Prediction of local buckling after global buckling of HSS brace members

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Abstract

HSS bracing members in seismic resistant concentrically braced frames (CBF) normally suffers from low-cycle-fatigue failure after local buckling occurred at the plastic hinge location. Nonlinear FE analysis methods usually employ beam-column element with fiber discretization scheme and fatigue material to predict the member failure. Since local deformation at the cross section level cannot be captured by this approach, the empirical equations based on sets of bracing experimental data is used to predict the failure occurrence. These approximate methods provide the critical key parameters for the fatigue of material without dealing with the onset and formation of local buckling in the member.

In this paper, the initiation of local buckling after the global inelastic buckling of the brace member is determined in terms of the axial deformation. The method uses the strain and stress history of the section fibers to find the tangent modulus of elasticity at each step, by which, the inelastic buckling stress and axial load is determined using buckling theory of shells. This method evaluates the story drift corresponding to the member local buckling, which is in close vicinity with the occurrence of the brace member fracture, since the latter occurs shortly after local buckling.

Keywords: Local Buckling; Bracing Buckling.