IMPROVING SEISMIC BEHAVIOR OF HEIGHT IRREGULAR STRUCTURES USING VISCOUS DAMPER DISTRIBUTION

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Stiffness and mass irregularityof buildings are usually unavoidable because of several constraints such as architectural requirements (Soni and Mistry, 2006). Irregularity could happen in the plan or the height of a structure which leads to seismic vulnerability of such buildings (Karavasilis et al., 2008). The aim of the present paper is to review the negative effects of vertical irregularityon the seismic responses of structures and find solution to improve their behavior in the earthquake (Nezamabadi et al., 2008) Thus, three 10-story steel structures each one demonstrates mass and stiffness irregularity at 6^{th} storey according to acceptable boundaries of the Iranian seismic code (standard 2800) requirements are considered. Then the structures are exposed to nonlinear static & dynamic analyses using seven two-directionalearthquake records.

The analyses show that the plastic hinges around the irregular level or at the base of the structures exceed the collapse threshold. As a result, the mass and stiffness irregularity boundaries are rejected for the analyzed structures according to the norms discussed by standard 2800. In order to improve the behavior of the buildings, seven types of viscous dampers distribution are considered along the height of the structures as indicated in Table 1 (The shape of each type of distribution is included in the full paper).

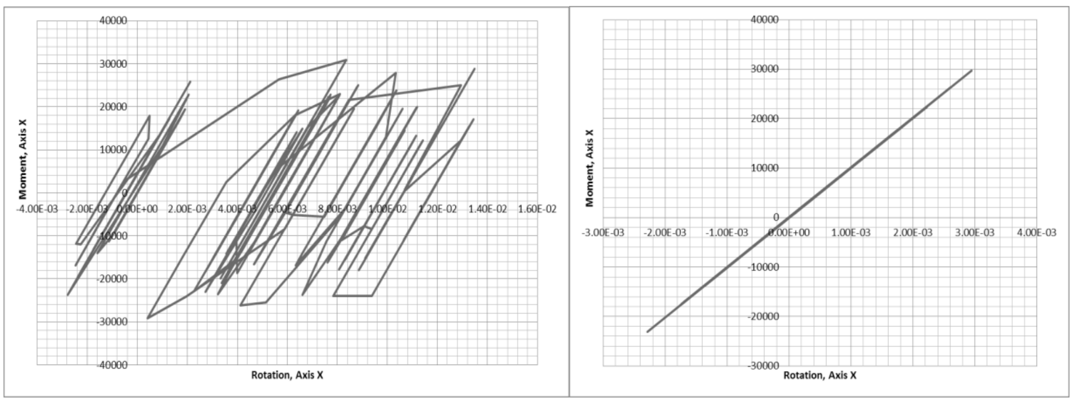
Table 1. Different distribution of viscous dampers in the height of the structures

Dampers at irregular level	Dampers at low performance levels	Angular type 2 (lower angular)	Angular type 1	Distribution of mass and stiffness	1st mode difference	Uniform	Type of distribution
type 7	type 6	type 5	type 4	type 3	type 2	type 1	

The results show that more improvements in structural behaviour are achieved when the dampers are distributed along the whole height of the structures compared to the case that they are concentrated in the vicinity of the irregular level. Considering the reduction in sum of all damper coefficients ($C_{total}=C_1+C_2+C_3+...$) as an economic factor, the lower angular distribution (type 5 as shown in Figure 1) improves structural behaviour with the least value of C_{tot} and acts as the optimal damper distribution.

Figure 2 shows the hysteresis loop of a typical column in the structures with and without dampers in the optimum case. As shown in the figure, using dampers in the optimum case makes the column to remain in the elastic range and consequently the performance of the structure improves.

Figure 1. Lower Angular Distribution (type 5)



(a) (b)

Figure 2. Hysteresis loop of a typical column, a) structure without damper, b)structure with dampers in the optimum case of distribution (lower angular)

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