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DEVELOPING AN EMPIRICAL FATALITY MODEL TO IMPLEMENT IN RAPID LOSS ASSESSMENT SYSTEM OF IRAN EARTHQUAKES (RAISE)

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Estimating fatalities and injuries after an earthquake is a basis of emergency response planning. This provides valuable information for medical groups and agencies for capacity buildings before an earthquake and to dispatch medical teams to the most affected regions aftermath of an earthquake. There are many examples of destructive earthquakes in Iran that lack of sufficient medical services multiplied the death toll. As a case in point, in 2003 Bam, Iran earthquake (Mw 6.6), the central government authorities were not aware of the number of casualties till several hours after the event. This issue caused delay in providing appropriate services to the injured or burial of corps (So and Spencer, 2013).

In the light of these explanations, the International Institute of Earthquake Engineering and Seismology (IIEES) has developed a rapid loss estimation of Iran's earthquakes called as "Rapid Assessment of Iran Seismic Event (RAISE)". The system provides the ground motion shaking map, the affected population, as well as probable casualties and damage maps of the target area in near real time. This paper essentially focuses on the procedure to model the earthquake fatality model that will be incorporated in the RAISE system.

There are three common approaches in literature to quantify the earthquake fatality: 1) empirical models; 2) semi-empirical models; and 3) analytical models. The empirical models developed based on the correlation of ground motion shaking parameters or other earthquake parameters and the fatality ratio. This procedure consists of many gross assumptions and eliminates many explanatory variables (Zhang et al., 2018). The semi-empirical models represent the number of fatality based on the damage rate of different building classes. In this approach, first, a rough estimation of damages of different building classes is obtained. Then, number of deaths is determined based on the fatality rate on different building classes. The analytical approach involves a multi-step process consisting of estimating the ground motion in term of spectral acceleration, exposure analysis, structural analysis, damage analysis and loss analysis (Jaiswal and Wald, 2010). Although the semi-empirical and analytical approaches provide more accurate estimations of fatality, their calculations are based on the building analysis, which are not appropriate for rapid loss estimation systems such as RIASE. To this end, in this paper, the authors present an empirical fatality model developed based on local characteristics in Iran.

This study has been implemented in three phases (Figure 1). In the first step, a reliable database of past earthquakes of Iran was compiled. This was a challenging step, as reliable data about the distribution of casualties in different earthquakes were not appropriately documented in advance. To address this issue, numerous sources including official reports, articles, mass media news and newspapers have been reviewed for each event. In the second step, the ground motion shake maps of the earthquake were derived. This issue is done based on a customized version of ShakeMap V4.0 system developed by U.S. Geological Survey. In the final step, a prototype model for estimation of the fatality model for Iran earthquakes was developed.

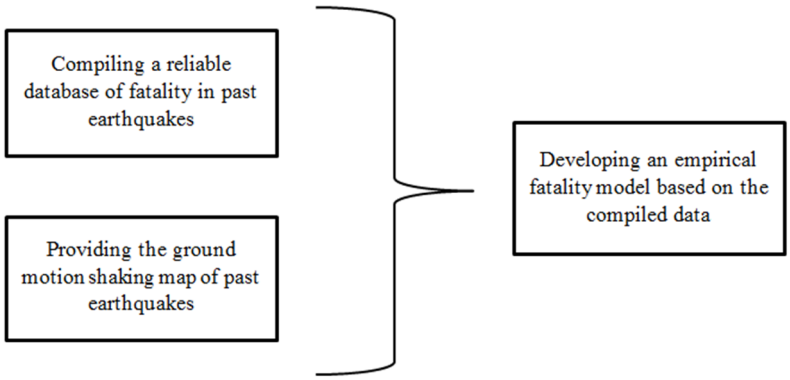

Figure 1. The general procedure to provide an empirical fatality model

The results of this study depicts that there is a good correlation between the number of deaths and earthquake parameters (specifically PGA). However, considering the limitation of data on urban earthquakes in Iran, the proposed method is more applicable for rural areas at this stage. This should be noted that by applying semi-empirical approaches, the necessary models for urban areas need to be developed to be used in RAISE.

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