2006 ECI Conference on Geohazards
Lillehammer, Norway
Editors: Farrokh Nadim, Rudolf Pöttler, Herbert Einstein, Herbert Klapperich, and Steven Kramer

Year 2006 *Paper* 18

A Capacity Spectrum Method for Seismic Risk Assessment

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http://services.bepress.com/eci/geohazards/18

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Abstract

Although earthquakes and the associated damage occur in a fundamentally deterministic way, the processes are so complex that our prediction scenarios are basically uncertain approximations. In the first attempts to model hazard and risk, point estimates based on empirical data were used, however, for quite some time the more advanced seismic hazard modelling has been based on models in which the variability/uncertainty of the input parameters are consistently carried through the computations so that the results are probabilistically combined to give a median value and confidence levels that reflect on the input parameter uncertainty. For seismic damage scenarios the first tools to model uncertainties are now developing. Aware of the importance of a proper seismic risk estimation, the International Centre for Geohazards, through NORSAR and the University of Alicante (Spain), has developed a Matlab based tool in order to compute the seismic risk in urban areas using the capacity spectrum method. The user will supply built area or number of buildings in the different model building types, earthquake sources, attenuation relationships, soil maps and corresponding ground motion amplification factors, capacity curves and fragility curves corresponding to each of the model building types and finally cost models for repair or replacement. This tool will compute the probability of damage in each one of the four damage states (Slight, Moderate, Extensive and Complete) for given building types. This probability is subsequently used with the built area or number of buildings to express the results in terms of damaged area (square meters) or number of damaged buildings. Finally, using a simplified

economic model, the damaged is converted to economic losses (in the input currency).

The algorithm is transparent in writing and loading the input files and getting the final results. The main innovation of this tool is the implementation of the computation under a logic tree scheme, allowing epistemic uncertainties related with the different input parameters to be properly included, and the final results are provided with corresponding confidence levels. The method has been successfully applied to the city of Oslo (Molina and Lindholm, 2005).

In this work we will show the main processes of the computation and an example to the seismic risk estimation.

Finally, the main future development will be focused in the implementation of first order reliability methods (FORM) which recently have been proved as useful to capture also the aleatory uncertainty.

No manuscript submitted by the authors.