

Review on Fragility Analysis of Mid-Rise Existing RC Buildings

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Abstract

Fragility analysis is simply vulnerability assessment of buildings subjected to seismic motions. In this analysis, seismic fragility curves are derived with the help of non-linear dynamic analysis of the building. These curves define the conditional probability which exceeds a particular limit of failure and evaluate the seismic vulnerability of the structure and this probability of failure is a function of ground motion intensity. This paper deals with literature review of different authors on fragility analysis, incremental dynamic analysis method and ground motion intensity measures. The object of this study is to evaluate the fragility curves by incremental dynamic analysis method for a G+6 storied hypothetical model of existing RC building which has a practically more relevant plan having plan and vertical irregularities.

Keywords: Fragility Curves, Incremental Dynamic Analysis, Ground Motion Intensity, Conditional Mean Spectrum

I. INTRODUCTION

Low to mid-rise, non-ductile, RC structures designed for only static loads constitute the major stock of existing buildings in India. Seismic performance of such buildings is expectedly very low hence; seismic vulnerability of such buildings has to be assessed especially of those in higher seismic zones. Incremental dynamic analysis method is considered to be a parametric method for vulnerability assessment and developing fragility curves. This method is also the state-of-art method as described by FEMA. In incremental dynamic analysis, IDA curves are obtained through non-linear dynamic method these curves show the building damage measure (Inter storey drift) as a function of ground motion intensity measure. Using these results fragility analysis can be done by obtaining fragility curves which show percentage of probability of failure as a function of ground motion intensity.

This paper deals with obtaining fragility curves of a hypothetical G+6 storied existing building having a practically relevant plan.

II. LITERATURE REVIEW

A. Jelena Pejovic, Srdjan Jankovic Studied on Selection of Ground Motion Intensity Measure for Reinforced Concrete Structure

In this literature, the author's aim is to find most efficient ground motion intensity measure for assessing the seismic behavior of reinforced frame system and ductile reinforced wall system. In this paper analysis of different ground motion intensity measures that can be used in assessing the seismic behavior of RC building has been done. Maximum inter-storey drift is used as seismic response parameter. Relation between response parameter against various ground motion intensity measures is developed by regression analysis after performing nonlinear analysis. Intensity measures like Peak ground acceleration, Peak ground velocity, Peak ground displacement, Spectral response acceleration value ($S_a T_1$), Spectral response velocity value ($S_v T_1$), Spectral response displacement value ($S_d T_1$), Predominant period (T_p) etc were analyzed against maximum inter-store drift for 8 storied RC building.

B. Ionnis P. Christovasilis, Gian Paolo Cimellaro, Simone Barani, Sebastiano Foti Worked on Selection and Scaling of Ground Motions for Fragility Analysis of Structures

In this paper, the effectiveness of scaling method on developing fragility curves is presented. For this, two datasets were selected for the comparison, those were, FEMA P695 and site specific dataset. A 5 storied hypothetical light framed wooden structure was considered for the application. This literature proposes a methodology which uses Conditional mean spectra which are defined for specific site and specific structure for different levels of seismic intensity. Author concludes that, the results obtained from proposed ground motion selection and scaling method are less conservative with respect to the set in FEMA P695, but author is reluctant to call it a generalized statement.

C. C. B. Haselton, A.S.Whittaker, J.W.Baker, J.Bray, D.N. Grant Worked on Selecting and Scaling Ground Motions for Performing Response-History Analysis

This literature deals with defining target spectrum for selecting and scaling ground motions. Three target spectra namely Uniform hazard spectrum, Conditional mean spectrum and Conditional spectrum are defined and explained. According to author, the most widely used ground motion intensity measure is 5% damped spectral acceleration. This paper provides guidelines on selecting and scaling ground motions as per ASCE/SEI 7-10. The acceptance criteria used to determine the acceptability of the structural responses are outside the scope of this study. Even so the manner in which the structural responses are interpreted are discussed

D. Dimitrios Vamvatsikos, Fatemeh Jalayer, Allin Cornell Studied on Application of Incremental Dynamic Analysis to a RC Structure

In this paper, methodology of applying incremental dynamic analysis on a midrise RC structure located at California's San Francisco is discussed. Detailed comments also have been made on the selection of ground motion intensities and their measures. Spectral acceleration $S_a(T1, 5\%)$ is used against damage parameter of inter storey drift. Immediate occupancy, collapse prevention and global instability these are the structural performance levels selected.

E. Jack W. Baker Worked on Conditional Mean Spectrum

In this literature, a procedure is described by author to compute the conditional mean spectrum and it also explains how that spectrum can be used for selection ground motions. Author has found that, conditional mean spectrum can provide the anticipated response spectrum conditioned on occurrence of a target spectrum acceleration value at the intended period. Author also concludes that, the uniform hazard spectrum is unsuitable for the purpose as it conservatively implies large amplitude spectral values will occur at all periods within single ground motion.

III. CONCLUSION

Most of the researchers have done fragility or vulnerability analysis of model having regular plan, elevation and non-eccentric beam to column joints. In this paper a practically relevant and irregular plan is considered having eccentric beam-column joints and different section.

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