

Development of comprehensive earthquake loss scenarios for a Greek and a Turkish city - structural aspects

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Abstract. The paper presents a methodology for developing earthquake damage and loss scenarios for urban areas, as well as its application to two cities located in Mediterranean countries, Grevena (in Greece) and Düzce (in Turkey), that were struck by strong earthquakes in the recent past. After compiling the building inventory in each city, fragility curves were derived using a hybrid approach previously developed by the authors, and a series of seismic scenarios were derived based on microzonation studies that were specifically conducted for each city (see companion paper by Pitilakis *et al.*). The results obtained in terms of damage estimates, required restoration times and the associated costs are presented in a GIS environment. It is deemed that both the results obtained, and the overall methodology and tools developed, contribute towards the enhancement of seismic safety in the Mediterranean area (as well as other earthquake-prone regions), while they constitute a useful pre-earthquake decision-making tool for local authorities.

Keywords: earthquake damage scenarios; vulnerability; loss assessment; fragility curves; capacity curves; hybrid methodology; restoration time.

1. Introduction

During the last 15 years or so, a growing interest is observed for seismic risk studies (Bard *et al.* 1995, Barbat *et al.* 1996, D'Ayala *et al.* 1996, Faccioli *et al.* 1999, Kappos *et al.* 2002, 2008, Erdik *et al.* 2003, Dolce *et al.* 2006, Anagnostopoulos *et al.* 2008) in a number of European cities, particularly those located in its southern part, where the earthquake activity and its consequences are significantly higher. The reason is that it is now widely accepted that seismic risk scenarios and the estimation of the economic and human losses incurred by the earthquake, notwithstanding the inherent uncertainties and practical difficulties involved, are a useful tool for seismic risk management and for prioritizing the pre-earthquake strengthening of the built environment.

The writers have been developing over the last decade a methodology for vulnerability and loss assessment of the building stock based on a 'hybrid' approach, combining statistical data from actual earthquakes with the results of inelastic analyses of representative structures (Kappos *et al.* 1998, 2006, Kappos 2007). Successive versions of this methodology have been applied to develop damage and loss scenarios for the building stock of a number of cities in Greece (Kappos *et al.*

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