Extending Application of Simple for Dead and Continuous for Live Load Steel Bridge System to ABC Applications in Seismic Regions- Phase II- Experimental

PROGRESS REPORT

Period ending June 30, 2016

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Aug 2016

ABC-UTC
Research Progress Report
Title: Extending Application of Simple for Dead and Continuous for Live Load Steel Bridge System to ABC Applications in Seismic Regions- Phase I- Numerical Study

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COMPONENT TEST

Develop an experimental testing program, capable of verifying the project recommendation in Phase II of the study. For this purpose, a column with girders at two side considered to construct in the structure lab of FIU. A schematic view of the component test was shown in Figure 1. According to CALTRANS capacity protected members such as footings, bent cap and superstructure should be designed to remain essentially elastic during seismic events when the column reaches its over strength moment capacity.

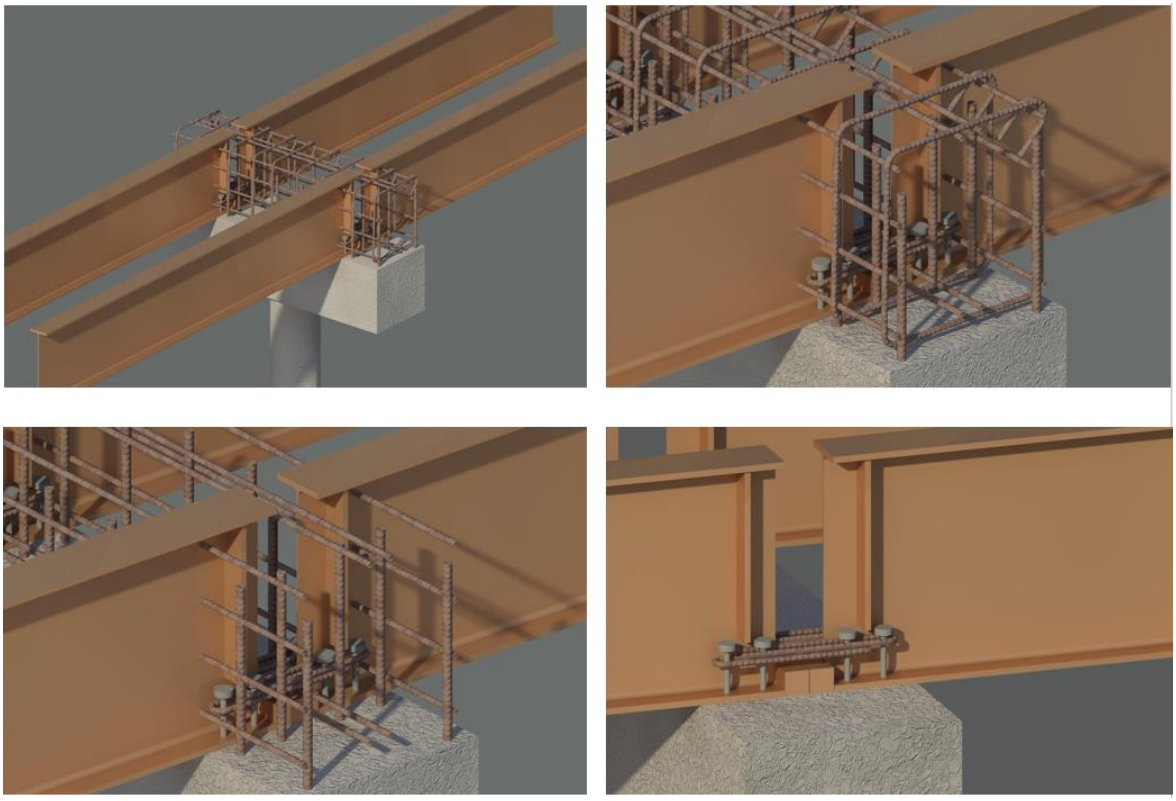


Figure 1 Schematic view of component test

COLUMN PROPERTY OF COMPONENT TEST

The column of component test designed by UNR research team. Based on provided information by UNR, the prototype bridge is a two span steel I girder bridge including 48 in diameter concrete column which reinforced with 32#11 vertical bars and #7 hoop every 4 in. One third scale specimen of this bridge is going to be constructed in FIU structure lab as component test. The component test comprising a 16 in diameter

concrete column which reinforced with 12#5 vertical bars and #3 hoop every 2.5 in. The stress-strain curve of core concrete considered as confined Mander. The geometry and reinforcement bars of the column demonstrated in Figure 2.

