LESSONS LEARNED FROM ELE STUDIES IN URBAN EARTHQUAKE-PRONE AREAS

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ABSTRACT

Predicting the likely consequences of an earthquake to a nation, a city or an individual facility is generally covered by the scientific field of earthquake loss estimation (ELE). Traditionally, ELE studies have been conducted empirically (e.g. Risk-EU approach) mainly because of a lack of instrumental ground motion data and the limitations of structural analysis techniques. However, with the advent of nonlinear structural analysis tools (e.g. the nonlinear static pushover analysis) and the introduction of Capacity Spectrum Methodologies (CSM), ELE studies have been more and more conducted in an analytical-predictive way.

Analytical ELE studies for a test bed, i.e. a city or a region, require estimates on the expected ground-motion characteristics including effects of local subsoil conditions, vulnerability of the prevalent building and infrastructure typologies, as well as exposure of the same. The paper at hand discusses the challenges and the associated uncertainties that are inherently connected to each of the three components, ways to either minimize or handle these uncertainties, and how the final results of analytical ELE studies can still be considered as valuable output given the involved uncertainties. More importantly, the paper will shed light onto the technical and nontechnical problems and challenges involved during the practical conduct of ELE studies. These challenges may not only affect the practical conduct of the data collection, but also increase the uncertainties of collected input and inventory data, and not the least hamper the practical implementation of results and the initiation of mitigative actions. The paper will thereby relate to various ELE studies and risk mitigation initiatives that were conducted during past years mainly in developing countries.

INTRODUCTION

Earthquake damage and loss estimation (ELE), often also referred to as earthquake risk estimation, is a comparably young research discipline, which basically began with the seminal works on earthquake hazard by Luis Esteva (1967; 1968) and Cornell (1968). Earthquake hazard, however, represents only one of the three main components that are required for a proper damage and loss assessment. The other main components are the collection of inventory data of all assets that are to be covered by the study (e.g. buildings, infrastructure facilities, population) as well as the provision of vulnerability estimates for these assets, i.e. to describe their damageability as a function of ground motion intensity.