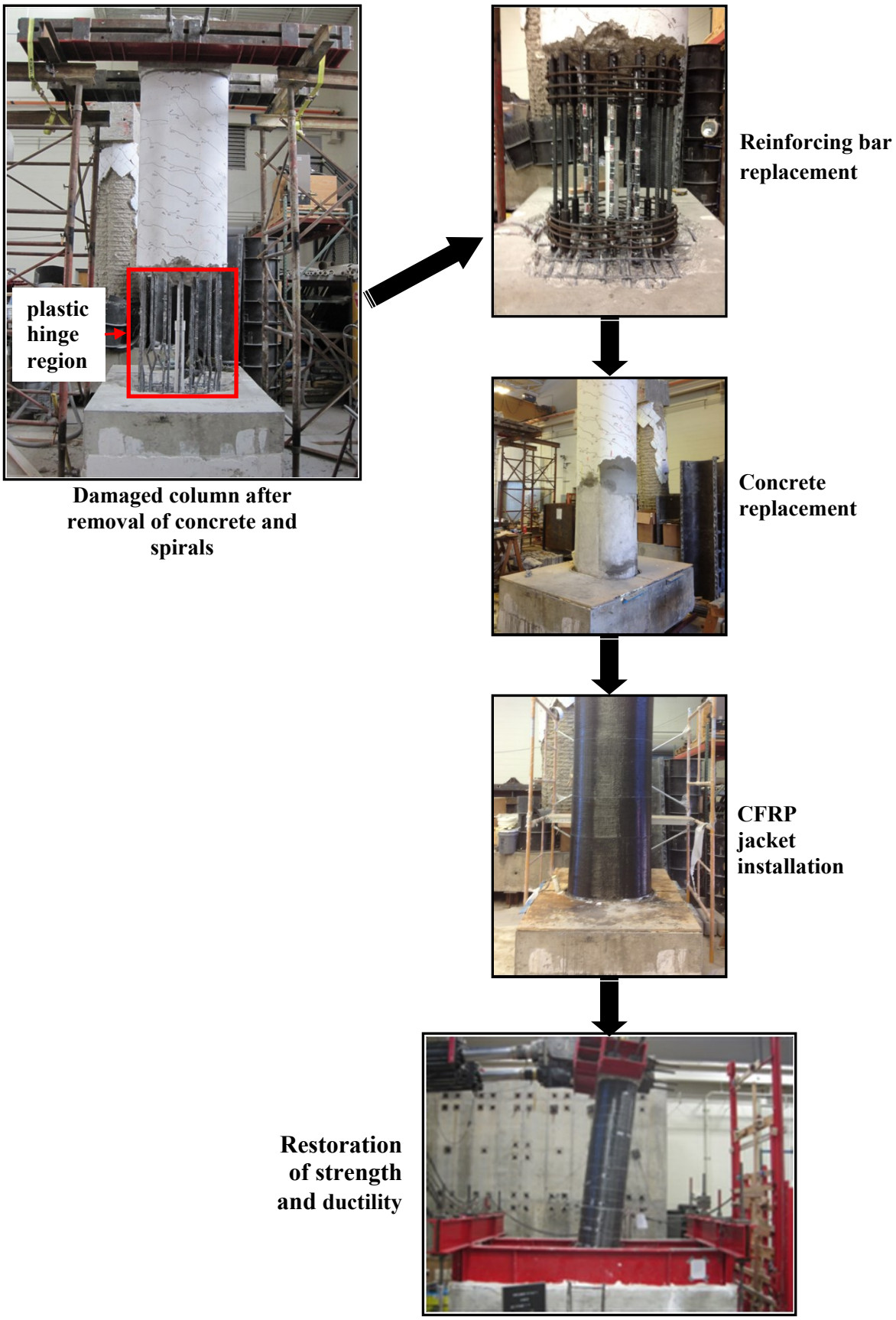

Figure 1: Repair of column with interlocking spirals and fractured longitudinal bars