EVALUATION OF THE EFFECTS OF MODELING UNCERTAINTIES ON THE SEISMIC PERFORMANCE OF REINFORCED CONCRETE FRAMES

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ABSTRACT

In recent years, researchers have paid much attention to evaluate the effects of modeling parameters in steel frames; however this subject has been less studied in reinforced concrete (RC) frames. The modeling parameters are one of the important parts of the epistemic uncertainties in probabilistic assessment of structures that are obtained from physical and geometrical features of the structure; for example ASCE 41-13 (2014) introduces the parameters of nonlinear moment-rotation behavior of RC's beam column elements as a function of longitudinal and transverse reinforcement and also axial and shear demand. The modeling parameters are indeed the parameters obtained from backbone curves of the beam-column elements; which have been previously introduced by Ibarra et al. (2005) and include plastic rotation (θ_p), post capping rotation (θ_{pc}),post yield hardening stiffness(M_c / M_y) and etc. Evaluating the effects of these parameters can be executed by analyzing several RC frames under different values of the mentioned parameters. This study is aimed at evaluating the uncertainty effects in some of modeling parameters on the seismic performance of RC frames by using incremental dynamic analysis (IDA) and obtaining the collapse fragility curves of four frames with different story heights.

Moreover, the importance of proper correlation assumption between different modeling parameters, and also the performance level in which the assessment is executed will be discussed in this paper.

INTRODUCTION

In general, the uncertainties are categorized into two types, one of which is the uncertainty due to inherent randomness of natural phenomena and the other one is the uncertainty due to lack of human knowledge. The first mentioned category is often called as 'aleatory' and the second one is often called as'epistemic'uncertainty. Despite the aleatory uncertainty, the epistemic uncertainty can be reduced by more research that results in better understanding of the modeled phenomena. However, separating the source of uncertainty is not as practical as discussed at all cases. In seismic evaluation of structures the earthquake record specifications are assumed as aleatory and the other modeling and designvariables are assumed as epistemic uncertainties. Predicting the effects of uncertainties on the seismic performance of structures has been investigated by many researchers. Esteva and Ruiz (1989) studied seismic failure rates of multistory frames and concluded that the geometrical and mechanical properties of the frame's elements do not have a significant effect on the failure probability of structure. However many later studies obtained contrary results that emphasized on the importance of epistemic uncertainties. Vamvatsikos and Fragiadakis(2010) evaluated the sensitivity of modeling uncertainties on the seismic performance of a nine-story steel moment-resisting frame through incremental dynamic analysis (IDA) and concluded that the uncertainties in beam hinges has