Problem Description: Atypical beam-to-column connection

Insufficient Information for Pipe-to-Tube Connections

- Since the beam-to-column connection used in this project has not been tested excessively and therefore is not considered a prequalified connection, Appendix S is necessary to determine whether the connection will behave as expected and whether the design has sufficient strength.
- Acceptance requirements from AISC 341-05: “The connection must be capable of sustaining an Interstory Drift Angle of at least 0.02 radians.”

Test Setup

- Sensors were tested and calibrated prior to the start of the test
- Placement of sensors on steel specimen
  - Sensors were tested and calibrated prior to the start of the test

Approach

- Assembling the test specimen and initial modeling
  - Rectangular HSS9x3x5/16 beam and circular HSS5.5x0.5 column, A300B steel, welded to one another.
  - Linear analysis of specimen: column expected to yield before beam; expected yield load = 5.98kip, and displacement = 0.75in. (Modeled with SAP2000 software).
  - Sensors attached to test specimen, wired to the data acquisition program, and calibrated.
  - Sensors used: 6 strain gauges (SG), 3 linear variable differential transformers (LVDTs), a wire pot, and 3 load cells (LC).

Test Details and Results

Loading Sequence

- Specimen was loaded using the following loading sequence from AISC 341-05. The sequence started with 0.01 increments in the drift angle \( \theta \) with 2 cycles each.
  1. 6 cycles at \( \theta = 0.00375 \) rad, displacement = 0.23625
  2. 6 cycles at \( \theta = 0.005 \) rad, displacement = 0.315
  3. 6 cycles at \( \theta = 0.0075 \) rad, displacement = 0.4725
  4. 4 cycles at \( \theta = 0.01 \) rad, displacement = 0.63
  5. 2 cycles at \( \theta = 0.015 \) rad, displacement = 0.945
  6. 2 cycles at \( \theta = 0.02 \) rad, displacement = 1.26
  7. 2 cycles at \( \theta = 0.03 \) rad, displacement = 1.89
  8. 2 cycles at \( \theta = 0.04 \) rad, displacement = 2.52

Results

- The beam-to-column connection performed well beyond what the seismic provisions required. The test was terminated at the completion of the second cycle at a displacement of 6.30 inches (drift angle = 0.10).
- The specimen was not tested to failure – small cracks were visible in the weld at the bottom of the beam-to-column connection.
- Actual yielding of the column occurred around 12kip, theoretical value = 5.98kip.