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RISK-TARGETED SEISMIC DESIGN MAP FOR IRAN: ACHIEVEMENTS AND CHALLENGS

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Iran is located in a very high seismic zone. Following the devastating earthquake of Buin-Zahra (Ms7.2) in 1962 which left 12000 deaths, the first draft of Iranian national seismic design code for buildings was presented and updated in 1987 as the first standards for this purpose, referred as Standard No. 2800 (STD-2800). To date, four editions of this code have been published, the latest of which was in 2014 (BHRC, 2014).

The current version of STD-2800 employs the Design Basis Earthquake (DBE) based on the uniform hazard philosophy. In recent years, several studies have shown that defining design basis earthquake based on the uniform hazard philosophy does not lead to design of structures with a uniform probability of collapse in different regions. The reasons for this are uncertainty in collapse capacity of structures and differences in the shape of hazard curves (Luco et al., 2007).

In this paper, using an algorithm developed by Luco et al. (2007) a new seismic design map referred as risk-targeted seismic design map, has been developed for Iran in order to provide a tool for designing buildings with equal or at least harmonized collapse probability across the country.

For the collapse risk assessment of the buildings conforming the STD-2800, same hazard curves resulted in the seismic zonation map of the code are required. However, since such models are not available, the seismic hazard curves of the EMME14 project were employed for this purpose. The resulted hazard curves were classified into four seismic zones corresponding to categories of seismicity in STD-2800. Subsequently, using the resulted hazard curves, the PGA values corresponding to 10% probability of exceedance in 50 years (DBE) were obtained for the whole country. A significant difference is observed between the resulted values of PGA based on EMME14 hazard curves and the DBE introduced by STD-2800.

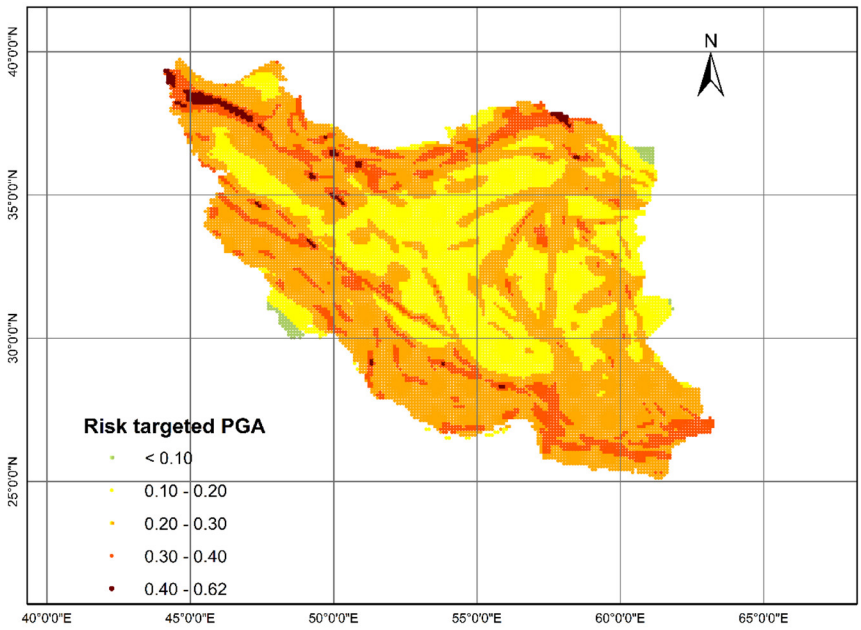
Table 1. Statistical comparison of STD-2800 and EMME14 DBE.

	PGA (g) based on STD-2800	PGA (g) based on EMME14
Max	0.35	0.80
Min	0.2	0.05
Median	0.3	0.27
STDEV	0.03	0.08
COV (%)	11.00	31.00

The next step in seismic risk assessment is to develop fragility functions for the structures under study. Since developing site and structure specific fragility functions have a considerable computational cost, generally a generic collapse fragility function is employed for all types of buildings in the risk-targeted ground motion calculation process. To define a generic collapse fragility function for Iranian code-conforming buildings, first it is necessary to determine the conditional probability of collapse under the design basis ground motion with 10% probability of exceedance in 50 years (Pc|gm) and the amount of uncertainty in the collapse capacity (β) of the code-conforming buildings in Iran. In this

study, based on series of the sensitivity analyses a generic collapse fragility function with Pc|gm=0.01 and β=0.8 was defined for the Iranian code-conforming buildings.

Based on the results of this study we found that with the selected parameters of the generic fragility function, the mid-range of calculated collapse probabilities in the whole country, are close to 1% in 50 years in the case which the DBE is defined based on the EMME14. Therefore, since applying large modifications to the existing uniform hazard DBE is not desired, the acceptable risk of 1% in 50 years is selected.



The results show that in the first case (based on the DBE corresponding to the STD-2800), the risk coefficients are between 0.16-2 with an average of 0.79. These results indicate that in order to reach to the acceptable probability of collapse, the seismic design map provided by the STD-2800 should be considerably modified (100% modification). In the second case (based on the DBE corresponding to the EMME14), the risk coefficients range between 0.75 and 1.26 with an average of 0.87. So, by applying modest modifications (up to 25%) on the EMME14 DBE, an acceptable risk of collapse across Iran will be achieved. Finally, the risk-targeted seismic design map for the country is shown in the figure below.

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