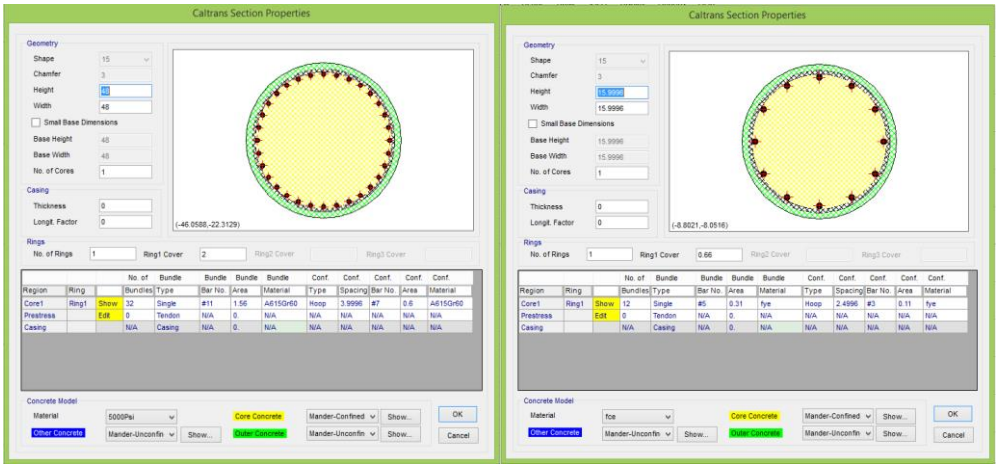


Figure 2 Column property definition- left (full scale), right (one-third scale).

COLUMN AND BENT CAP FLEXURAL CAPACITY

Moment capacity of the column and cap beam in transverse direction (here cap beam refers to the concrete beam which comprises bent cap and concrete diaphragm) calculated by a Moment-Curvature analysis. Section Designer inside of SAP2000 software was used for this purposes and calculating Icracked for the column (SAP2000). The finite element software ANSYS used to compute the moment capacity of the system in longitudinal direction (traffic direction). Notice for the moment curvature analysis in the transverse direction, the section is not symmetric, therefore analysis conducted for both negative and positive moments and the minimum considered for comparison with the column capacity.

According to CALTRANS, bent cap shall be designed as a capacity protected member and remained essentially elastic for flexural forces once the column reaches its over strength moment capacity. The capacity design approach guarantee the super structure and bent cap have enough demand strength to carry transferred forces from the column at the ultimate load level. The expected nominal moment capacity Mne of the capacity protected members might be computed using M-ϕ analysis. The expected nominal moment capacity shall be based on expected material property when concrete strain reaches 0.003 or the steel strain reaches ε_{su}^{R}. Reduced ultimate tensile strain (ε_{su}^{R}) is equal to 0.09 for #10 bars and smaller, and is equal to 0.06 for #11 and larger. Following Figures show the moment capacity of the column and bent cap (longitudinal and transverse direction) for the full scale and one third scale model. For the bent cap in longitudinal direction, the moment capacity of one girder calculated based on finite

element model and two times of this capacity compared with moment capacity of the column.

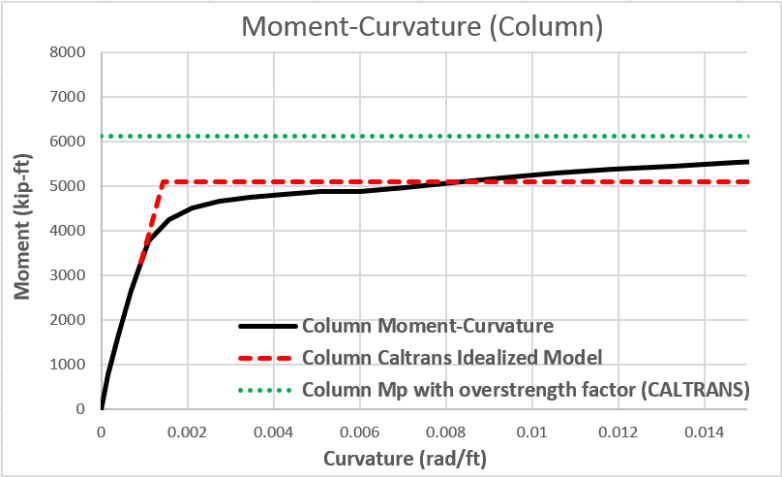


Figure 3 Column Moment-Curvature for the full scale model.

