International Journal of Technical Innovation In Modern Engineering & Science (IJTIMES),(UGC APPROVED)
Impact Factor: 5.22 (SJIF-2017),e-Issn:2455-2585
"Recent Trends in Structural Engineering" (RTSE-2018)
Volume 4, Special Issue 01, Sept.-2018

A REVIEW PAPER ON DEVELOPMENT OF FRAGILITY CURVES FOR PERFORMANCE EVALUATION OF RC MOMENT RESISTING FRAMES

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Abstract*— *The aim of the study is to develop the fragility curves for high rise, low rise concrete moment resisting frame building. fragility curves provide the conditional probability of structure response when earth quack load as a fraction on ground motion intensity or another parameter. seismic fragility curves are used for the pre-earthquake planning and post-earth quack program and also retrofitting program. The objective of study is the reliability assessment of the case study for the building to earth quack loading. through the development of fragility curves. in fragility evaluation for first time and demonstrate its computational efficiency compare to computationally intensive Monte Carlo method. fragility curve of an RC frame is developed using high dimensional modal representation (HDMR) response surface method. There are also other simplified approaches which are computationally easy for fragility curve development. Cornell proposed such a simplified method which assumes a power law model between the damage parameter and intensity measure of earthquake.

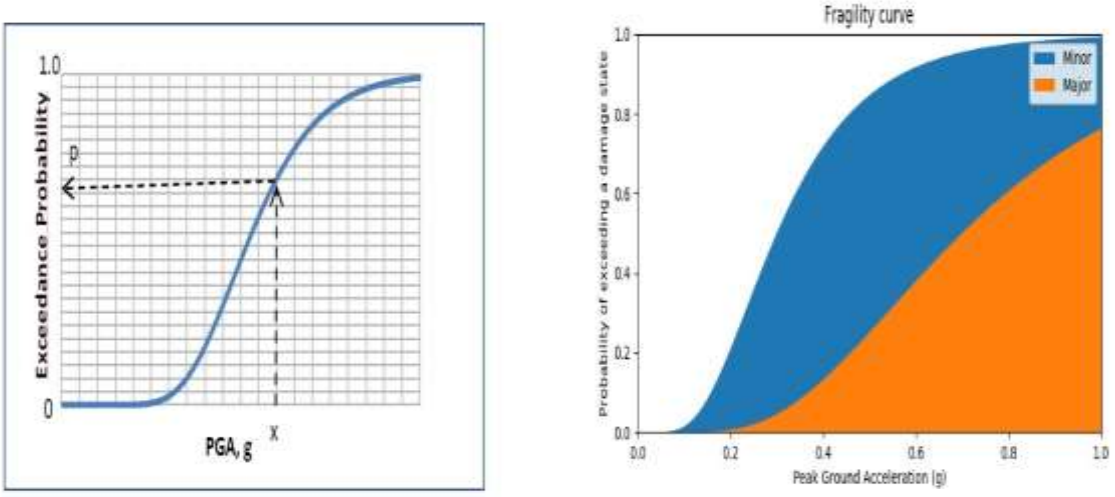
Keywords*— *Earthquake engineering, Fragility Curves, seismic Analysis, Ground Motion, Non-linear static Analysis

I. INTRODUCTION

In past decades, several costly and destructive earthquakes have occurred and this phenomenon is going to recur. Trying to predict and reduce the risks and consequences of this natural disaster is the only thing that can be done. The earthquakes and fragility of structures due to these natural disasters cause risks. Both risk components have inherent uncertainties including structural and seismic uncertainties. Therefore, it is necessary to assess the seismic performance and vulnerability of buildings for a given seismic parameter by employing these uncertainties. Tall buildings are specific types of buildings which are extensively used in seismically active regions, so it is necessary to conduct seismic risk assessments of these buildings. The vulnerability assessment is formerly done through developing fragility curves and relationships for some specific types of structures such as bridge piers, masonry and reinforced concrete structures, etc. This method is also applicable to the types of buildings we assess. Analytical fragility curves corresponding to a specific damage state define the probability of exceedance of the specified damage state for a given intensity of the seismic parameter of ground motion. In this investigation, fragility curves are obtained using nonlinear dynamic analysis procedures, specifically IDA method.

