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Probabilistic assessment of the seismic risk of Barcelona

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SUMMARY:

A probabilistic methodology is used to obtain an actualized estimation of the seismic risk of Barcelona. The main steps of this methodology are: 1) a probabilistic seismic hazard assessment (PSHA); 2) a probabilistic assessment of the seismic vulnerability and; 3) the estimation of the seismic risk. According to the results of the PSHA analysis, which has been done using the CRISIS2008 code, the macroseismic intensity of VI-VII has a return period of 475 years. On the other hand, a probabilistic version of the methodology of the vulnerability index was used to assess the seismic vulnerability of 69982 buildings of Barcelona. According to the results, Ciutat Vella is the more vulnerable district in Barcelona. In this district the probability that the vulnerability index of the buildings will be greater than 1.0 range between 18.76% and 44%, with a mean value of 30.43%. In this case, values close to 1 of the vulnerability index represent high levels of seismic vulnerability. On the other hand, according to the seismic risk results, the districts of Ciutat Vella and the Eixample have the higher levels of seismic risk of Barcelona.

Keywords: Seismic Risk, Seismic Hazard, Seismic Vulnerability, Barcelona.

1. INTRODUCTION

The damage that occurred in several buildings in Spain due to the 2011 Lorca earthquake, and the damage that was related to the 2010 Haiti earthquake, were considered socially unacceptable. These cases are examples of the importance of executing adequate assessments of the seismic risk in any urban areas, with the purpose of improving the seismic management of the cities. In the case of Barcelona is possible to affirm that there are a solid group of academics and public authorities, which consider as an important task to do periodical evaluations of the seismic risk of Barcelona. Some of these persons have been the responsible of the main part of the databases related to the buildings in Barcelona that were used in the present work (Aguilar-Meléndez, 2011).

2. SEISMIC RISK OF BARCELONA

2.1. Methodology

In order to assess the seismic risk of Barcelona the LM1_P methodology (Aguilar-Meléndez, 2011) was chosen. The main steps of this methodology are: 1) the probabilistic seismic hazard assessment, 2) the seismic vulnerability analysis and, 3) the estimation of the seismic risk.

2.1.1. Seismic hazard in the LM1_P Methodology

In the LM1_P methodology it is recommended the use of the code CRISIS2008 (Ordaz et al, 2011). This code allows estimating the seismic hazard according to the Esteva-Cornell approach (Esteva, 1970; Cornell, 1968). The CRISIS2008 code and its previous versions have been widely validated in different international projects. The new version of this code has significant improvements. For instance, now it is possible to assess the seismic hazard using attenuation laws in terms of peak ground