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THE INFLUENCE OF GEOMETRIC CHARACTERISTICS ON THE PERFORMANCE OF STEEL SHEAR WALL

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In the last four decades, attention has been paid to Steel Plate Shear Walls (SPSW) as means of resisting earthquake and later wind forces on buildings, and especially in high-rise building (Ghasem Pachideh et al., 2019). Regarding high ductility and potential of steel plate shear walls in energy absorption, they are required to be very thin in thickness especially in upper floors of the building in order to resist lateral loads and sometimes it will reach to a fraction of millimeter in calculations. Since preparation of such thin steel plates is not simply possible, a thicker plate with an opening can be used to reduce stiffness. On the other hand, the existence of opening is inevitable due to architectural considerations such as lighting (Afshari and Gholhaki, 2018). It also becomes noticeable to investigate and compare the performance of these walls provided with steel stiffeners. As a result, in this study, the performance of steel shear walls with openings of various dimensions and steel stiffeners with various angles has been investigated using ABAQUS, and the results have been compared to pre-obtained laboratory results to assure the validity of modeling; therefore, the shear wall used in the article (Alavi and Nateghi, 2013) was initially modeled to assure that the results are valid. The investigation process was done on eight sample single-story shear walls with ½ scale under envelope loading. Seven single-story samples were stimulated with ½ scale, width of 2 m and height of 1.5 m. The boundary elements were made of HEB160 standard profile, and the thickness of the interior plate was assumed 1. The boundary elements were designed to meet the initial requirements of steel shear wall and AISC 341-05 criteria. The connections between columns and beams were all assumed moment resisting. Figure 1 exhibits the comparison between the simulation in ABAQUS and the results of the article (Alavi and Nateghi, 2013). According to the stress contours obtained from the Pushover Analysis in Figure 1, which is in accordance with von Mises yield criterion, for ultimate load at approximate horizontal displacement of 70 mm, it can be concluded that this deformation and the chart resulted from the simulation and the article correspond well to the test sample. In Table 1 the simulated samples are introduced and for each sample, number of slots, diameter of slots, type of stiffeners and number of stiffeners have been given. In Figure 2 the charts resulted from the Pushover Analysis have been investigated, which shows that as the diameter of the slots increases, the absorption of energy grows, reaching approximately the maximum level when the slot diameter is 8%. Moreover, stiffeners have the maximum energy absorption in X type, but in large displacements, its ductility falls.

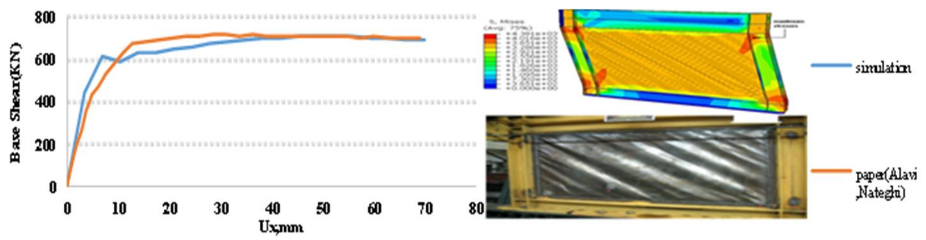
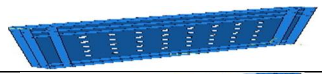
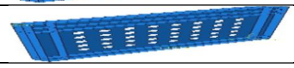
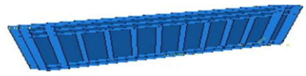
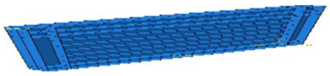
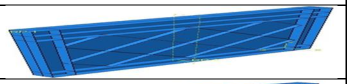
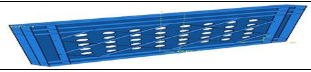


Figure 1. Comparison between the nonlinear capacity of verification article and current simulation.

Table 1. Introduction of simulated samples.

	Model specifications	Hole diameter	Number of holes	Kind of STIFFNER	Number of STIFFNER	Damper shape
S1	Model of shear wall with an opening of d=5% of height	6	40	-	-	
S2	Model of shear wall with an opening of d=8% of height	9.6	40	-	-	
S3	Model of shear wall with an opening of d=10% of height	12	40	-	-	
S4	Model of shear wall with vertical stiffener	-	-	vertical	8	
S5	Model of shear wall with horizontal stiffener	-	-	horizontal	5	
S6	Model of shear wall with x-type stiffener	-	-	x-type	10	
S7	Model of shear wall with x-type stiffener and 8% opening	9.6	40	x-type	10	

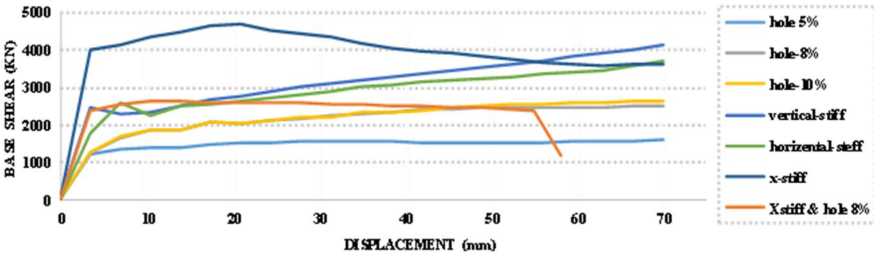


Figure 2. Comparison of the nonlinear capacity envelope of several shear wall models.

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