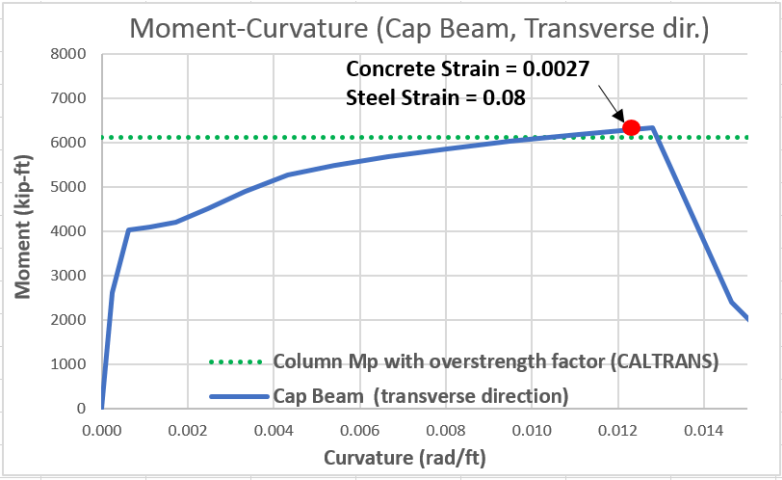


Figure 4 Cap beam Moment-Curvature in transverse direction for the full scale model.

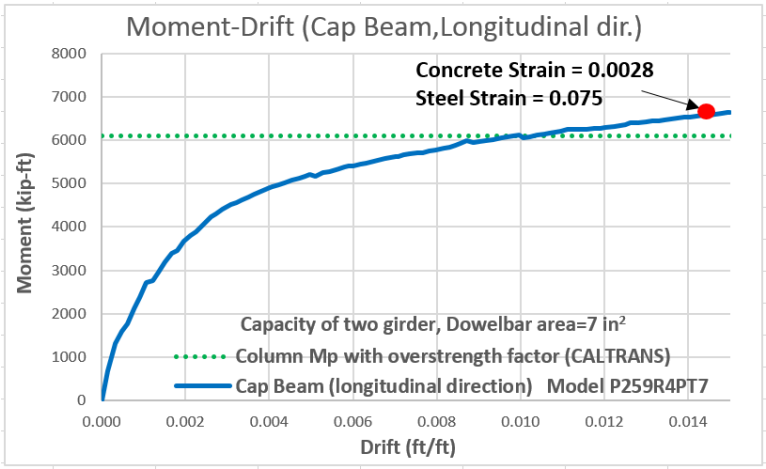


Figure 5 Cap beam Moment-Drift in longitudinal direction for the full scale model.

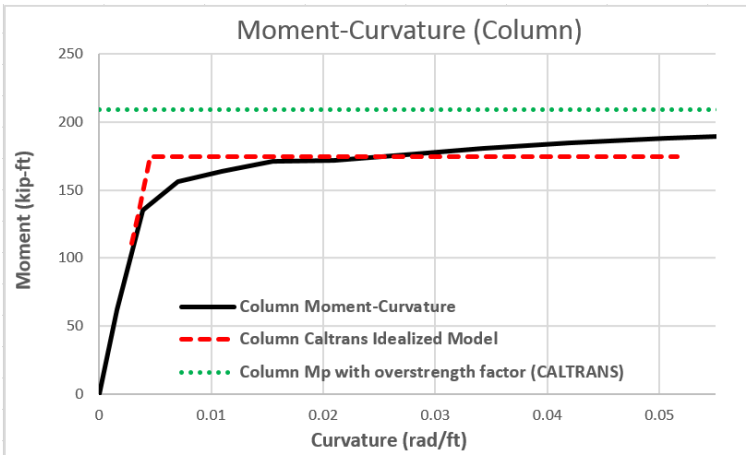


Figure 6 Column Moment-Curvature for the one third scale model.

