JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

NON- LINEAR STATIC ANALYSIS OF SYMMETRIC & UNSYMMETRIC PLAN BUILDING WITH AND WITHOUT FLOATING COLUMN

[1]Ajay Vadher, [2]Arjun Butala, [3]Priyesh Bhavsar

[1]M. Tech Student, [2]PG Coordinator(SE), Assistant Professor, [3] Assistant Professor
Department of civil Engineering,
UVPCE, Ganpat University, Mehsana, Gujarat, India,

Abstract: Modern multi storey structures having irregular layout like floating column, soft storey structures and/or with bracings etc. are highly affected by lateral forces especially at critical areas where large seismic excitation or wind forces are regularly occurred. In the present study, the effect of seismic forces is carried out for irregular structures with floating column condition. The behaviour of structures has been studied by non-linear static analysis method named Push-over analysis. The collapse load of the structure under seismic excitation and its ductile behaviour is studied out for various RC frame of five storey, nine storey and thirteen storey structures. Also, the structures are compares with symmetric and unsymmetric plan with different parameters like storey displacement, storey shear with failure point condition in ETAB software

Index Terms **- floating column, irregular plan, pushover analysis, earthquake resistant structure, ETABS software.**

1. INTRODUCTION

In recent times, multi-storey buildings in urban cities are required to have column free space due to shortage of space, population and also for aesthetic and functional requirements. For these buildings are provided with floating columns at one or more storey. These floating columns are highly disadvantageous in a building built in seismically active areas. The earthquake forces that are developed at different floor levels in a building need to be carried down along the height to the ground by the shortest path. Deviation or discontinuity in this load transfer path results in poor performance of the building. The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. Many buildings with an open ground storey intended for parking collapsed or were severely damaged in Gujarat during the 2001 Bhuj earthquake

FLOATING COLUMN:

The floating column is a vertical member which rest on a beam and doesn't have a foundation. The floating column act as a point load on the beam and this beam transfers the load to the columns below it.

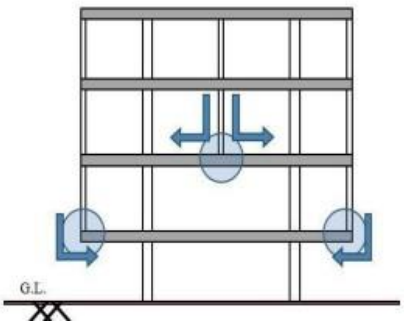

Fig.1.1 Floating or hanging column

It carries the load just like a normal column and transfers the load as a point load to the below supporting beam which is referred as girder beam or transfer beam and does not transfer loads directly to the foundation. Therefore, they act as point loads over a beam. It is not really floating; it's rest on a beam. They are capable to bear the gravity loads if the transfer girder is well suitable

Nonlinear Static Pushover Analysis

The guidelines and standards mentioned in the introduction include modelling procedures, acceptance criteria and analysis procedures for pushover analysis. These documents explain the force-deformation criteria for potential locations of lumped inelastic behaviour, represented as plastic hinges used in pushover analysis. As shown in Figure 1.2 below, five points labelled A, B, C, D, and E are used to define the force deformation behaviour of the plastic hinge, and the three points labelled as IO (Immediate Occupancy), LS (Life Safety) and CP (Collapse Prevention) are used to define the acceptance criteria for the hinge. Fig-1.2: Force-Deformation Relation for Plastic Hinge in Pushover Analysis Both ATC-40 and FEMA 356 documents present similar performance-based engineering methods that rely on nonlinear static analysis procedures for prediction of structural demands. While procedures in both documents involve generation of a "pushover" curve to predict the inelastic force-deformation behaviour of the structure, the technique used to calculate the global inelastic displacement demand for a given seismic ground motion differs.

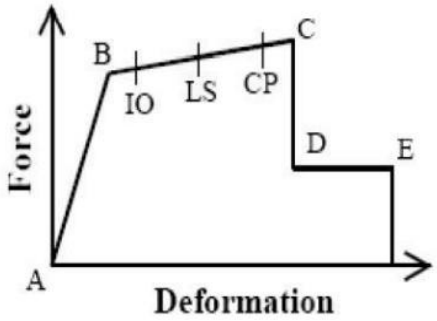

Fig.1.2 Force-Deformation Relation for plastic hinge in pushover analysis

2. LITERATURE REVIEW

2.1. Shrikanth M. K, Yogendra.R. Holebagilu In this paper study is all about to compare the behavior of a building having only floating column and having floating column with complexities. High rise building is analyzed for earthquake force. For this purpose created four models in ETABs and analyzed for lower and higher earthquake zones for medium soil condition. Analysis was carried out by using extended 3-dimensional analysis of building system ETAB version 9.7.4 software. The results are presented in terms of Displacement, soft storey, storey drift for these four models and tabulated on basis of linear seismic analysis. [1]

2.2. Sabari, in this paper the time history analysis of RCC frame structure of different stiffness.In this they considering the building frame base fixed, the author has created artificial stimulation of earthquake similar to bhuj earthquake ground motion with the help of FEM Package SAP 2000. In these various parameters were taken like base shear, roof displacement, axial force, storey drift were considered. By changing the column size dynamic analysis is carried out and concluded that with increase in column size, the maximum deflection and inter storey drift are reduced. [2]

2. 3. A.p. mundada, S.G. Sawadakar In this paper study is done for architectural drawing and the framing drawing of the building having floating columns. For comparison of G+7 existing residential building with and without floating column are taken for carry out entire project work. by using STAAD ProV8i 3D 3 model are created. equivalent static analysis of these model are done by using STAAD Pro V8i. Different parameters such as axial load, moment distribution, importance of line of action of force and seismic factors are studied for all this models. This will help them to find the various analytical properties of the structure and also have a very systematic design and economical design for the structure. [3]

