EXPLICIT DEMAND MODEL FOR MULTI- STORY STEEL MOMENT RESISTING FRAMES

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ABSTRACT

Probabilistic structural demand models are considered as an essential ingredient for a seismic fragility analysis. This concept is commonly developed using statistics which needcollecting data in large quantities. Preparation of such a data-base is often costly and time-consuming. In this paper, generic seismic drift demand model for regular-multi-story steel moment resisting frames is presented to eliminate the need of time-consuming analyses. The demand model defined as a linear function of intensity measure,the spectral acceleration at fundamental period $\left(Sa(T_1)\right)$, in logarithmic space predicts overall maximum inter-story drift. In addition,the model is coupled with a set of relations to directly estimate unknown statistical characteristics of the model parameters. These relations are developed using a Bayesian regression technique to explicitly address uncertainties arise from randomness and lack of knowledge. The developed demand model is employed to perform Seismic Fragility Analysis (SFA) for three designed building. The accuracy of the results is assessed by comparison with the results directly obtained from Incremental Dynamic analysis as an alternative.

INTRODUCTION

Next-generation Performance Based-Earthquake Engineering (PBEE) proposed by Pacific Earthquake Engineering Research (PEER) center employs probabilistic framework to serve a mathematical basis for seismic performance assessment. In this framework, uncertainties embedded in an earthquake occurrence, nonlinear response of structures and vulnerability of structural components during seismic events are explicitly addressed. To this end, next-generation PBEE requires probabilistic models for seismic hazard, structural response, damage and consequence to evaluate seismic performance of a building. Recent studies have tried to meet this need by developing multifaceted probabilistic models for different part of PBEE. In the present study the focus in particular is placed on structural demand model. Demand model is commonly developed for a typical structure based on data obtained from numerous nonlinear response history analyses (Ramamoorthy et al. (2006), Berahmanand Behnamfar (2009), Garcia and Miranda (2010), Bai et al. (2011),Tondini and Stojadinovic (2012).). Albeit, this methodology is suitable for academic purpose, but cannot be appealing for practical purpose because of its computational cost. In this paper, generic probabilistic demand model is proposed for multi-story steel moment resisting frames (SMRFs) that satisfy seismic requirements of ASCE-07-10. The model estimates overall maximum inter story-drift and have linear formulation in logarithmic space respect to earthquake intensity. Also, a set of relations in terms of building characteristics is developed using Bayesian regression technique to compute unknown models