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COMPARISON OF THE SEISMIC BEHAVIOR OF 1-STORY AND 8-STORY UNSTIFFENED STEEL PLATE SHEAR WALLS

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In the recent decades, many analytical and experimental research works have been conducted on the steel plate shear wall (SPSW) as one of the main lateral resisting systems in buildings. The main characteristics of such a system are its high elastic stiffness, large deformability, and stable hysteretic behavior. The primary function of this system is its resistance against the story shear and overturning moment caused by the lateral forces such as wind and earthquake. In general, a SPSW includes a steel plate, boundary beams and columns. In fact, it performs like a vertical plate girder in which the boundary columns and infill plate act as the flange and web of the girder, respectively. SPSWs are used in two major ways of with and without stiffener. In the recent years, the type of without stiffener has been used more in practice because of its low cost and simple details. The design method of this system is based on pure shear ignoring the effects of bending moments due to ground motion on its seismic performance. Therefore, it is important how does such a system perform when its height is increased? In order to investigate this fact, two finite element models using ANSYS was generated and analyzed for the effect of the height and its overall performance on the building characteristics. Modeled structures, with the same plan and different heights were 1 and 8-story, having steel plate shear walls. The buildings are symmetric in plan and along the height. The SPSWs are designed based on the Canadian Code, Can/Csas 16-01. It is assumed that all of connections are fixed type. The results indicate that bending has a remarkable effect on the performance of system and plays a significant role in the behavior of buildings when their heights are increased. Thus, the ratio of failure to design base shear, ductility of the building, and the initial stiffness are reduced by increasing the height of building. In fact, the failure trend moves from the ductile toward brittle state

MODELING

The columns and beam are modeled using Beam 188 elements. This Element allows biaxial bending, axial stretching and warping of the cross section and includes linearly elastic transverse shear deformations according to the Thimoshenko beam theory. The infill plates are modeled using Sell 181 elements. This element has three rotational and three translational degrees of freedom at each node.

VALIDATION OF FINITE ELEMENT METHOD IN MODELING SPSWS

To establish the accuracy of the numerical modeling methodology, finite element model of steel plate shear wall in ANSYS is compared with tested specimen by driver and kulak, specimen. Figure 1 compares the output of the finite element modeling in ANSYS and results of the experiment on four-story steel shear wall. The comparison between load-displacement curves shows that the ANSYS model is in a good agreement with the experiment.

FINITE ELEMENT ANALYSIS

This section describes investigation on the seismic behavior of 1and 8-story SPSW using the finite element software

ANSYS. The Von-mises stress graph was taken in to account for the study. Figure 2 shows Von-mises stress graph of SPSWs.

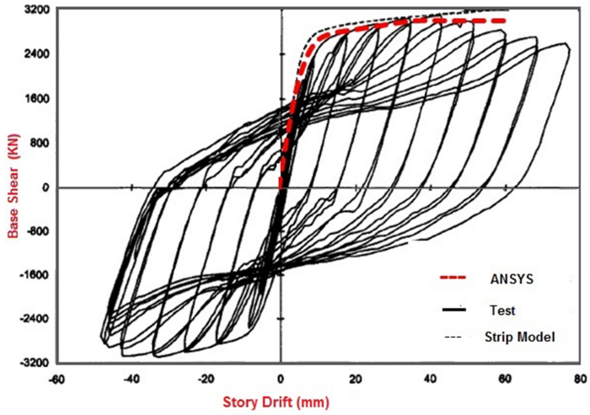
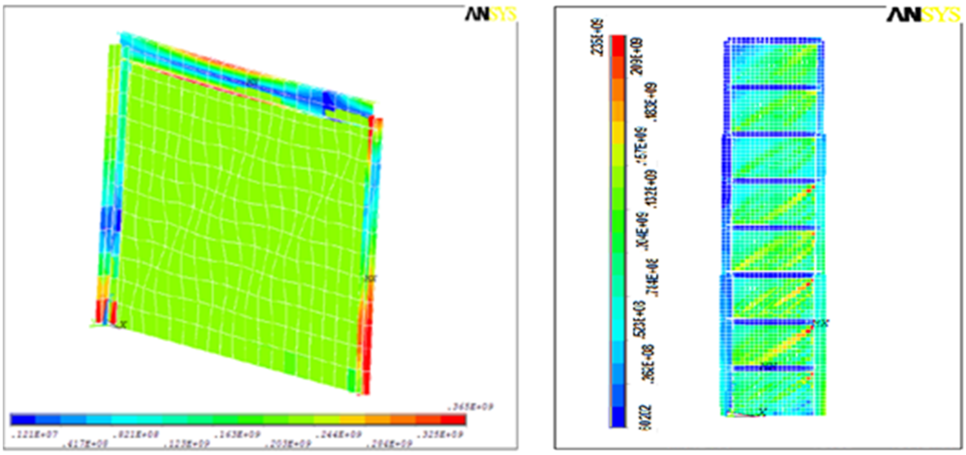


Figure 1. Comparison of the finite element results (red ANSYS) and the sample tested under cyclic load (Black).



(a) (b)

Figure 2. Von-mises stress graph of SPSW: (a) 1-story and (b) 8-story.

CONCLUSION

The results indicate that bending has a remarkable effect on the performance of system and plays a significant role in behavior of buildings when their heights are increased. Therefore, the ratio of failure to design base shear, ductility of the building, and the initial stiffness are reduced by increasing the height of building. In fact, the failure trend moves from the ductile toward brittle state.

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