Seismic performance of reinforced concrete frame for the risk assessment process

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ABSTRACT
Risk assessment is a suitable method for general decision making in the field of seismic safety. The aim of seismic risk assessment is to calculate the probability of detrimental economic and social effects in a particular region due to earthquake. Performing risk assessment requires information about seismic performance and response of the structure. In this paper, the seismic performance of moment resisting reinforced concrete frame with shear wall is studied using incremental dynamic analysis. 20 far-field earthquake records are used and the fragility curve is presented. The results indicate considerable effect of structural stiffness on the probability of limit states violation.

Keywords: Structural Design, Reinforcement, Seismic Performance, Risk Assessment

1. INTRODUCTION

Urban development and the high density of buildings especially in large cities have made it necessary to consider effects of earthquake on structural design. Performing seismic reliability assessment requires a powerful tool for seismic analysis and one of the most modern tools at present is incremental dynamic analysis (IDA) [1]. IDA can also provide the possibility of performing probabilistic analysis. Using this method requires an accurate structural modelling by taking into account environmental and loading conditions [2].

2. PERFORMANCE BASED ASSESSMENT

Performance based method that is developed at the Pacific Earthquake Engineering Research Centre (PEER), includes four types of random variables and its stages are shown in Figure 1. These four mentioned random variables are considered as Intensity Measure (IM),

Engineering Demand Parameter (EDP), Damage Measure (DM) and Decision Variable (DV) [6].

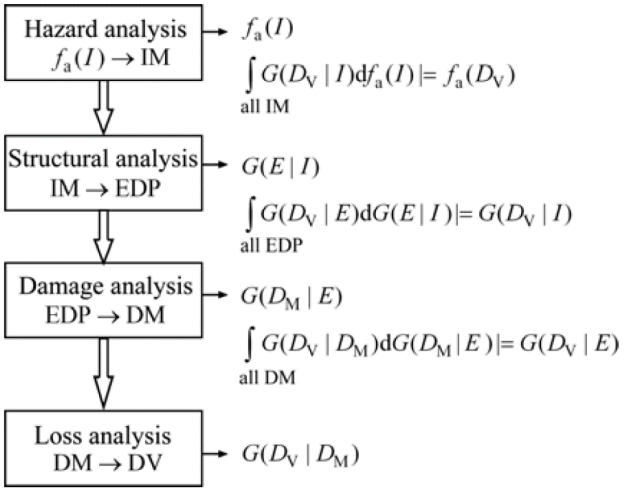

Figure 1 – Four stages of performance based assessment [6]

3. THE MODEL

The modelled structure is an eight-storey moment resisting reinforced concrete frame with shear wall, which is designed according to the ACI-318 code. The period of the first mode of this structure is T1=0.92 s. This frame is located in an area of high seismicity with gravitational acceleration of 0.3g.

In order to perform incremental dynamic analysis, a selection of ground motion records is required. 20 records that are used by Cornell and Vamvatsikos are considered in this study [5].

4. RESULTS

The IDA curves are illustrated in Fig 2 and 3. The horizontal axis corresponds to Maximum Interstory Drift Ratio (MIDR) and the vertical axis pertains to spectral acceleration values in the period of structure's first vibration mode considering a damping coefficient of 5% (S_a(T1,5%)).

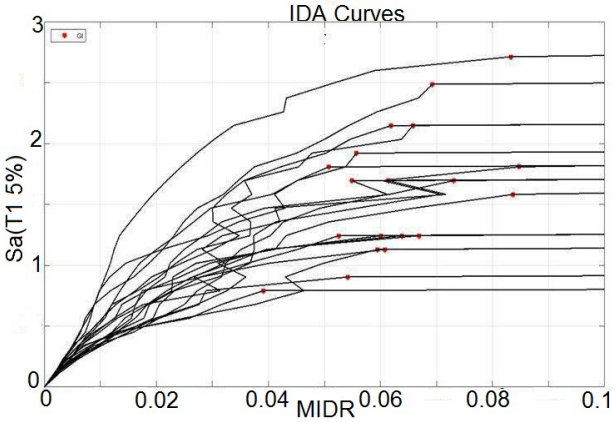

Figure 2 – IDA curves of earthquake records

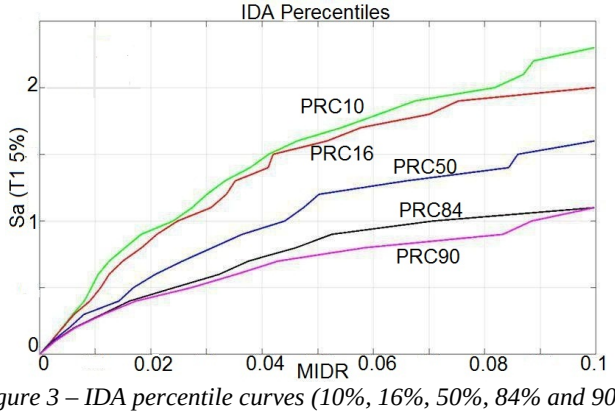

Figure 3 – IDA percentile curves (10%, 16%, 50%, 84% and 90%)

Fig. 4 presents MIDR fragility curve in initial levels of spectral acceleration (0.3g) which is obtained using IDA curves. In this figure, the horizontal axis is related to maximum interstory drift ratio values and the vertical axis corresponds to the probability cumulative distribution function.

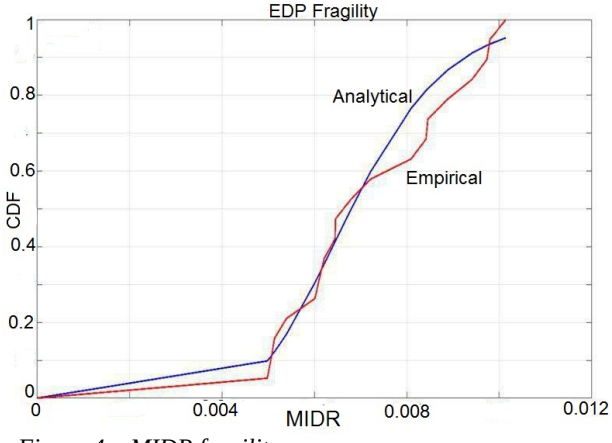

Figure 4 – MIDR fragility curve

The results show that, considering the structural stiffness, the probability of violating limit states in the dual structural system is considerably low. Furthermore, according to the IDA percentile curves, earthquake records damage the structure uniformly.

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