Analysis of Behavior of Large Steel Beam-Column Connections

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Abstract

Recently completed experimental steel beam-column connection tests on the largest specimens of reduced-beam section specimens ever tested have shown that such connections can meet current seismic design qualification protocols, allowing to further extend the current AISC Seismic Provisions and the AISC Provisions for Prequalified Connections for Special and Intermediate Steel Moment Frames. However, the results indicate that geometrical and material effects need to be carefully considered when designing welded connections between very heavy shapes. Understanding of this behavior will ease the use of heavier structural shapes in seismic active areas of the United States, extending the use of heavy steel sections beyond their current use in ultra-tall buildings. To better interpret the experimental test results, extensive detailed finite element analyses are being conducted on the entire series of tests, which comprised four specimens with beams of four very different sizes. The analyses intend to clarify what scale effects, at both the material and geometric level, influence the performance of these connections. The emphasis is on modeling of the connection to understand the balance in deformation between the column panel zones and the reduced beam section, the stress concentrations near the welds, the effects of initial imperfections and residual stresses and the validity of several damage accumulation models. The models developed so far for all four specimens have been able to accurately reproduce the overall load-deformation and moment-rotation time histories.