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Cyclic behavior and design of wide-flange steel beam-columns bent about weak axis

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For seismic resistance, wide-flange columns in a braced frame or moment frame are usually oriented to experience strong-axis bending in the plane of the frame. For moment frames, designers in high seismic regions in the U.S. also prefer to use deep sections because the much larger moment of inertia for strong-axis bending is very effective to control and meet the story drift requirement specified in the building code. These columns are designed as beam-columns because they are subjected to both axial load and moment. These columns are also sometimes designed to resist not only strong-axis but also weak-axis bending. In some applications like Multi-tier braced frames recently introduced in the 2016 edition of the AISC Seismic Provisions, columns are intentionally oriented to experience weak-axis bending in the plane of the frame because lateral bracing cannot be applied in the out of the plane. For design purposes, AISC specifications specify compactness requirement to control local buckling. But the compactness for weak-axis bending is treated the same as that for strong-axis bending. As part of a comprehensive research program to study the seismic behavior and design of deep, wide-flange columns, three full-scale specimens were subjected to inelastic lateral cyclic loading about the weak-axis with two levels of constant axial load. Testing showed that the plastic rotation capacity of these specimens was much larger than their counterpart that was bent about strong-axis because local buckling was significantly delayed, indicating that the compactness requirement for weak-axis bending is unnecessarily conservative. To establish a weak-axis compactness requirement for both non-seismic and seismic applications, high-fidelity numerical simulations of more than 100 columns under both monotonic and cyclic loading conditions were also conducted to generate a comprehensive database. Based on regression, proposed compactness requirements for weak-axis bending will be presented.

Biography

Gulen Ozkula research is in the seismic design, and testing of large-scale steel structures. She studies seismic code design issues to ensure that structures perform well and withstand forces during earthquakes. She received an award from Turkish Ministry of Education for her work on structural engineering. She received her PhD degree in Structural Engineering from University of California, San Diego in 2017. She completed her MS degree in Civil and Environmental Engineering from University of Illinois at Urbana Champaign. She completed her BS degree from Celal Bayar University in Turkey.

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