COMPARISON OF SEISMIC RISK OF LOW RISE IMPORTANT BUILDINGS DESIGEND BY DIFFERENT EDITIONS OF IRANIAN SEISMIC CODE

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Buildings with high degree of importance and facilities such as hospitals, police stations, fire stations and other vital facilities play crucial role in crisis and risk management of cities. Therefore special attention has been paid to design and construct these buildings in order to maintain their performance during and after the earthquake. Design of important building in Iran is conducted based on the Iranian code of practice for seismic resistant design of buildings (ISC). The ISC was first introduced just before Manjil-Rudbar earthquake in 1988. Since then, three different editions of code introduced. Although many improvement in design force and detailing of structures have been introduced in the design of important buildings in the recent versions of the code, some studies shown that the important buildings (or very important building which indicated in the code) designed based on the latest version of ISC are not satisfied the ISC's criteria (see Mahmoudi and Ghobadi, 2011 and Shakib, 2000). Therefore, it is useful to study the improvement of seismic safety in different editions of ISC and compare that with acceptable level of safety. The results provide good information on the safety of important facilities designed in different periods based on each seismic code.

In this study, a very important 3-story steel building located in very high seismic zone is chosen and designed base on all three editions of the ISC in different soil conditions. These lead to design of 12 different frames. Then, the probability of two different condition of structures; the disruption of functionality and collapse, are evaluated by developing the fragility function of structure employing the stochastic approach. The distribution of response is evaluated by numerical method using dynamic analysis subjected to numerous ground motions (number of selected records for analysis have been include 37 in soil I, 44 in Soil II, 45 in soil III and 37 in soil IV). HAZUS damage thresholds including slight and complete are chosen which they are equivalent to disruption of functionality and collapse, consequently. The Eq. 1 was fitted to the results.

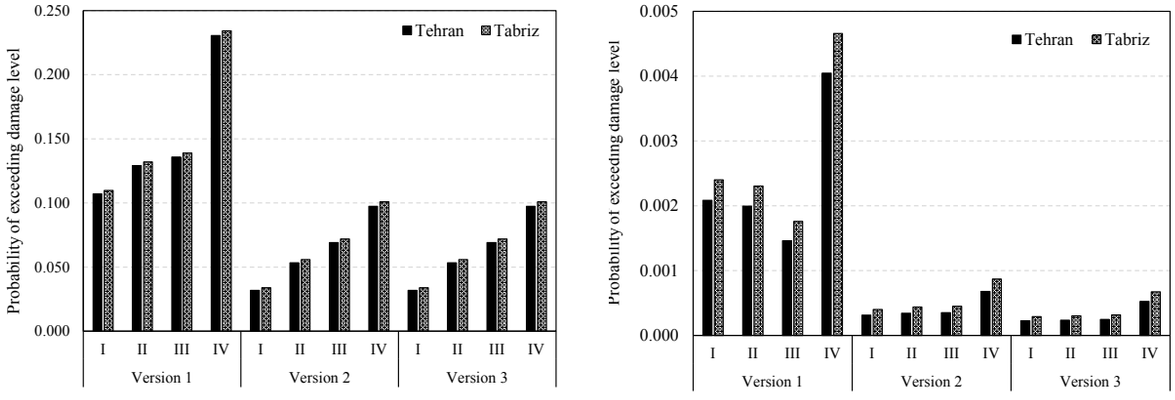
$$P(D > d_i \mid pga) = \Phi\left(\frac{\ln(pga/pga_{m_i})}{\beta_i}\right) \qquad (1)$$

In which, $P(D > d_i \mid pga)$ is exceeding probability of damage (D) in structure from any damage state d_i (e.g. loss of functionality or collapse) in any given pga , pga_i and β_i are median and lognormal deviation of PGA of ith damage state respectivley. The parameters of fragility function for studied frames are given in Table 1.

The probability of failure of frames have been evaluated for Tehran and Tabriz, two major urban areas located in very high seismic zone using their hazard curves and evaluated fragility functions. The results are shown in Figure 1.

Table 1. Fragility functions parameters of damage state in loss of functionality and collapse for three code editions and various soil types

Editions of ISC	Soil Type	Damage state			
		Loss of functionality		Collapse	
		PGA_{m1}	β_1	PGA_{m2}	β_2
Edition 1	I	0.1812	1.0647	1.4296	1.0108
	II	0.1462	0.9864	1.4308	1.0017
	III	0.1353	0.9411	1.2384	0.8633
	IV	0.0820	0.8144	0.7266	0.8310
Edition 2	I	0.2727	0.8037	2.3189	0.6907
	II	0.2077	0.7946	2.2428	0.7147
	III	0.1762	0.7724	2.2131	0.7178
	IV	0.1331	0.6809	1.2956	0.6183
Edition 3	I	0.2727	0.8037	2.7509	0.6732
	II	0.2077	0.7946	2.7450	0.6967
	III	0.1762	0.7724	2.6395	0.6824
	IV	0.1331	0.6809	1.5442	0.6036



a) Loss of functionality

b) Collapse

Figure 1. Comparison of probability of loss of functionality and collapse in important buildings located in Tehran and Tabriz designed based on three editions of ISC and different soil conditions

The result of analysis have shown that the second and third editions of the code have been improved significantly in term of providing a minimum safety for structures in terms of maintaining the functionality of structures and limiting risk of structural collapse. As demonstrate in literatures (such as Mahmoudi and Ghobadi (2011) and Shakib (2000)) which performance of very important buildings are not satisfied ISC's criteria, in this study it has been illustrated that the probability of loss of functionality and collapses are not suitable for these building as well. Within any code edition, a constant limit of safety was not provided for different soil types and structures designed for softer soil types, experiences more risk. This need to be addressed in future editions of codes. In addition, comparison between two cities reveals that the risk of Tabriz is a bit higher than Tehran, in terms of the probability of failure of structures.

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