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Design Recommendation for Lateral Bracing of Highly Ductile Beam Members

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Abstract : In the design of an H-shaped steel beam, lateral torsional buckling is one of the main considerations. The beam should be braced properly so that the plastic moment capacity can be well developed. Although the design guideline for lateral bracing has been available for decades ago, the design guideline was established based on past research which mostly used a very simple model to derive the proposed design equations provided. Most of the beam structures considered in the past research were simply supported beams subjected to transverse loading. Recalling that a simply supported beam is a kind of beam structure that is the most susceptible to lateral torsional buckling, the design requirements derived based on this structure may be too conservative for beams with other boundary conditions. As in the beams of a moment-resisting frame, both beam ends are rigidly connected to the column and thus have higher resistance against the lateral torsional buckling. On the other hand, the use of lateral bracing to support the bottom flange of the beams in building structures often becomes an obstacle. If the actual boundary condition of the beams in moment resisting is considered when analyzing the beam bracing requirements, the chance that a beam does not need to be braced at the bottom flange will become higher. Nowadays, by utilizing the power of computers to conduct numerical analysis, the buckling behavior of the beams with various kinds of boundary conditions and loading configurations can be explored conveniently as long as a reliable analysis model can be developed. In this study, finite element analysis is conducted to investigate the buckling behavior of H-shaped steel beams with various kinds of cross-sections and lengths subjected to seismic-type loading. The considered beam is laterally restrained along the top flange of the beam to account for the presence of floor slab, while no lateral bracing is provided to the bottom flange. The lateral torsional buckling of the beam is evaluated by observing the magnitude of the twist angle during the loading history. The main parameters that affect the buckling potential of the beam are found to be the beam length-to-beam depth ratio and the beam depth-to-flange width ratio. Higher values of these two parameters indicate a higher lateral torsional buckling potential in the beam. The limit values for the two design parameters are found to be related to the desired acceptance criteria which in this case is the magnitude of the twist angle considered as acceptable.

Keywords : H-shaped steel beam, lateral bracing design, lateral torsional buckling, seismic design
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