INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The main objective of the research in this thesis encompasses the behaviour of Elliptical-Hollow-Section (EHS) members under cyclic loading. Expressions for cross-section capacity prediction curves are formulated based on the Direct-Strength-Method (DSM) approach through a lower bound fit for an exhaustive data of structural carbon steel Circular-Hollow-Sections (CHSs) found in the literature. Also, a unified set of cross-section slenderness limits for CHS members is proposed. Later, to promote applicability of the proposed CHS cross-section classification criteria also to the EHSs, improved empirical expressions for the equivalent CHS diameter of EHS according to the Equivalent-Resistance-Capacity-Method (ERCM) are derived. Further, the plastic interaction response analyses and the expressions for the equivalent CHS diameter for compact and plastic EHSs are also presented.

The structural performance of EHS members under the Extremely-Low-Cycle-Fatigue (ELCF) load is examined in this study through numerical investigations by employing a Non-Linear Combined (isotropic/kinematic) Hardening Material (NLCHM) model in the general Finite-Element (FE) package, Abaqus. The response of FE modelled EHS steel braces under cyclic axial displacement loading history is analysed at various displacement ductility levels. It is observed that cross-sectional aspect ratio, *a*/*b* has less significance on normalized cyclic compressive resistance and energy dissipation values at cyclic displacements of higher displacement ductility levels for EHS braces with non-dimensional global slenderness ratio greater than ~0.8. A set of equations for cyclic post-buckling compressive resistance, mid-length lateral deflection, and energy dissipation curves of EHS braces at various displacement ductility levels are also proposed. Further, FE analyses carried out on EHS steel cantilever member models under ELCF uni-directional flexural load along major and minor axes separately is also presented. A set of predictive equations for cyclic rotation capacity and flexural over-strength with-respect-to the cross-section slenderness are derived. It is observed that the cyclic rotation capacity and flexural over-strength are not significantly affected by *a*/*b* ratio. Lastly, the behaviour of EHS cantilever columns under the combined constant axial compressive load and ELCF uni-directional flexural load along the major or minor axis is presented. Under various axial load levels, the interaction between axial compressive load and the cyclic moment is interpreted.