EFFECT OF STRUCTURAL MODELING UNCERTAINTIES ON SEISMIC PERFORMANCE OF STEEL MOMENT RESISTING FRAMES

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ABSTRACT

Prediction of structure's response to seismic loads is a complex problem with many parameters involved that some of them can behave highly uncertain. Nonetheless it is needed to have a clear understanding of how these uncertainties affect structural seismic performance. In this matter, it is convenient to separate uncertainties into two categories: *aleatory* (due to variability of strong ground motions) and *epistemic* (related to structure's numerical model).

This Paper aims to investigate effect of structural uncertainties on seismic performance of steel moment resisting frames through extended IDA of a sample 5-storey frame. In this regards, uncertainties in damping, mass, yield strength and ultimate strength of structural steel have been considered as probabilistic variables. Latin Hypercube Sampling (LHS) has been used to create random realizations of structures. With the aid of reliability methods, different sources of uncertainty and their ranges of influence on seismic performance have been disaggregated

Considering results, it can be seen that uncertainties in selected parameters have important effect on seismic performance. Capacity and demand estimations based only on deterministic procedures may ignore some substantial points. Also including these uncertainties in performance calculations can considerably change probability of achieving desired performance at some levels.

INTRODUCTION

Incremental dynamic analysis (IDA), introduced by Vamvatsikos and Cornell (2002), is nowadays a widely used tool to study seismic performance of structures and has been discussed in many researches and technical reports (FEMA-350, 2000; FEMA-440, 2005; Vamvatsikos and Fragiadakis, 2010). Using this method is usually based on a deterministic numerical model of structure, which is affected only by aleatory uncertainties (known as record to record effect). But in a more developed method, which is named *extended IDA*; it is possible to perform IDAs with a probabilistic description of structural model. In such case, results will contain both aleatory and epistemic uncertainties.

Extended IDA has been subject for many researches in recent decade. Dolsek (2009) studied effects of epistemic uncertainties on seismic capacity of a 4-storey concrete moment resisting frame through extended IDA, with selecting a set of various structural modeling parameters as probabilistic variables. Zareian and Krawinkler (2007) suggested a probabilistic-based methodology for quantifying the collapse potential of structural systems, based on different sources of uncertainty and for desired levels of confidence.

Lignos et al. (2008) evaluated reliability of a 4-storey steel moment resisting frame against collapse caused by seismic loads in which they modeled moment-rotation characteristics of plastic hinges as