ASSESSMENT OF EARTHQUAKE HAZARD IN MARMARA REGION, TURKEY

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After 1999 Mw7.4 Kocaeli earthquake the probabilities of having a Mw7+ earthquake in the Marmara Sea to the immediate south of Istanbul have increased due to stress transfer on the existing seismic gap. Earthquake hazard in the Marmara region has been investigated using Deterministic (scenario earthquake based) and Time-dependent probabilistic (renewal) models. A fault segmentation model was developed for main Marmara Fault, damage distribution of the historical earthquakes was carefully correlated and the inter-event time periods between characteristic earthquakes were estimated. . For the probabilistic studies characteristic earthquake based recurrence relationships are used. Assuming normal distribution of interarrival times of characteristic earthquakes, the Mean Recurrence Time, Covariance and Time Since Last Earthquake parameters are developed for each segment. The characteristic earthquake recurrence rates are determined by assigning characteristic magnitude and recurrence intervals to each fault segment in the region. For the renewal model, the conditional probability for each fault segment is calculated from the mean recurrence interval of the characteristic earthquake. The probabilities are conditional since they change as a function of the time elapsed since the last earthquake. For the background earthquake activity, a spatially smoothed seismicity is determined for each cell of a grid composed of cells of size 0.005° x 0.005°. Seismic activity in each cell is determined for earthquakes of magnitude between 5.0 and 7.0 assuming that a Gutenberg-Richter type recurrence relationship governs the earthquake recurrence in the background for magnitudes between 5.0 and 6.0. For background earthquakes with magnitude 6.0 to 7.0 finite faults are used. Earthquake hazard is quantified in terms of peak ground acceleration (PGA) and the spectral accelerations (SA) for natural periods of 0.2 and 1.0 seconds. The ground motions are determined for soft rock (NEHRP B/C boundary) conditions. Locally developed and Western US–based attenuation relationships with appropriate weights were utilized. Earthquake hazard results obtained for 10% and 2% probabilities of exceedence in 50 years for PGA and SA for the Deterministic and Renewal models are presented in terms of contour maps with comparisons and suggestions for use in performance based design of engineering structures.

Current "official" earthquake hazard zonation map, other deterministic, probabilistic and time–dependent hazard maps that resulted from several projects (e.g. GSAHP, SESAME, TEFER) are compared with appropriate suggestions for use in performance based design of engineering structures.

Current earthquake hazard models are mostly static; they do not change with time unless exchanged every few years for a new generation of maps. However, in order to respond to changing societal needs and emerging capabilities, a new physics-based and time-dependent "forecasting" approach to hazard assessment is needed. This approach will accommodate re-computation of hazard automatically when new significant data becomes available or when detectable changes in the seismicity distribution have occurred. A newly started EU-FW6 project (NERIES, http://www.orfeus-eu.org/neries/neries.htm) incorporates a sub-project that will develop, implement and test such reference time-dependent earthquake models that reflects clustering of earthquakes in space and time. In this connection a statistical time-dependent earthquake hazard model that takes into account the contribution of aftershocks, potential foreshocks and earthquake swarms into hazard computations will be created. The model will provide an important resource for emergency response workers and decision

makers after a mainshock, a comprehensive platform to communicate time-dependent hazard to the public and a benchmark for seismologist for the development of more sophisticated models.