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Parametric Study on the Self-centering Buckling-restrained Braces Based on Post-tensioned Composite Cables

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Abstract

A self-centering buckling-restrained brace (SC-BRB) has excellent potential to reduce the residual drifts of a structure while utilizing the seismic energy dissipation capacity of the steel BRB core. The present study uses post-tensioned carbon fiber composite cables (CFCCs), which provide the necessary restoring force and additional post-yield stiffness to minimize residual deformation. The carbon fiber composite cables have limited post-tensioning (PT) force loss under cyclic tensile loading, thus ensuring a sufficient restoring mechanism until its failure strain level. A numerical model has been developed using OpenSees to study the hysteretic response of the brace subjected to the loading protocol as per the American Institute of Steel Construction (AISC) 2016 Seismic Provision manual. The effect of the different core areas, cable area, and initial PT force for a particular brace force demand on the residual deformation and hysteretic energy dissipation potential has been extensively studied using the numerical model. The optimum range of values of energy dissipation ratio (βed) and post-yield stiffness ratio (α) has been proposed in the study for designing the SC-BRBs.

Keywords: Buckling-restrained braces, Seismic analysis, Self-centering, Carbon fiber composite cable