FRAGILITY CURVES:

Fragility curves are functions that describe the probability of failure, conditioned on the full range of loads to which a system might be exposed. In general fragility curves provide estimates for the probabilities of a population of structures reaching/ exceeding limiting deformation at given levels of ground shaking or it can be defined as a plot of the computed probability (deflection) Vs. Ground motion parameter. The data derived from fragility curves can be used to analyse, evaluate and improve the seismic performance of both non-structural and structural elements.
Fragility curve is an effective tool for vulnerability assessment of structural systems. The fragility curve, which is developed from the behaviour model of structure, capacity and a suite of ground motions, is a graphical representation of the seismic vulnerability of a structure.



Fragility Curve showing PGA vs. Probability of exceedance

METHODS OF DEVELOPMENTS OF FRGILITY CURVES

- Monte Carlo simulation (MCS)
- Cornell et al. (2002)
- Response Surface Method

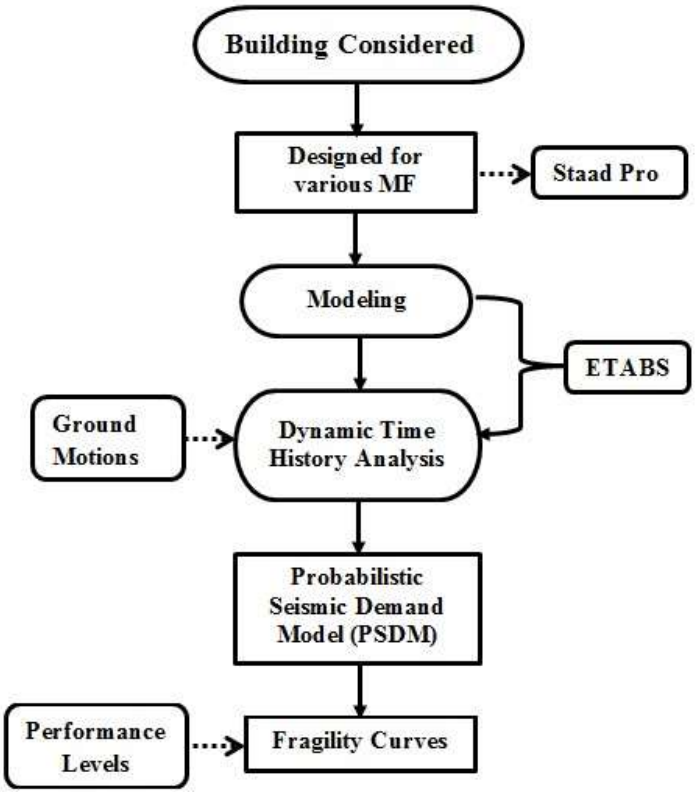
II. LITREATURE REVIEW

A. Vulnerability Assessment Using Fragility Curves

Sopna niar, Dr. G Hemalatha, Dr. P Muthupriya: Performance-based design is a more general design philosophy in which the design criteria are expressed in terms of achieving stated performance objectives when the structure is subjected to stated levels of seismic hazard. The performance targets may be a level of stress not to be exceeded, a load, a displacement, a limit state or a target damage state. Performance based engineering implies a shift away from the dependence of empirical and experience-based conventions and towards a design and assessment process more firmly rooted in the realistic prediction of structural behaviour under a realistic description of spectrum of loading environment that the structure will experience in future. It allows for selection of a specific performance objective based on various parameters, including the owner's requirements, the functional utility of the structure, the seismic risk and potential economic losses. In spite of these advances, many structures in the GCC countries and around the world were not designed for any level of seismic resistance.

