A Survey on Effective Parameters on Shear Resistance of Steel Plate in Composite Shear Wall

Abstract

The composite shear wall studied in this thesis consists of a steel shear plate and a concrete cover connected together with a suitable mechanical means such as studs or bolts. The use of these types of composite shear walls is useful in places where the base shear is too large to be carried only by the steel plate.The most important role for the steel plate of a composite shear wall is to increase stiffness and ductility while that of the concrete cover is to prevent buckling of the steel plate. The focal point in this study is to assess the variables affecting the lateral behavior of such walls, such as thickness of plate, thickness of concrete cover, spacing between the connectors and strength characteristics of concrete and steel. In this study, as a reference for comparison, a comprehensive nonlinear finite element model is developed and calibrated with the available experimental data. For modeling the nonlinear behavior, material and geometric nonlinearities and large deformations are considered. The finite element analysis is performed for different cases of the above parameters and appropriate graphs displaying relative effect of each parameter are presented. Thickness of the metal plate proves to be the prime factor affecting lateral strength, stiffness and ductility of the wall. Based on the above analysis, semi-analytic equations are derived for computation of the initial and secondary stiffnesses and shear capacity of the wall. Moreover, a diagonal nonlinear hyper-element equivalent in behavior to the actual complex wall is developed as its substitute in modeling and analysis. This element simplifies the wall analysis to a great extent. It is shown that the proposed hyper-element is an accurate analytical substitute for the whole composite wall in nonlinear lateral analysis.

Keywords: composite shear wall, nonlinear finite element, stiffness, strength, ductility, semi-analytical, hyper element.