ANALYTICAL STUDY ON COMPOSITE STEEL PLATE WALLS USING A MODIFIED STRIP MODEL

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ABSTRACT

A composite steel plate shear wall (CSPSW) system consists of a steel plate shear wall with reinforced concrete panels attached to one side or both sides by bolts or connectors. This arrangement restrains the possible occurrence of out-of-plane buckling of thin-walled steel plate, thus significantly increasing the load-carrying capacity and ductility of the overall wall. In this paper, a new analytical model for the CSPSW-Strip Model was proposed based upon the mechanism and failure mode of CSPSW. The cross sectional properties and hysteretic model for the cross strips in the model were determined with theoretical analysis. Comparison with experimental results showed that the proposed model was able to capture accurately nonlinear behavior of CSPSW under monotonic and cyclic loading.

INTRODUCTION

Shear walls have been widely used as lateral load resisting system in concrete buildings in the past, especially in high-rise buildings. In steel buildings, in many cases concrete shear walls are used with a boundary steel frame to resist seismic effects. However, there are several disadvantages for using a concrete shear wall in this case. The most important one is the development of tension cracks and localized compressive crushing during large cyclic displacement, which can result in spalling and splitting failure of the wall and lead to serious deterioration of stiffness and reduction in strength. Also, reinforced concrete shear walls used in tall buildings tend to develop relatively large shear forces during seismic events due to their relatively large lateral stiffness, but the high weight to strength ratio of concrete material will make the use of reinforced concrete shear walls impractical for this case. In addition, the casting and curing of reinforced concrete walls in a steel building makes the construction not so efficient compared to other systems such as braced frames or moment frames.

In recent years, steel plate shear wall has been used in a number of buildings and achieved satisfactory results regarding construction efficiency and economy. However, overall buckling of the steel plate shear wall will result in reduction of shear strength, stiffness and energy dissipation capacity of the whole system (Zhao and Astaneh-Asl, 2004). It could be prevented by adding stiffeners to the steel plate, which, however, will result in additional fabrication costs (Astaneh-Asl, 2001). In addition, in structures with steel shear walls, due to relatively large inelastic deformations of the panel, the connections of the boundary