THE EFFECTS OF STIFFNESS IRREGULARITY IN HEIGHT ON SEISMIC RESPONSE OF STRUCTURES BY CONSIDERING SOIL-STRUCTURE INTERACTION

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A significant part of infrastructure of the modern urban is formed by irregular buildings in height. Event irregularities in height are mainly due to the sudden changes in stiffness, strength and mass between two adjacent stories. These changes are because of variety reasons, including changes in lateral loading resistant between levels, changes in dimensions of plans, removing the lateral load elements, etc. According to the past experiences, these structures have had different performance compared to regular structures during the earthquake (Sony and Mistry, 2006). In addition, soil effects on structure response during an earthquake are a considerable matter that has been studied by many researchers in recent decades. As a matter of fact, when external forces are applied to the system, such as earthquakes, the soil responses affects the structural responses and vice versa (Wolf, 1985).

At the present research, seismic behavior of irregularity structures due to stiffness by considering the effect of soil-structure interaction is studied. The assumed soil-structure three-dimensional interaction systems are regular and non-geometric irregular ten-story building resting on the surface of an elastic half-space with shear waves velocities 175(m/s). These irregularities are occurred at three different locations, including the bottom part (i.e. floors 1 to 5), the lowest floor (i.e. floor 1) and the middle floor (i.e. floor 5). The stiffness of the soft floors is 60% of its top floor (Figure 1). According to the substructure, one ensemble of earthquake records is selected. This ensemble includes seven earthquake records with two translational components. Applied earthquakes are recorded in specified site in accordance with the soil system. SSI system analyses are carried out in time domain and interaction forces are simulated by using frequency-independent soil springs and dashpots (Balendra et al., 1982).

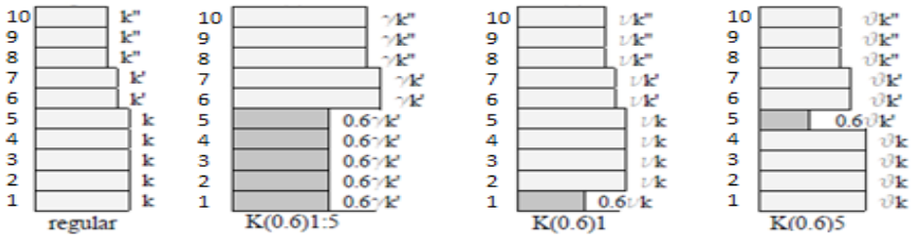

Figure 1. The types of irregular structures with irregular distribution of stiffness in height compared to the regular structure (Pirizadeh and Shakib, 2013)

The seismic response histories of regular and stiffness irregular structures resting on elastic half space is obtained under excitation of applied earthquakes in two directions by the step-by-step integration method. Based on the results, irregularity increases the mean of maximum drift ratio under an ensemble of earthquake compared to the regular structure, in soft stories, this increase in the most critical conditions is more than 200%. However, irregularity decreases this demand in other stories (Figure 2).

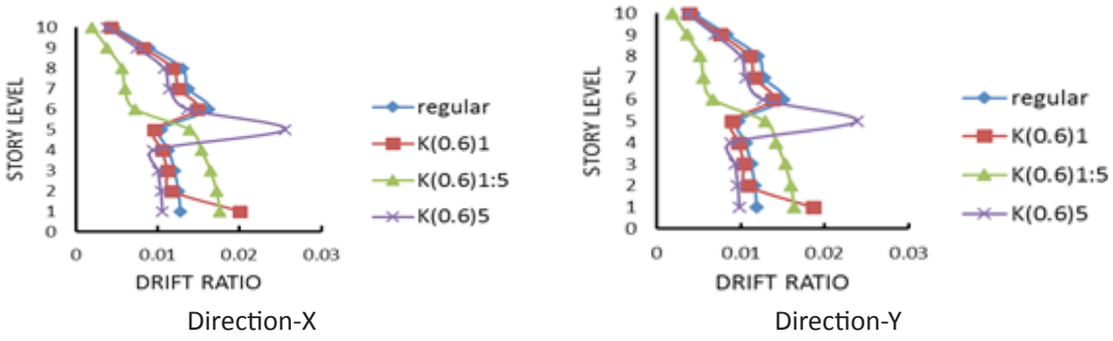

Figure 2. The mean of maximum drift ratio under an ensemble of earthquake compared to the regular structure

According to the analysis, stiffness irregularity doesn't have any significant effects on the mean of maximum shear story and its distribution pattern in height under an ensemble of earthquake (Figure 3).

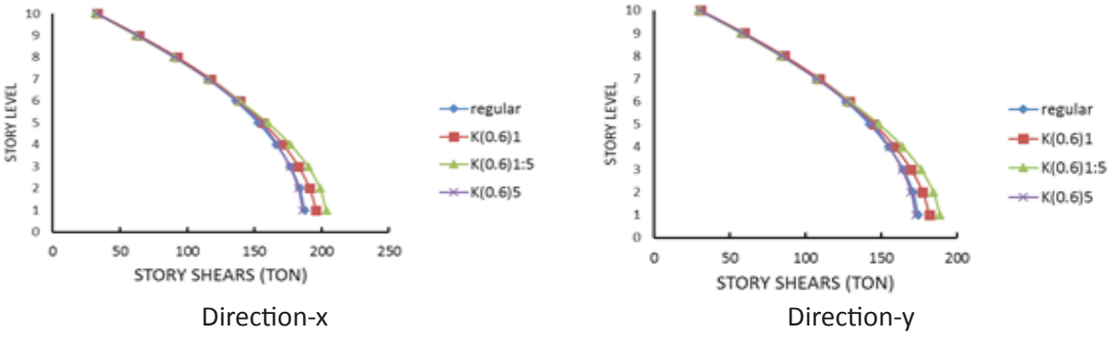

Figure 3. The mean of maximum shear story under an ensemble of earthquake compared to the regular structure

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