ABC-UTC Seismic Performance Studies of Precast Bridges from Connections to Components to Bridge Systems at UNR

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ABSTRACT

The focus of the research conducted at the University of Nevada, Reno (UNR) as a partner of the ABC-UTC has been on projects that lead to information and tools for the implementation of reliable Earthquake-Resisting Elements (ERE) that utilize prefabricated bridge elements (PBElements) for bridges in moderate and high seismic zones. Towards this goal, much emphasis has been placed on three areas: 1) earthquake-resistant connection performance with prefabricated bridge columns, pier caps, and footings as Earthquake-Resisting Elements (ERE); 2) prefabricated bridge columns incorporating conventional and novel materials; and 3) the performance behavior of these prefabricated elements and their connections as they behave as an earthquake-resisting system (ERS).

The studies to be presented in the first category have concentrated mostly on pocket connections in cap beams and footings. The shake table tests of these connections as an ERE utilizing conventional grouts and ultra-high performance concrete (UHPC) will be summarized. ERE studies conducted to date include prefabricated precast columns that are post-tensioned using carbon fiber reinforced polymer (CFRP) composite tendons and columns with plastic hinges that incorporate engineered cementitious composite (ECC) and UHPC. The differences between the performance of the columns with steel tendons and those with CFRP tendon will be presented; in addition to the test results that have revealed the relative merit of using ECC and UHPC in the plastic hinge zones.

Finally, a two-span bridge system model utilizing a steel superstructure with precast full-depth deck panels, columns with grouted duct connections, and pocket connections at the base has been designed with construction underway for shake table testing. The shake table test of this bridge model can help extend the application of the simple for dead and continuous for live load (SDCL) steel-girder bridges in high seismic regions using the SDCL seismic detail that was developed at FIU. An ERE test for the SDCL connection is planned at FIU prior to the shake table testing of an entire ERS. These models are also being analyzed using nonlinear dynamic methods to compliment the outcomes of the shake table tests. The workshop presentation will summarize the studies and practical lessons that have been learned.