International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Vol-07, Issue-05, AUG 2021

A Review on identifying seismic Vulnerability assessments procedures

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Abstract: Predicting the expected seismic damage in future seismic events is essential part for planning disaster management strategies. If prediction about future damage is rational, its mitigation can be accurate and vise versa. Seismic vulnerability assessment can be a good tool to predict the future damage of the structure under seismic events. The current study takes a detail review of past research on seismic vulnerability procedures proposed by different researchers. The paper identifies advantages and disadvantages of different seismic vulnerability procedures and thereby one can select the particular procedure for given situation.

Key words: Seismic Analysis, Vulnerability, Fragility analysis, Seismic Events, Loss Estimation

I. INTRODUCTION

In the recent past, world has witnessed many major disasters, such as flood, earthquakes and draught etc. The occurrence of these disasters has been increased mainly due to manmade reasons [1-3]. The focus of this paper is on earthquakes only. The increase in seismic disaster can be attributed to many reasons such as, densely populated infrastructure, weak structural design (i.e. from concept level to detailing level and misuse of structures by the users (i.e. structures was designed for residential purpose but finally it has been used as store/ ware house).

The prediction of loss for future seismic event is not only useful to predict the loss assessment but it also mitigate the risk associated to structures [4-8]. The prediction of seismic damage can identify the percentage of building from the stock of the building under particular vulnerability limit; thereby can fix strategies for the mitigation.

The goal of seismic vulnerability assessment is identify the probability of a given level of damage for particular structure under particular seismic event. The different vulnerability procedures can be broadly divided in to three categories, which is as follows

1) Empirical procedures
2) Analytical procedures
3) Hybrid procedures

Hybrid procedure is actually the combination of empirical procedure and analytical procedure.

II. EMPIRICAL PROCEDURES.

Empirical procedures means, the procedures has been based on some experimental results. Further the empirical procedures are broadly divided into subcategories that is based on 1) damage probability matrices (DPM) and 2) vulnerability functions.3) Continuous Vulnerability Curves 4) Screening method

Damage probability Matrices

The idea behind the DPM is that for a given structural system there is a particular damage level under particular seismic demand[9].

Vulnerability Index Method

The procedure is based on field survey data. In this method a field survey has been done to identify the different parameters which influence the seismic vulnerability of the structures. Some of the parameters are plan of the structures, elevation configuration of the structures, types of the framing system, type of foundation and amount and location of nonstructural members. These parameters are weighted by four qualification coefficients[10-11].

Continuous Vulnerability Curves

The major problem in DPM was that, macroseismic intensity is not a continuous variable. To tackle this problem continuous vulnerability curves were develop. Example is fragility curves [12-14].

Screening Methods

As every structures is not equally vulnerable to future seismic event. In this method structures are divided based on different screening levels. First we need to identify the good structures which are looks strong at first go using screening of level 1. This will help to element large amount building from further investigation. Remaining structures are investigated for level 2 screening as an intermediate level investigation. If some structures passed level 2 screening, remaining structures can be further be investigated in detail[15-16].

III. ANALYTICAL PROCEDURES

Recent development in computer programming has made it possible to develop the vulnerability model analytically.

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In this procedure we have to deal with seismic intensity, computational model and damage states. At first we have to fix the seismic intensity then choose a set of earthquakes. At model level, at first we have to select the particular computation model for the structures from the available options from the past research. Then we have to fix do characterization of the structural system parameters. Then we have to choose the methodology for the nonlinear analysis. At Damage level, first we have to define different damage states and then we have to define different criteria's to identify the damage states.

Once we fix the set of earthquakes, modeled the structures and defined the damage states, then we can apply the different earthquake one by one and do the nonlinear dynamic analysis. Once we got the response of the structures under the set of earthquakes we can develop the probability distribution of damage, these probability damage states can be of two categories one is vulnerability curves and the other is damage probability [16-18].

IV. Hybrid Methods

Hybrid method uses analytically developed damage probability matrices and vulnerability functions based on post earthquake damage survey report data. Thus hybrid method is combination of empirical methods and analytical methods [19-20].

V. Methods Based on Collapse Mechanism

This method uses a term called collapse multipliers. This term is calculated from the concept where it has to assure that the mechanism have to form thus damage will happen. This method is particularly very useful in energy based design.

VI. Capacity Spectrum Based Method

The method has included two differently analysis, namely capacity curve and demand curve. Capacity curve is derived using nonlinear state incremental load analysis also called as pushover analysis, whereas demand curve is derived from nonlinear SDOF analysis of any seismic event. The point where capacity curve crosses the demand curve, it is called as performance point. This is the most recent method to develop the vulnerability of the structure. A detail investigation is also done other past research [21-30].

VII. CONCLUSION

Following the research on the topic, it is found that every method has got certain advantages and disadvantages. One method can be very useful for particular case and vice versa. Thus avoiding a growth of particular method at this stage of development is not recommended.

It is found that some common features should be there in every method in the further development of all the methods. Theses common features are as follows

- Seismic hazard assessment should be based on most recent development in the field of hazard analysis
- All efforts should be done to minimize the uncertainty at different levels such as material level, hazard level and analysis level
- Computational model should be as simple as possible ao that it can be used worldwide with easiness.
- Though the computational model is simple, it should generate most basic and essential out puts for the further analysis.

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