Fragility Analysis of Reinforced Concrete Buildings with Multiple Irregularities – A Review

S. Siva Bhanu Sai Kumar
Assistant Professor
Department of Civil Engineering
MVGRCoE(A), Vizianagaram, A.P, India

P. Sahithi Priyanka
M. Tech Student
Department of Civil Engineering
MVGRCoE(A), Vizianagaram, A.P, India

Abstract

In the seismic analysis of a structure, fragility analysis helps to reduce the damage and risk of life. In this analysis the Non- linear static analysis is carried out for the RC frames with and without stiffness irregularity. Non- linear pushover analysis is carried out and performance point was found out subsequently fragility curves are developed probability of damage and spectral displacement. By developing the fragility curves the probability of damage is estimated so that in such a way that the probability of damage can be reduced. This paper deals with the literature review of different authors on fragility analysis, irregularities of the buildings. The object of this to estimate the probability using fragility curves for S+6 storey building for both geometric, with and without stiffness irregularity frames.

Keywords: Fragility curves, Irregularities, SAP2000, Non-linear static analysis, Probability of damage state

I. INTRODUCTION

In the field of construction the development of new technologies has become a trend in the construction of structures as fast as possible and fulfilling the requirements, but while constructing there are many disadvantages while considering the natural disasters like earthquakes these buildings may collapse completely may cause severe damage. To reduce the damage the seismic performance is to be studied. The irregularities in the structure induce in the weaker sections. The structures with vertical irregularity are more prone damage than the plane irregularity. The irregularities in the structure are mainly caused by the uneven distribution of mass, strength, stiffness. The main aim of the structure is to calculate and plot the probability of damage. The fragility curves shows the probability of damage during the earthquakes.

Here in this paper shows the fragility curves for the S+6 storied building having both the geometric and stiffness irregularity.

II. LITERATURE REVIEW

A. *[1]. Alex H. Barbat, Luis G. Pujades, Nieves Lantada studied on the seismic damage evaluation in urban area using the capacity spectrum method: Application to Barcelona*

In this paper damage, risk evaluation and vulnerability are discussed. The capacity spectrum method and obtaining of fragility and capacity curves are discussed. The determination of capacity curves and the development of fragility curves are explained by using the non-linear structural analysis for the buildings. Based on the application of the capacity spectrum method for the buildings of Barcelona, Spain the seismic risk analysis is done and it is described by means of reduced 5% damped elastic response spectrum. From the results the evaluation done for the area is low to moderate seismic hazard area. The capacity and fragility curves are obtained about 97% compared to the residential buildings.

B. *[2] P.Rajeev, S.Tesfamariam studied on seismic fragilities for reinforced concrete buildings with considerations of irregularities*

In this paper the author demonstrated on designs prior to 1970's of three, five and nine storey RC frames considering the soft storey and the quality of construction of seismic vulnerable structures based on fragility. Considering the interactions between soft storey and quality of construction using the nonlinear finite element analysis for gravity loads an equation for the probabilistic seismic demand model parameters is developed as a function of soft storey and quality of construction using response spectrum method. In this the results shows the model sensitivity to the interaction of soft storey and quality of construction. The fragilities are drawn considering the soft storey, quality construction and their interactions for the three structures and these are used decision making for analyzing the risk.

C. *[3] A.Bakshi, P.Asadi studied on Probabilistic evaluation of seismic design parameters of RC frames based on fragility curves.*

In this paper the author describes that under the earthquake excitations there are many parameters to obtain the more reasonable performance for the structures. In seismic provisions the general considered parameters are PGA, importance factor (I) and typical inherent overstrength and global ductility capacity (R). Under seismic excitation the main characteristic of design of structures is probabilistic rather than deterministic, so it is to be determined that these parameters tend to decrease the probability of damage. Fragility curves are used for various probability parameters. From the results by increasing the global ductility capacity (R) the probability of damage is decreased but in the increase of importance factor (I) for hospital buildings, office buildings, there is no guarantee in the decrease of probability of damage. In general cases by considering PGA uncertainly do not mean that the probability of damage will be increased.

D. *[4] Jack P. Moehle studied on seismic response of vertically irregular structures.*

In this paper, to introduce the seismic response of four irregular reinforced concrete test structures. This test structures was interpreted using with static analysis methods. In this paper the comprising frames and frame wall combinations are introduced. Discontinuities in the vertical plane of the structure was introduced it is found that static limit and static inelastic provide good measures related to strength and deformation under strong earth quake motions. The discontinuities caused by a tall first storey by varying height of stiff structural wall. Evaluate relative displacements at different floor levels and computed displaced shapes. Strength of the structure under strong base motions could be estimated using standard limit analysis. Evaluated response indicated that the structure achieved approximately effective stiffness of 20% of gross section stiffness.

E. *[5] Pradip Sarkar, A. Meher Prasad, Devdas Menon worked on vertical geometric irregularity in stepped building frames*

In present days stepped building frames with vertical geometric irregularity, are now increasingly encountered in modern constructions. In this paper aim to proposes a new method for evaluating irregularity in such building according for mass and stiffness. Evaluation of degree of irregularities in stepped building frames regularity index was proposed. This paper also introduces modification of code specified for evaluation of empirical formula for estimating fundamental period for regular frames. Also estimate the fundamental time period of stepped building frames, it should be expressed as a function of regularity index. It should be validated by free vibration analysis. Introducing the comparison of static displacement shape and fundamental mode shape for selected stepped building and selected regular building.

F. *[6] Regina Gaiotti and Bryan Stafford Smith worked on P-Delta analysis of building structures*

Now a days slender and lighter building has resulted in potentially more significant P-delta effects. This effect leads to the demand for the accurate methods of P-delta analysis. Different method are reviewed and compared in terms of efficiency and accuracy. Considering different method for evaluation like amplification factor method, direct method, iterative method, negative property member method and second order computer program method. Also in addition to introducing new method similar to iterative method but in this method using the actual gravity loading applied to the successive deflected shapes. Results are identical fir both methods while the analysis take less than one third of time. This method gives better accuracy and simple manner they are applicable to all type of structures.

III. CONCLUSION

In this paper fragility curves are used to determine the spectral displacement for a fixed probability to the frames both with and without stiffness irregularities and maximum displacements, drifts and base shear is also determined.

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