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AN INVESTIGATION OF NEAR-FIELD EARTHQUAKES ON THE SEISMIC RESPONSE OF STEEL STRUCTURES WITH ECCENTRIC BRACE FRAME (EBF) WITH MASS IRREGULARITIES

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Near-Field earthquakes refer to points in the earth that the distance from the epicenter is less than a certain limit. There is disagreement among the researchers in this regards. For this reason, researchers have proposed distances between 10 and 50 km in the range of the near-field earthquakes. With the occurrence of near-field earthquakes, which caused a lot of damage and the vertical component of the earthquake, was known as its cause. The necessity for further study on the effect of the vertical component of the earthquake on building, which has long been discussed by researchers and design engineers, is increasingly felt. Steel buildings are one of the most widely used buildings, and on the other hand, due to the lack of sufficient science in designing, executing and etc., these buildings suffer severe damage during the earthquake. Therefore, the study of steel buildings in this research has been considered. Nowadays, buildings with mass irregularities in height are significantly increasing due to different usages of the floors. Seismic design codes, such as "Iranian Code of Practice for Seismic Resistant Design of Buildings – Standard No. 2800– 4th Edition", allow some degree of irregularity in mass and stiffness. However, since the code basis of "Standard No. 2800 – 4th Edition" is used for far-field earthquakes, it is necessary to investigate the permissible amount of irregularity for the near-field earthquakes (Standard 2800, 4th edition). The structures used in this research are steel structures with eccentric brace frame with the number of stories of 3, 7 and 10, which are designed according to the "Standard No. 2800 – 4th Edition" of Iran and section 10 of National Building Regulations - "Design and Construction of Steel Buildings". The models have frames with 6 space with a length of 4 m along X and a length of 4 m along Y and the height of the floors 3.2 m. Usage of all buildings in this study are residential. The structures considered in each model are both regularity and irregularity states in mass. In order to provide an irregularity in the masses, it has been tried to apply the dead load of 1500 Kg/m2, which is more than twice as usual on the specified floor. Alavi and Krawinkler (1998) showed that mass irregularity has little effect on the seismic behavior of structures. In addition, they showed that increasing mass in the upper classes had a relatively greater effect on class drift than increasing mass in the middle or lower classes (Alavi et al., 1998). Magliulo et al. (2002) carried out studies on four 5-storey shear frames designed using both static and dynamic (multi-modal) methods. For irregular frames, the mass in one class was twice that of the other. In all cases there was no significant difference in the performance of regular and irregular structures. Sadashieva et al. (2008) Showed that the effect of irregularity depends on the structural model used, the location and amount of irregularity and the method of analysis used. In a study by Hosseini and Firoozi Nezamabadi

(2004), the effect of the vertical earthquake component on the steel structure was investigated and it was found that the effect of this component on the middle columns was greater than the side and corner columns. The results of nonlinear dynamic analysis showed that the most variations in lateral displacement between different regularity and irregularity states, the slope of the variations of this parameter, has been reduced by increasing the number of stories. Besides, floors that are irregular have larger deformations than other floors. These floors have been treated as soft stories.
The model elevation is shown in Figure 1 and the acceleration records were taken from the PEER website and their specifications are given in Table 1.

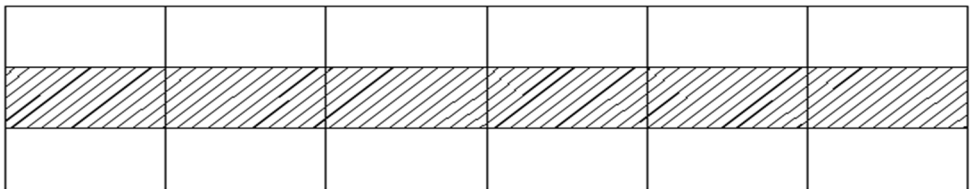

Figure 1. Model elevation of 3-story buildings with irregularity in mass.

Table 1. Selected earthquakes specifications.

	Earthquake	Station	Distance (km)	M_w	PGA-H_{max} (g)	PGA-H_{min} (g)	PGA-V_{ert} (g)
1	Kocaeli	Gebz	4.38	17	0.244	0.137	0.203
2	Landers	CoolWater	2.19	7.3	0.417	0.284	0.176
3	Northridge	cobyon	12.44	6.7	0.472	0.404	0.303
4	Kobe	Takarazuka	1.2	6.9	0.693	0.693	0.433
5	Imperial Valley	El Centro	5.3	6.5	0.352	0.480	0.707
6	Gazli	Karakyr	5.46	*7.1*	0.718	0.608	1.264
7	Loma Prieta	Bran	10.3	6.9	0.501	0.453	0.507

REFERENCES

Alavi, B. and Krawinkler, H. (1998). Development of an improved design procedure for near-fault ground motions. SMIP 98 seminar on utilization of strong motion data, Oakland, CA.

Hosseini, M. and Firoozi Nezamabadi, M. (2004). A study on the effect of vertical ground acceleration on the seismic response of steel buildings. *Proceedings of the 13th World Conf. on Earthquake Engineering (13WCEE)*, Vancouver, British Colombia, Canada.

Magliulo, G., Ramasco, R., and Realfonzo, R. (2002). Seismic behavior of irregular in elevation plane frames. *12th European Conference on Earthquake Engineering*, London.

Sadashiva, V.K., McRae, G.A., Deam, B.L., and Fenwick, R. (2008). Determination of Acceptable Structural Irregularity, *J. Engineering and Technology*.

BHRC (2014). *Iranian Code of Practice for Seismic Resistant Design of Buildings*. Standard 2800 (Edition 4), Building and Housing Research Center (in Persian).