Seismic Performance of Pile to Pile-Cap Connections

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A 3-column prestressed bridge bent representing a design to be used by the South Carolina Department of Transportation is being constructed at the University of Nevada, Reno. As an initial investigation into the 3-column bent project, single prestressed column experiments were performed at the University of South Carolina in order to better understand the pile to pile-cap connections. The full scale specimen will be used to study the seismic performance of these connections under increasing earthquake intensities. The results of this experimental study together with the analytical model data with allow future bridge engineers to design these types of bridge supports more accurately and economically.

Initially, the University of South Carolina constructed single pile computer models in order to determine the characteristics of each individual prestressed pile. This data was used to better understand the behavior of the piles, better understand the demand on the lab equipment, and as a comparison to the test data that was recorded during the tests that followed. Many pile connection details were analyzed in order to determine the types of connections to be used on the 3-column bent specimen.

Figure 1: University of South Carolina Test Setup.

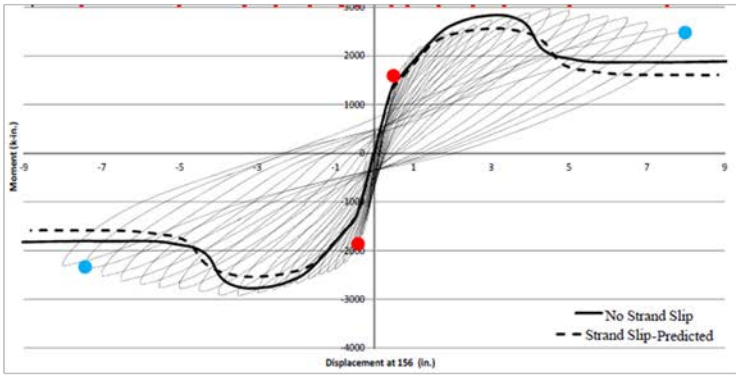

Figure 2: Single Pile Test Data (Moment-Displacement Curve).

A 3-column bent model was analyzed at the University of Nevada, Reno using the structural analysis program SAP2000. This model was used to determine the structure's behavior under various earthquake motions in order to determine the ground excitation that put the highest demand on the column to bent-cap connections.

The model was also used to convert the ground accelerations from the chosen motion to displacements at the bent cap. These displacements will be performed by an actuator in order to simulate the earthquake.

Due to the immense size of the 3-column specimen and the fact that the shake tables at the University of Nevada, Reno Large Scale Structures Lab were already occupied, the decision was made to test the structure on its side on the newly constructed floor addition to the structures lab. This created a new set of challenges to overcome in order to mimic the true bent behavior in the field and the true earthquake motion. First, a bridge deck is the main source of dead load weight for a bridge support. With the bent on its side this load would no longer be applied through the length of the columns by gravity. In order to fix this, rams will be used to apply a force in each column equal to the force that would occur due to the bridge deck.

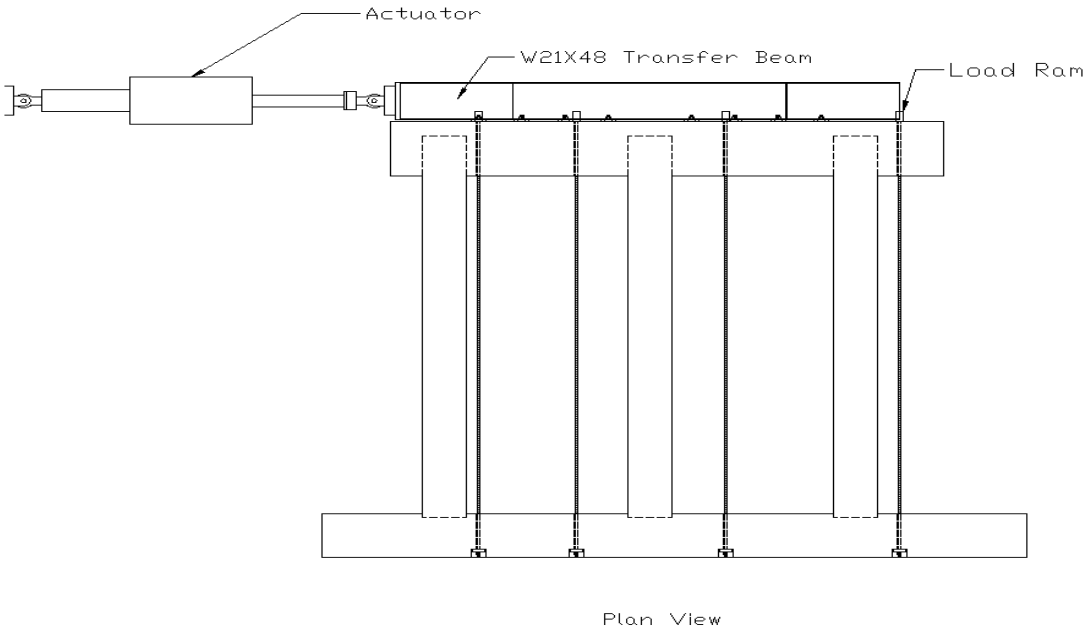

Figure 3: 3-Column Bent Test Setup

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