Novelty Journals

ISSN 2394-7357

International Journal of Novel Research in Civil Structural and Earth Sciences
Vol. 2, Issue 2, pp: (51-53), Month: May - August 2015, Available at: www.noveltyjournals.com

# Pushover Analysis of Asymmetric Three Dimensional Building Frames

Mr. Vijaykumar G. Sawant[1], Dr. D. N. Shinde[2]

[1]PG Student, [2]Associate Professor, [1,2]Department of Civil Engg. Padmabhooshan Vasantraodada Patil Institute of Technology, Budhagaon, Sangli, Maharashtra, India

***Abstract:*** **After revealing the deficiencies of Conventional Pushover Analysis (CPA) method for structures with significant higher modes. The effect of higher modes of vibration on the total nonlinear dynamic response of a structure is very important and unsolved problem. The recent advent of performance based design has brought the nonlinear static pushover analysis procedure to the forefront. A simple method for the nonlinear static analysis of complex building structures subjected to monotonically increasing horizontal loading (push-over analysis) is presented. The method is designed to be a part of new methodologies for the seismic design and evaluation of structures. In the present study, the non-linear response of RCC frame using SAP2000 under the loading has been carried out with the intention to investigate the relative importance of several factors in the non-linear analysis of RCC frames. This method is applied to the analyses of symmetric frames as well as asymmetric frames permitting to draw significant conclusions.**

***Keywords:*** **Asymmetric structures, nonlinear analysis, Pushover analysis, Seismic design.**

## I. INTRODUCTION

Structures are usually designed on the assumption that the structure is linearly elastic and that remains linearly elastic when subjected to any expected dynamic excitation .However there are situations in which structure have to be designed for eventual excitation of large amount of strong motion earthquake .In such cases the normal structure will undergo inelastic deformation. Since elastic capacity is limited; the inelastic behavior in the critically stressed elements of a structure can be anticipated. Multi-storeyed R.C. framed buildings are getting popular in hilly areas because of increase in land cost and under unavoidable circumstances due to shortage of land in urban areas. Thus, many of them are constructed on hilly slopes. Setback multistoried buildings are frequent over level grounds whereas step-back buildings are quite common on hilly slopes. Combinations of step-back and setback buildings are also common on hilly slopes. At the location of setback stress concentration is expected when the building is subjected to earthquake excitation. These are generally not symmetrical due to setback and/or step-back and result into severe torsion under an earthquake excitation. Current building code suggests detailed dynamic analysis for these types of buildings. Buildings in hilly areas are irregular and asymmetric and therefore are subjected to severe torsion in addition to lateral forces under the action of earthquake forces. Buildings may be considered as asymmetric in plan or in elevation based on the distribution of mass and stiffness along each storey, throughout the height of the buildings. Most of the hilly regions of India are highly seismic. A building on hill slope differs in different way from other buildings. Earthquake resistant design of structure is a highly complex problem, especially for modern building with irregular configuration .The irregularity of building may be in plan or in elevation .In case of irregular structure, center of mass and center of stiffness or center of gravity do not coincide with each other, this creates an eccentricity between center of mass and center of stiffness. To perform well in an earthquake ,building should possess four main attributes ,namely simple and regular configurations , and adequate lateral strength ,stiffness and ductility .Building

International Journal of Novel Research in Civil Structural and Earth Sciences
Vol. 2, Issue 2, pp: (51-53), Month: May - August 2015, Available at: www.noveltyjournals.com

having simple regular geometry and uniformity distributed mass and stiffness in plan as well as in elevation ,suffer much less damage than with irregular configuration .

## II. OBJECTIVES OF THE STUDY

The case study selected for the investigation is the five storeys RC building comprising a base frame structures with brick infill masonry .The system is regular in plan and asymmetric in elevation in X –direction. Investigation based on pushover analysis is carried out considering following points:

1. To record the fundamental natural period and frequency.

2. To record the sequence of cracks, yielding, plastic hinge formation at failure of various structural components.

3. To analyse the yield displacement, ductility reduction factor and response reduction factor.

4. To prepare a computer model for Structural Analysis.

5. Capacity Spectrum Method is used for design of asymmetric RC building.

## III. DESCRIPTION OF THE SAMPLE BUILDING

The structure that is considered represents the medium rise reinforced concrete framed building. This structure is designed according to IS 456-2000 for reinforced concrete and IS 1893-2002 for earthquake forces. The structure is located in medium seismicity region (ZONE III). The number of stories is "G+4". Material properties are assumed to be M20 grade concrete for compressive strength of concrete and Fe415 for yield strength of the longitudinal and transverse reinforcement. The plan layout which is common for both symmetric and asymmetric building models are as shown in figure The difference between symmetric and asymmetric considered models are, symmetric building models are having equal height of columns in ground storey where as in the case of asymmetric building models column height varies from 1.5 to 3.5 m in ground storey in longitudinal direction. In these buildings four analytical models are considered for symmetric and asymmetric buildings, namely:

**Asymmetric Structures:-**

Model 1: Building has no infill walls .The building is modeled as bare frame.

