Abstract

Steel shear wall (SSW) as a lateral load bearing system has been in use since 1970 in tall buildings especially in Japan and the US. Research studies on the seismic behavior of SSW's and past experience prove them as a very effective and ductile seismic resistant system. Main advantages of this system are its large energy dissipation capacity, lightness compared with the equivalent concrete shear wall, high stiffness, quick installation, less occupation of useful building area, and simplicity in being strengthened or replaced. Despite the above facts, there are some factors preventing a widespread use of SSW in design and construction. A void in most design codes on requirements and guidelines for design of steel/concrete buildings composed of such elements, inadequacy of information of SSW's behavior in earthquakes comparing with that of RC shear walls, and practically most important, lack of a reliable and effective analytical tools for detailed analysis and design of SSW, are among those factors.

With the above shortcomings in practice, in this research an "exact" nonlinear finite element model of two multistory frame buildings, 5 and 10 stories in height, and one single story frame building, containing an SSW in each story in the same bay is modeled and analyzed. In modeling of the SSW, both material and geometrical nonlinearities are taken into account and the post-buckling behavior is captured. To estimate the seismic behavior, a nonlinear static pushover analysis is implemented on the models and their monotonic force-displacement behavior is followed up to the target design displacement. The accuracy of the analytical model is approved through comparison with the past experiments. Effects of factors such as cases with and without gravity loads, distributions type of the lateral loads, number of stories, type of modeling, and existence of openings are investigated. Through a vast parametric study for the cases with openings, Effects of shape, and relative size are studied. Immature buckling of SSW resulting in nonlinear buckling of first story columns adjacent to the wall is found to be the governing effects resulting in a sharp decrease of system ductility for the case of large openings "close" to the wall perimeter. Recommendations are presented for practical design of SSW's.