SOIL-STRUCTURE INTERACTION EFFECTS ON THE SEISMIC PERFORMANCE OF THE RC WALL-FRAME DUAL SYSTEM

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The reported results of previous research works carried out in the field of soil-structure interaction (SSI) indicated that the SSI effects changes the dynamic response of the structure (Chopra and Yim, 1985). This study investigates the SSI effects on the seismic performance of the RC wall-frame dual system of three 5-, 10- and 15-story RC structures. The lateral load resisting system considered for each model is located at the perimeter of the structure. For numerical modeling, OpenSees software was used in this study. The shear flexure interaction (SFI) model was used to model the shear wall because it includes the axial, bending and shear interaction of the shear wall (Kolozvari et al., 2015). Besides, the beamWithHinges and nonlinearBeamColumn elements were used to model the beams and columns, respectively. For the simulation of SSI, the beam on nonlinear Winkler foundation (BNWF) approach was applied. The results of eigenvalue analyses show that the SSI effects lead to increase the first mode period of structure and the increasing ratios for the 5-, 10- and 15-story models are 1.75, 1.24, 1.13, respectively. Pushover analyses and nonlinear time history analyses were carried out on the models. For nonlinear time history analyses, 11 ground motion records from 44 far-field ground motion records presented in the FEMA P695 (FEMA P695, 2009) were selected, and the peak ground acceleration (PGA) of each record was scaled to 0.4 g and 0.7 g, respectively.

Table 1. Average base shear contribution ratios of shear wall and moment frame.

Model	Contribution Ratios for Fixed-Base Models Given PGA= 0.4 g		Contribution Ratios for Flexible-Base Models Given PGA= 0.4 g		Contribution Ratios for Fixed-Base Models Given PGA= 0.7 g		Contribution Ratios for Flexible-Base Models Given PGA=0.7 g	
	Wall (%)	**Frame (%)**	**Wall (%)**	**Frame (%)**	**Wall (%)**	**Frame (%)**	**Wall (%)**	**Frame (%)**
5-story	69	31	45	55	70	30	52	48
10-story	72	28	55	45	75	25	62	38
15-story	62	38	51	49	63	37	54	46

Figures 1 to 3 show the pushover curves of the 5-, 10- and 15-story models, respectively. The results indicate that for fixed-base models a significant percentage of base shear is carried by shear wall, whereas for flexible-base models, the shear wall contribution in the base shear is little at the linear stage and it increases in the nonlinear stage. The average base shear contribution ratios obtained from the nonlinear time history analyses for the fixed-base and flexible-base models are shown in Table 1. It can be seen that for the fixed-base models, when PGA is equal to 0.7 g, the base shear contribution ratios of the shear wall and moment frame have no remarkable differences with those when PGA is equal to 0.4 g. On the other hand, for each of the flexible-base models, moment frame has a larger average base shear contribution ratio compared to that for its corresponding fixed-base model.

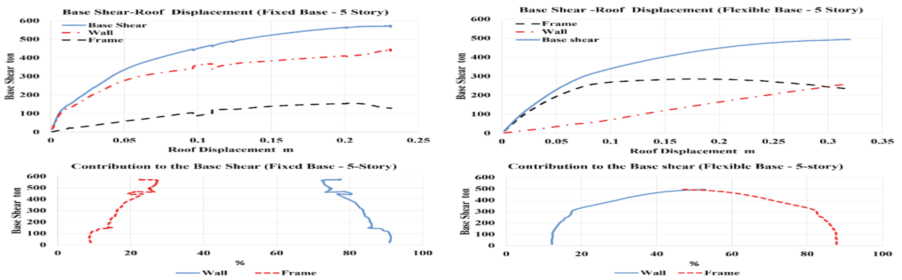

Figure 1. Base shear contributions of shear wall and moment frame for the 5-story model.

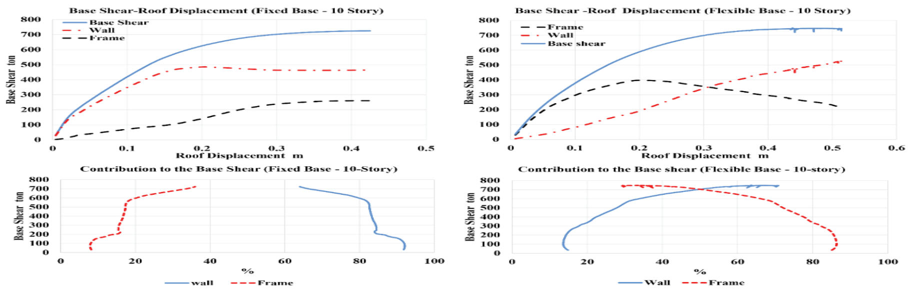

Figure 2. Base shear contributions of shear wall and moment frame for the 10-story model.

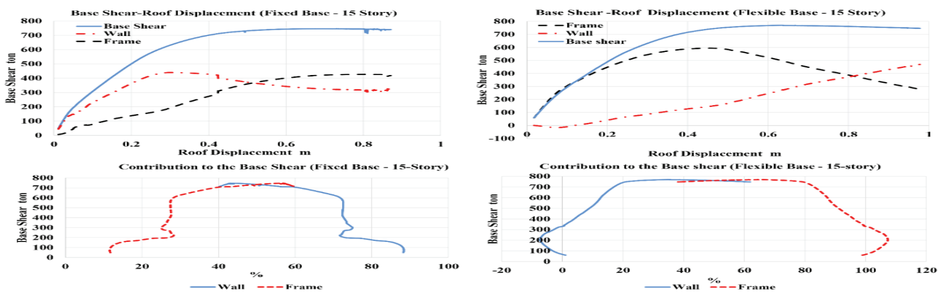

Figure 3. Base shear contributions of shear wall and moment frame for the 15-story model.

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