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Seismic fragility assessment of RC high-rise buildings in Montenegro

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Abstract

This paper presents seismic fragility assessment of RC high rise-buildings in Montenegro. The key points of the procedure for obtaining the fragility curves are described by using algorithm, defined in this paper, and generally applicable to all types of RC high-rise buildings. The fragility curves are derived and log-normal cumulative distribution function parameters are obtained for the four damage states by conducting 1800 nonlinear time-history analyses on the basis of 60 ground motions with wide range of magnitudes, distance to source and different site conditions, for seismic excitation characteristic for Montenegro. As a prototype buildings, 20-story, 30-story and 40-story RC high-rise buildings with core wall structural system are selected. The whole approach presented in this paper may be used for obtaining seismic fragility curves for RC high-rise buildings of different configurations and for different seismic zones.

Keywords: high-rise buildings; fragility curves; non-linear time-history analysis; log-normal distribution function parameters.

1. Introduction

Fragility curves are defined as the conditional probability of exceedance of particular damage (DS) or limit state for a given ground motion intensity measure (IM). Fragility curves can be written in mathematical form as follows (DM is a demand measure, dm^{DS} is limit value of demand measure for particular damage state DS):

$$\mathrm{P}[DS/IM] = \mathrm{P}[DM > dm^{DS}/IM] \quad (1)$$

There are different ways for obtaining fragility curves, from simple to more complex. Simple methods provide approximated fragility curves while more complicated methods provide more realistic and accurate curves. Rossetto and Elnashai [1] classify the existing fragility curves into four groups: empirical fragility curves, expert fragility curves, analytical fragility curves and hybrid fragility curves. Empirical fragility curves are obtained by statistical analyses of damaged buildings in the occurred earthquakes. Expert fragility curves are based partially or completely on expert's opinion and represent the simplest way for obtaining the curves [2]. Analytical fragility curves are derived using numerical models to simulate the behavior of systems. In the absence of experimental data, observational data or an opinion of an expert, the only way to explore vulnerability of buildings is by using analytical methods [3], [4], [5] . Hybrid fragility curves are derived by combining the mentioned curves. For

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