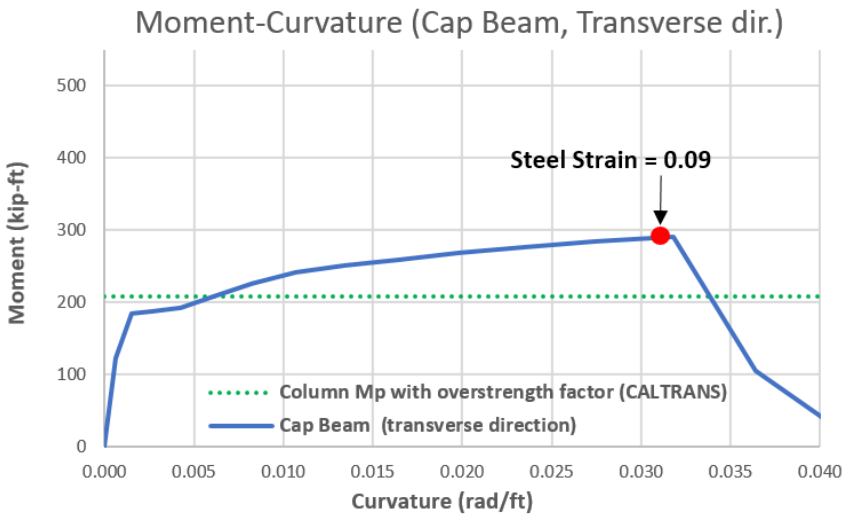


Figure 7 Cap beam Moment-Curvature in transverse direction for the one third scale model.

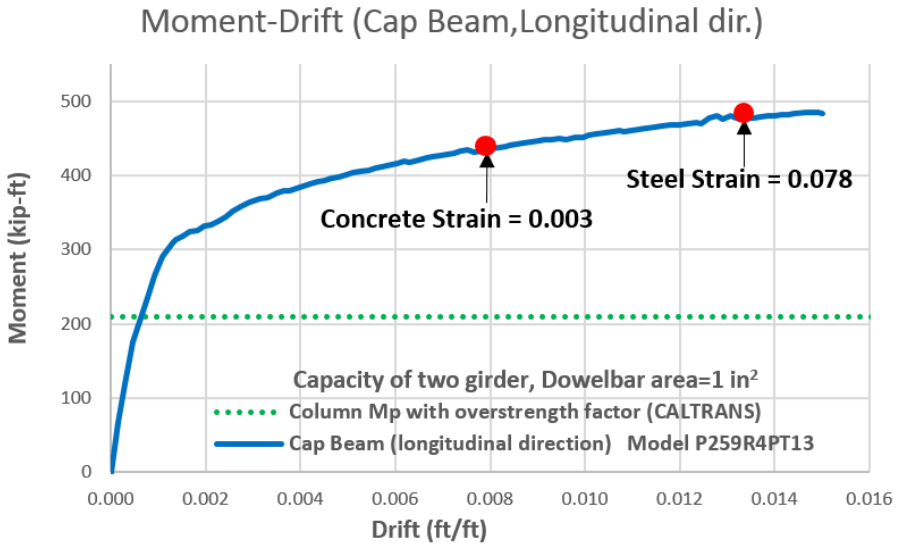


Figure 8 Cap beam Moment-Drift in longitudinal direction for one third scale model.

