Approximate Closed-Form Solution for Inelastic Buckling of Brace Members

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Abstract

HSS and W structural sections are widely used for the steel bracing members in concentrically braced frames (CBF) systems. The common behavior expected from a brace member during a ground motion event is yielding in tension and buckling in compression. Brace members with practical slenderness ratio always have a lower buckling strength compared to their tension strength and are designed for compression axial forces. In addition to axial load capacity of a brace, which is reasonably calculated by the steel structures codes, the axial and lateral deformations before and after the buckling are of importance for the seismic evaluation of bracing systems. This extra information is usually attainable via load-deformation response extracted from a nonlinear FE analysis.

In this paper, the nonlinear response of a brace member with pin-pin support condition is determined by an approximate closed-form solution. For HSS, square or round, and W shapes, the presented response equations are calibrated with respect to the axial load capacity calculated from the code and FE analysis results. This method can be well considered as a preliminary and fast solution to evaluate the seismic response of CBF systems.

Keywords: Brace Member; Nonlinear Response; Closed-Form Solution.