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Near and far field spectral demand curves for Iran; using Iranian strong motion records

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1. Introduction: The Iranian strong motion data are studied in order to find the spectral demand ordinates of the selected recorded having better signal to noise ratios. The capacity spectrum method is used in this study and the spectral demand curves are estimated for 89 records. The records having low signal to noise ratio in the frequency range of less than 0.3 Hz are excluded, and the rest of records with a PGA (at least for one of the three-components) greater than 50 cm/sec2 are processed and analyzed in this study. The site classification for these records is performed based on the receiver function method (estimating the H/V ratio for each of the recorded motions). According to this procedure, the numbers of the selected records were 22, 16, 25 and 26 for the site classes 1, 2, 3 and 4, respectively. The frequency contents of most of the records show dominant amplitudes between frequencies 0.2 and 10Hz. This selected catalog of 89 accelerograms obtained from 45 earthquakes.

2. Methodology: The spectral demand curves are represented and discussed in the recent years to provide the input for the design methods using the energy dissipation in selected components of the framing system for maximum earthquake shaking (Hanson and Soong 2001, Ramirez et al. 2002). These curves are developed in this paper for the first time for the Iranian selected strong motion records.

This method is based on the assumption that the response of a building can be related to the response of an equivalent Single Degree of Freedom (SDOF) system. This implies that the response is controlled by a single mode when the shape of this mode remains constant throughout the response history. The consequence of these assumptions is the reliable assessment of maximum seismic response of the Multi-Degree of Freedom Buildings (MDOF), such that the provided response is dominated by the first

mode. The method applies the initial effective stiffness and secant stiffness information to calculate the target displacement. The methodology applies usually the higher damping values based on the shape of the hysteresis and the maximum deformation level. Using this method it is necessary to estimate the target displacement. Having the equivalent viscous damping, a design response spectrum for that damping could be developed. The acceleration response spectrum could be related to the displacement response spectrum by multiplying its ordinates by a factor of T/42. Increasing the damping value, the acceleration and displacement spectral ordinate decreases. This relationship between the acceleration and displacement spectral ordinates shows that these two can be related to each other in a simple plot, which is called as the demand curve. The spectral acceleration and displacement ordinates are plotted for different selected equivalent viscous damping values, in which the radial lines represent the constant period. This form of design loading can be directly compared with the non-linear load-deformation envelope with the response spectrum for the appropriate damping value, normalized with respect to the equivalent SDOF coordinates (FEMA 274, Seismic Rehabilitation Commentary, 1997). According to this method, the target displacement for the equivalent SDOF system is at the intersection of the load deformation envelope with the response spectrum for the appropriate damping level.

3. Results and Conclusions The demand curves for the 89 selected records are classified for horizontal and vertical components and for two major seismotectonic regions of Iran; Alborz-Central Iran and Zagros. The demand curves for 2 near-fault recorded motions in Bam and Tabas are classified separately and the average demand curves for such conditions are presented as well. These curves show significant difference for near and far fault motions, and for the rock and soft soil sites. However no important different could be distinguished between the hard alluvium and deep cohesionless soil classes. This could be resulted from the lesser available data for the some of the site classes, and for the unequal available data for different conditions.

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