B. Fragility analysis of open ground storey rc building designed using various multiplication factors

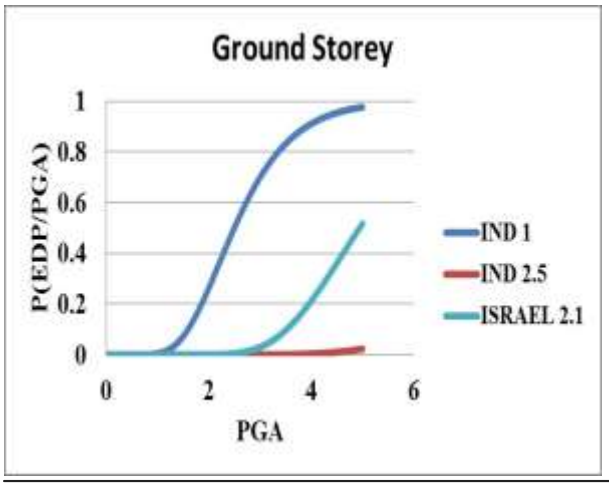
J. Chaudhari, Prajakta T. Raipure: In performing a seismic risk analysis of a structural system, it is essential to identify seismic vulnerability of component structures associated with various states of damage. The development of vulnerability information in the form of fragility curves is a widely practiced approach. Fragility functions are the essential tools for seismic loss estimation. They represent the probability of attaining or exceeding a damage limit state for a given structure type subjected to a seismic excitation (Shinozuka et al. 1999). Fragility curves are the conditional probability of exceedance of response of a structure for a given ground motion severity. Fragility curves are used commonly for the estimation of probability of damage of structure due to earthquakes as a function of ground motion indices or other design parameters. In this research paper comparison of Indian codes and Israel codes and also comparison of magnification factor.



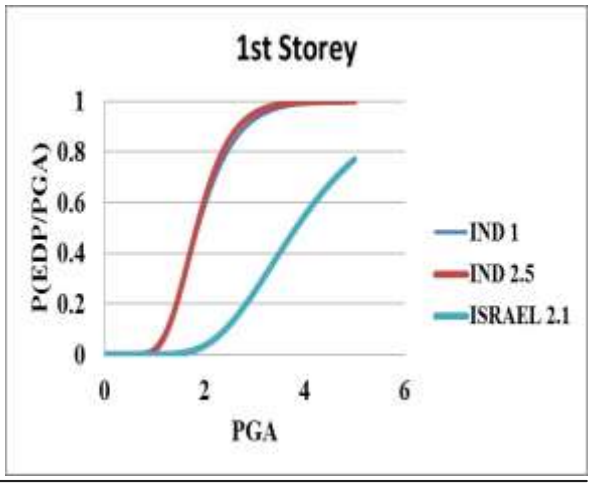
Flowchart for Development of Fragility Curves

Damage Limits with Various Structural Performance Levels for RC Frames

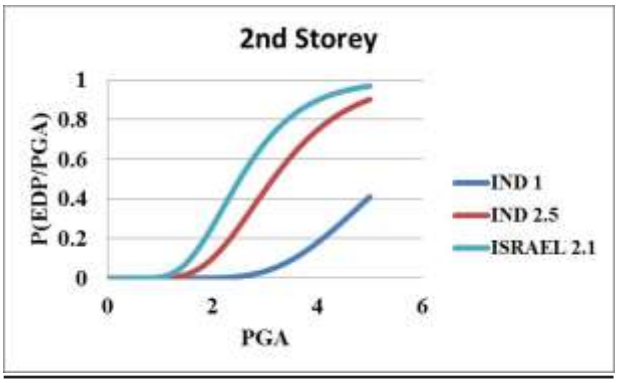
Limit state designation	Performance level	Inter storey Drifts, Sc (%)
Immediate occupancy (IO)	Light repairable damage	1
Life safety (LS)	Moderate repairable damage	2
Collapse prevention (CP)	Near collapse	4