Model 2: Building has one full brick infill masonry walls (230 mm thick) in all storeys. The building is modeled as bare frame. However masses of the walls are included.

**Symmetric Structures:-**

Model 1: Building has no infill walls .The building is modeled as bare frame.

Model 2: Building has one full brick infill masonry walls (230 mm thick) in all storeys. The building is modeled as bare frame. However masses of the walls are included.

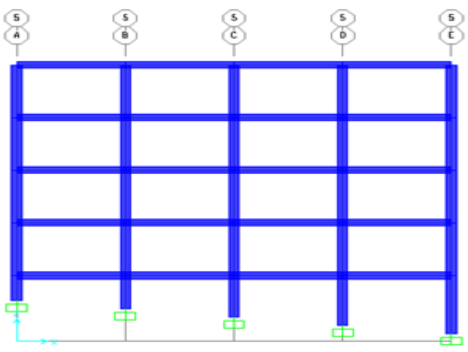

**Fig1. Elevation of Building (Asymmetric)**

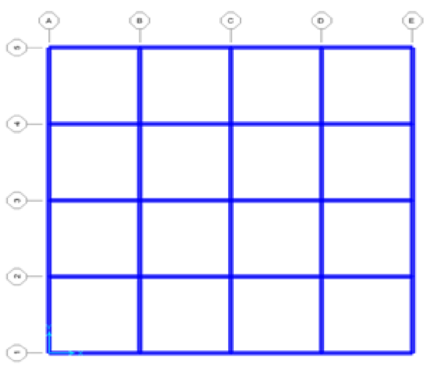

**Fig 2. Plan of Building**

International Journal of Novel Research in Civil Structural and Earth Sciences
Vol. 2, Issue 2, pp: (51-53), Month: May - August 2015, Available at: www.noveltyjournals.com

## IV. CONCLUSION

The following conclusions are made from present study:

1. The Fundamental natural period of the structure decreases with effect of infill wall.

2.Ductility ratio is maximum for bare frame structures and it gets reduced with the effect infill wall .It indicates that bare frame structures will shows adequate warning before collapse.

3. Joint displacements are considerably reduced when effect of infill wall is considered. The presence of masonry infill influences the overall behavior of structures when subjected to lateral forces.

4. Base shear and displacements are less in asymmetric building compared to symmetric building.

5. Response reduction factor is more for bare frame structures compared to the infill frame structures. It indicates that bare frame structures are capable of resisting the forces after hinge formation

## REFERENCES

[1] J. L. Lin, K. C. Tsai and M. C. Chuang, 2014 “The reasons for the trends in torsional effects in asymmetric-plan buildings” .Proceedings of the 10th National Conference in Earthquake Engineering, Earthquake Engineering Research Institute, Anchorage, AK.

[2] Abdi Mohammed, 2012 ‘‘Comparison of conventional and modal pushover analysis of buildings”, Department of Civil Engineering, Addis Ababa University.

[3] Carlos Augusto de Almeida e Fernandes Bhatt ,2011 “Seismic Assessment of existing buildings using NSPs-A new 3D Pushover procedure” IST-Technical Univercity of Lisbon, October(2011).

[4] Rui Carneuro Barros ,Ricardo Almeida,2010 “Pushover analysis of asymmetric three –dimensional building frames” Journal Of Civil Engineering And Management ,Feb-(2010), Vol.XI,No1,3-12.

[5] Andrea Lucchini, Giorgio Monti, Enrico Spacone, 2009 “Asymmetric Plan Buildings Irregularity Levels And Nonlinear Seismic response”,Sapienza Univercity di Roma ,Italy .University deglistudi G.D. Annunzio.

[6] S.M. Wilkinson, R.A. Hiley, 2006 “A nonlinear response history model for the seismic analysis of high –rise framed buildings”, Computer &Structures 84(2006)318-329.

[7] VojkoKilar and Peter Fajfar ,2004 “Simple Pushover Analysis of Asymmetric Buildings” Univercity of Ljubljana Jamava 2, 1000 Ljubljana ,Slovenia 2004.

[8] Anil K Chopra and Rakesh K Goel 2002 “A Modal Pushover Analysis Procedure For Estimating Seismic Demand For Building” Journal of EQ.Engg.&Structure .Dynamic ,Vol.31, No .3 Page No.561-582.

[9] Wilkinson S, Thambiratnam D. 2001 “Development and application of a simplified procedure for seismic analysis of asymmetric buildings”, Computer Struct 2001;79 (32):2833–45.

[10] Ashraf Habibullah, S.E. 1, and Stephan Pyle ,S.E. 1998 “Practical Three Dimensional Nonlinear Static Pushover Analysis” Structure Magezine ,Winter ,1998.