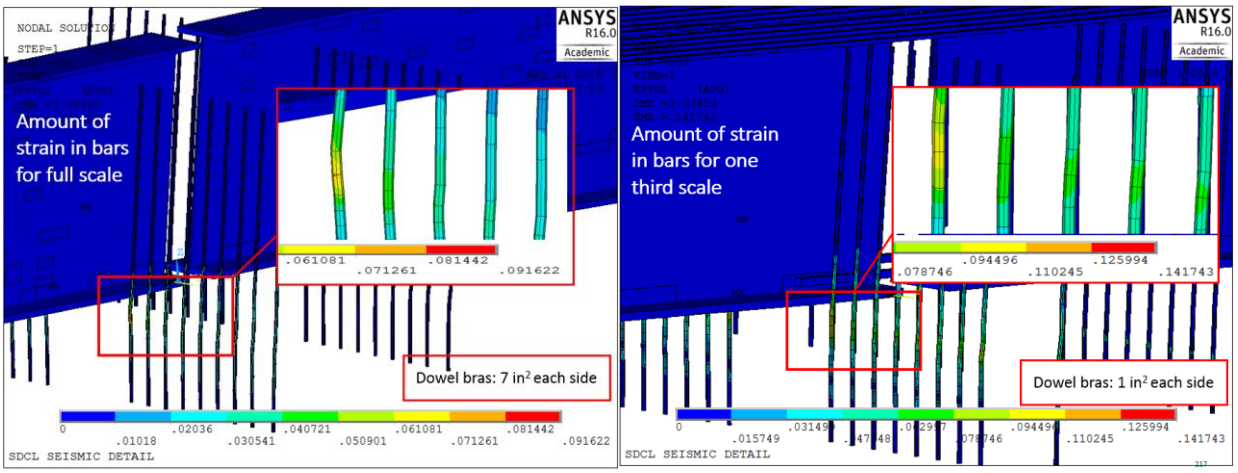


Figure 9 Amount of strain in dowel bars in full scale model (left) and one third scale model (right).

The following pictures show the geometry, dimensions and test set up in one third scale test specimen.

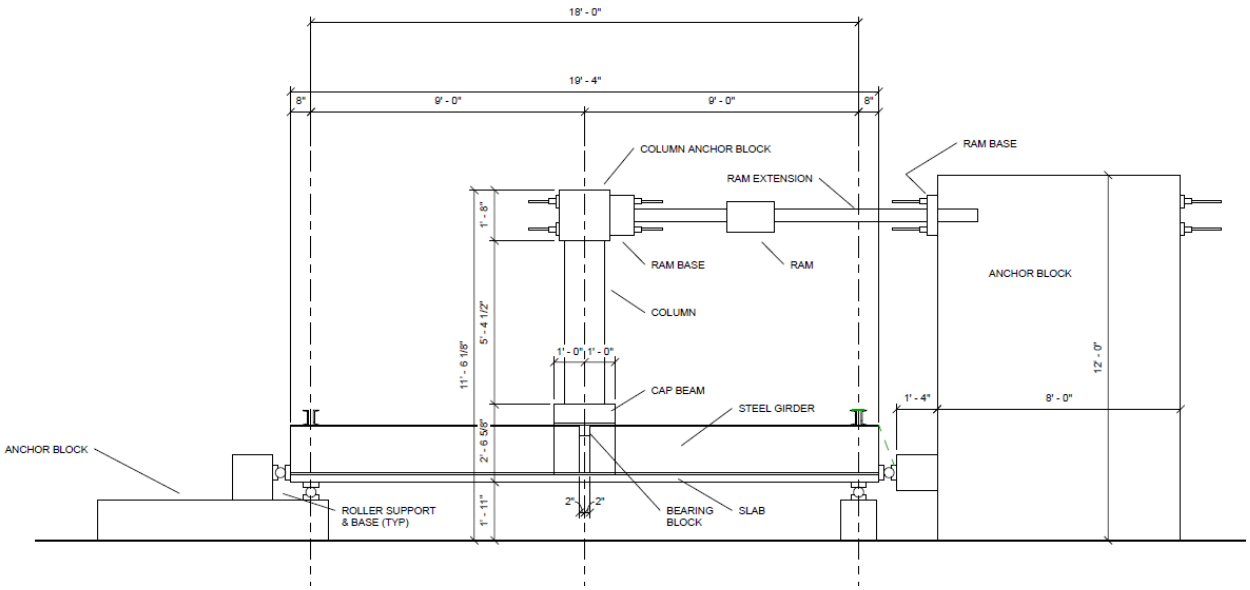


Figure 10 Inverted specimen under lateral cyclic load (longitudinal direction).