Fragility Curves for Ground Storey



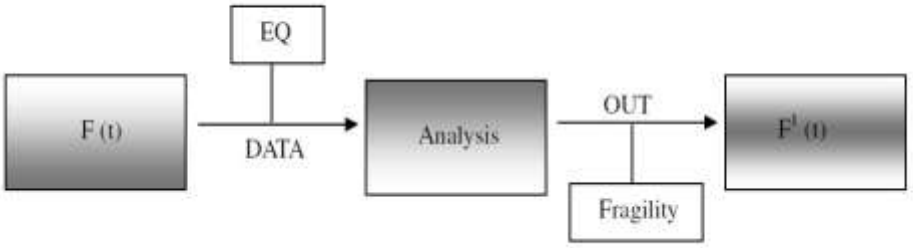
Fragility Curves for First Storey



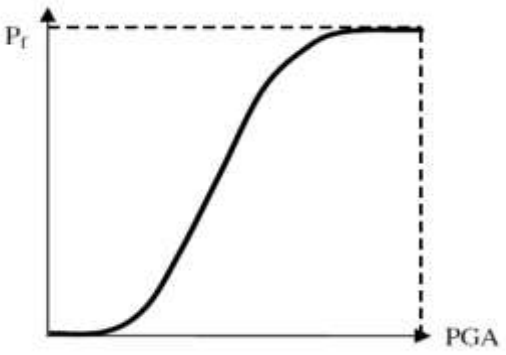
Fragility Curves for Second Storey

C. EVALUATION OF SEISMIC FRAGILITY ANALYSES

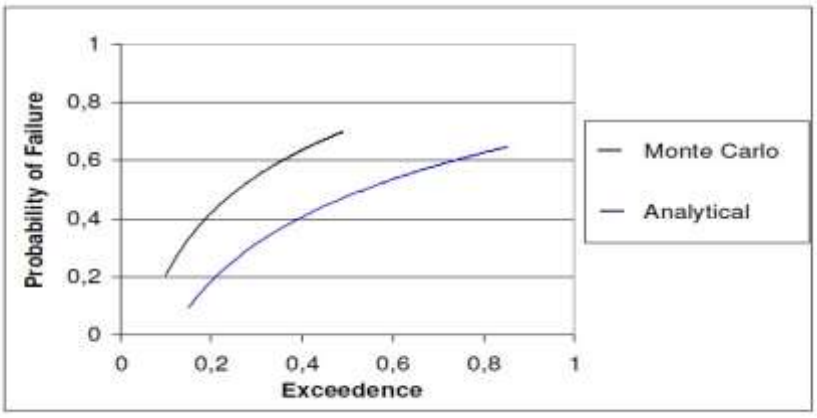
K.A. Korkmaz: In last decades, through further development of computer technology in civil engineering, so many different seismic analyses became possible and accuracy of the analysis is increased. Therefore, there are lots of methodologies for seismic assessment in use. Including the probabilistic approaches into the seismic assessment offer more realistic approaches. Recently, seismic assessments are done with this consideration. Fragility analysis is one of them. The fragility analysis which is a system reliability analysis with correlated demands and capacity is performed with different methodologies to establish the probabilistic characterization of the demands in different aspects. In the present study, probabilistic seismic analyses to define the structural seismic behaviour are evaluated. A representative R/C frame structure is taken in to consideration in the analytical part. A comparison is realized with the results of different methodologies as Monte Carlo Simulations and analytical based analysis.



Input-output relationship for Fragility Analysis



Schematical of Seismic Fragility Curve



Fragility Curves of Sample Buildings

I. CONCLUSION

From the study of above research papers, it can be concluded that,

- Fragility curves can be used for reliability and vulnerability assessment of buildings. Fragility curves developed for a building can be effectively used as a tool for predicting the damage levels for buildings of similar type.
- In study comparison of monte Carlo methods and analytical approximation method these methods, the methods give close results with each other in the analysis of symmetric structures as the selected one.
  Simulation based fragility analysis is counted more reliable.
- It is found that the performances of the OGS frames, in terms of ground storey drift is increasing in the increasing order of magnification factors used by Indian and Israel code for all the performance levels.
- In case of Indian code first storey is more vulnerable than the ground storey whereas for Israel code it is not so.

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