International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

A Review on Fragility Analysis of Structures under Seismic Loads

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Abstract - *Fragility is the probability of exceedance of particular limit state of damage under particular hazard level. Fragility analysis of structures for seismic loads includes probability of exceedance of particular damage level of structure under particular seismic hazard. Here, damage level can be represented by performance limit states such as Immediate Occupancy, Life Safety and Collapse Prevention. Whereas, seismic hazard can be represented by peak ground acceleration, spectral displacement, spectral velocity and spectral acceleration etc. The present paper gives detail review of different approaches utilized in fragility analysis.*

Key Words: **Seismic Analysis, Vulnerability, Fragility analysis, Seismic Events, Loss Estimation.**

1.INTRODUCTION

By definition hazard represents potential to make damage, whereas disaster represents actual damage to life and built environment. The source of hazard is nature. Some of the major types of hazard are Fire, Flood, Drought and Earthquakes etc. These hazard were present before the birth human race. Hazards are used as tools to maintain balance of ecology. Whereas, all disasters are human made. In true sense humans transforms the natural hazards into disasters. This we can understand by many examples such as flood disaster by construction blockages in drains (e.g. Mumbai), no safety against fire in high rise buildings leading to fire disaster in high rise building at top floors, large cities without provisions of water source (e.g. Chennai) will create situation of drought in peak summer. Going ahead densely populated multistoried building structures not designed considering earthquake loads. Thus it is said that, "Earthquake does not kill peoples, their houses kill them". The focus of this study is earthquake loads only.

The increase in seismic damage can be due to many reasons such as weak and or soft structural design and details, faulty construction and poor quality of materials etc. The other reasons may be the misues of building structure. For example, building designed for residential purpose, and using it for commercial purpose. Due to this, live load on the building increases, for which it has not been designed. Again densely populated buildings increase the vulnerability against more life loss.

Thus there is an urgent need to analysis the exiting building for probable seismic events. This is to investigate the performance of existing buildings. Based on the performance the building structures, fragility of the structure can be predicted

2. REVIEW ON FRAGILITY ANALYSIS

Fragility analysis of structures under seismic loads gives the level of fragility that the structure will undergo under particular earthquake intensity. Many researchers have worked in this field. Present paper gives a short review of some of the important research in this field. Following is the contribution of key research in this field [1-10].

Table -1: Literature Review

Lang K, Bachman H (2003)	In this study the seismic vulnerability is represented in the deterministic approach. The seismic hazard is represented in the form of spectral displacement. Where as seismic demand side is represented different damage grades. As it is based on deterministic approach, it is computationally efficient. Curves developed using this approach is also called as Fragility curve
Ghowsi, A.F. and Sahoo, D.R. (2015).	The study considers a suite of 40 near field earthquake for the analysis. Near field earthquakes are also called as near source earthquakes .these ground motion recordings are distinct than far field earthquakes such as, it has large permanent displacement and high peak acceleration value with low frequency. Research suggests that, these near field earthquake are more damaging particularly at lower stories of the buildings. As some of the Indian big cities like Delhi is situated near the epicenter of past earthquakes. It is needed to consider the fragility of generic building stock under near field earthquakes
Dolsek M. and Fajfar P. (2008).	The study is about developing a simplified probabilistic approach to predict the seismic performance of the structure

	under seismic loads. The proposed method was based in increamental N2 analysis using instead of rigorous nonlinear dynamic time history analysis. But this study is limited to a four story building only.
Wen, Y.K., Ellingwood, B.R. and Bracci, J.(2004).	The study purposes an equation to determine the fragility of the structure under seismic loading. It also suggest the fitted power law equation for inter story drift demand. The equation is simple and requires less computational efforts.
Furtado A, Rodrigues H, Arêde A. (2015).	The study considers "Open Seas" programme to models different structural members. The programme is a handy tool to model different structural members under seismic loadings

Other research works are also studied which consider analysis of structures for seismic loading[11-20].Irjet template sample paragraph, Irjet template sample paragraph .Irjet template sample paragraph. Irjet template sample paragraph

3. FRAGILITY CURVES AND IT NEED

Fragility curves are the curves which gives the relation between state of damage of particular structure and level of seismic hazard. Thus with the help of these curves we can find the state of damage of building as well as structural members under each level of seismic hazard.
These curves can be used as handy tools to predict the performance of building structures under different seismic hazard level. This leads to pre-disaster preparedness and post disaster response planning.

4. CONCLUSIONS

Following the different literature, i.e. about fragility of structures, near field earthquakes and structural irregularities the conclusions can be as follows

•It is the need of hour to find the fragility of generic building structures for the pre-disaster preparedness and post disaster response planning

•It is needed to consider near field earthquake for the nonlinear time history analysis as near field earthquakes are more vulnerable to lower floors compare to far field earthquakes.

•It is also needed to consider the effect of near and far field earthquakes for soft storey, specially at ground floors.

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