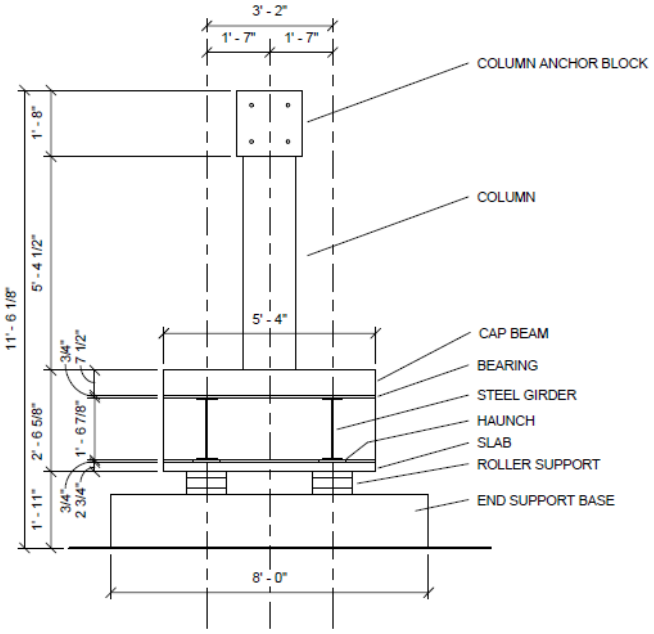
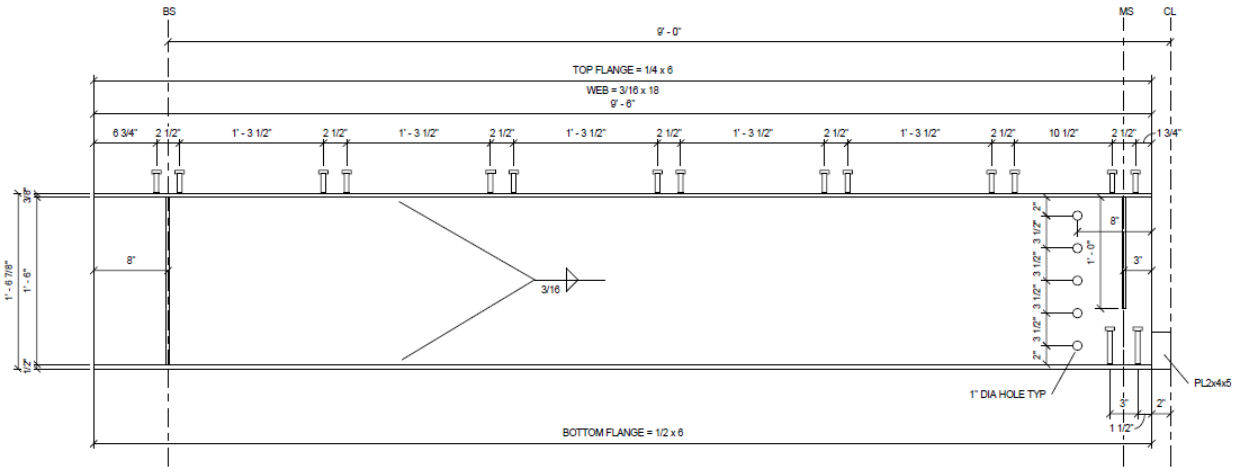


Figure 11 Inverted specimen under lateral cyclic load (transverse direction).



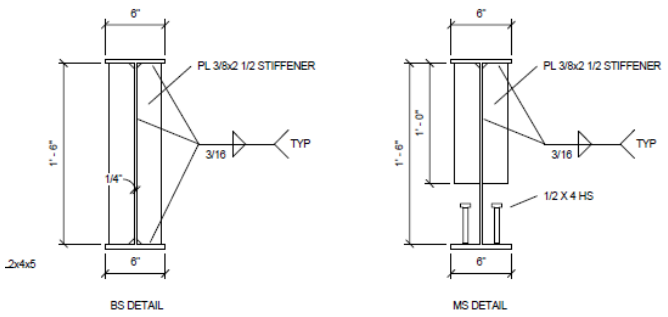


Figure 12 Steel girder with holes in the web, end bearing plate and shear studs.

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