2.4Hardik Bhensdadia, Siddarth shah in this study an attempt is made to reveal the effects of floating column & soft story in different earthquake zones by seismic analysis. For this purpose, push over analysis is adopted because this analysis will yield performance level of building for design capacity (displacement) carried out up to failure, it helps to determine of collapse load and ductility capacity of the structure. To achieve this objective, three RCC frame structures with G+4, G+9, G+15 stories respectively will be analysed in SAP 2000 software and compared the base force and displacement of RCC frame structure with G+4, G+9, G+15 stories in different earthquake zones like Rajkot, Jamnagar and Bhuj using SAP 2000 software [4]

3.Methodology

The present study is done by using ETABS 9.7.4. It is a fully integrated program that allows model creation, modification, execution of analysis, design optimization, and results review from within a single interface. ETABS9.7.4 is a standalone finite element based structural program for the analysis and design of civil structures. It offers an intuitive, yet powerful user interface with many tools to aid in quick and accurate construction of the models, along with sophisticated technique needed to do more complex projects.

3.1Building details

For the analysis purpose of two model considered as:

MODEL 1- Building without floating column

MODEL 2-Building in which floating column

In which building with symmetric plan and in symmetric plan are consider, with G+8 storey and G+12 are cpnsider for height comparison, so total 8 modal are analysed in ETABS software. Modal basic details are given in table no 3.1

Structure data			
Parameters	4 Storey	8 Storey	12 Storey
Height of Building	14m	26m	38m
Height of floor	3m	3m	3m
Height of bottom floor	3.2m	3.2m	3.2m
Thickness of slab	125 mm	125 mm	125 mm
Material properties	M25 Fy 415	M25 Fy 415	M25 Fy 415
Beam Size	250 X 350 mm2	300 X 400 mm2	300 X 450 mm2
Column Size	250 X 350 mm2	300 x 500 mm2	300 X 600 mm2
Beam cover	25mm	25mm	25mm
Column cover	40mm	40mm	40mm
Loading data			
Dead Load	2 KN/M2	2 KN/M2	2 KN/M2
Live Load	3 KN/M2	3 KN/M2	3 KN/M2
Floor finish	1KN/M2	1KN/M2	1KN/M2
Earthquake Data			
City	Rajkot		
Seismic Zone	3		
Seismic zone factor	0.16		
Response Reduction Factor	3		
Important Factor	1.2		
Soil type	Rock or hard soil (type 1)		

Table 3.1: - Basic details of modal

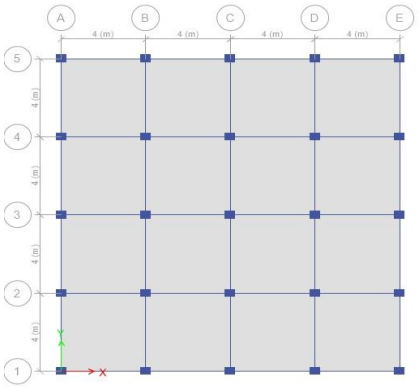

Figure 3.1: - Symmetric plan

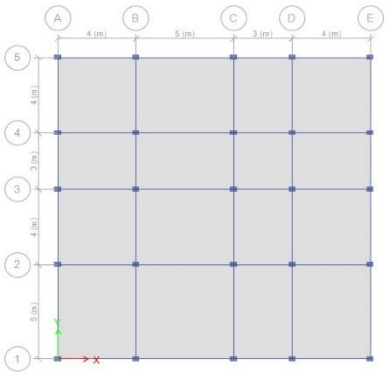

Figure 3.2: - Unsymmetric plan

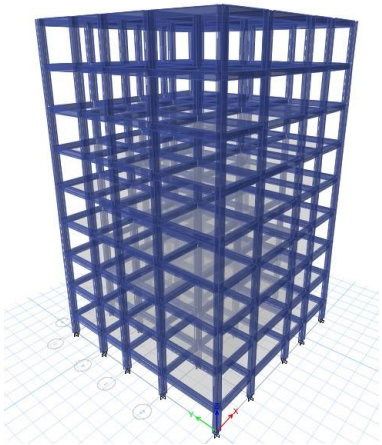

Figure 3.3: - Without floating column

Figure 3.4: - With floating column

3.2 Result and discussion

In the present study, the effect of varying the location of floating columns floor wise of multi storey RC building on various structural response quantities of the building using static analysis. The results are compared in tabular form and graphically for the analysis of the building without floating columns and with floating columns of all four model.

Base shear

Base shear is the horizontal reaction at the base of the structure against horizontal seismic load. This base shear is acting upon the structure at the base or supports of the structure or wherever structure is fixed. . variation in base shear are shown through graph in fig no.6 The base shear of the structure is decreases by 5-10% for floating column building as compared to without floating column building.

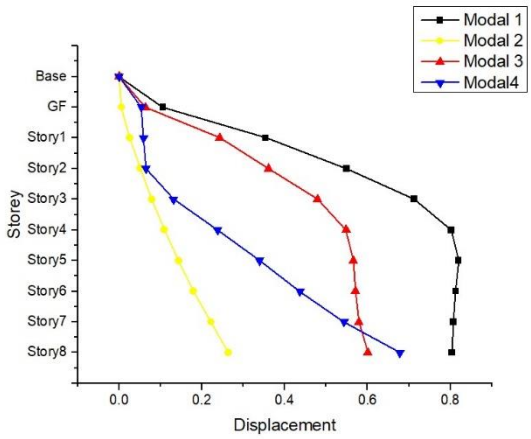

Figure 3.5: - Storey vs Displacement for G+8

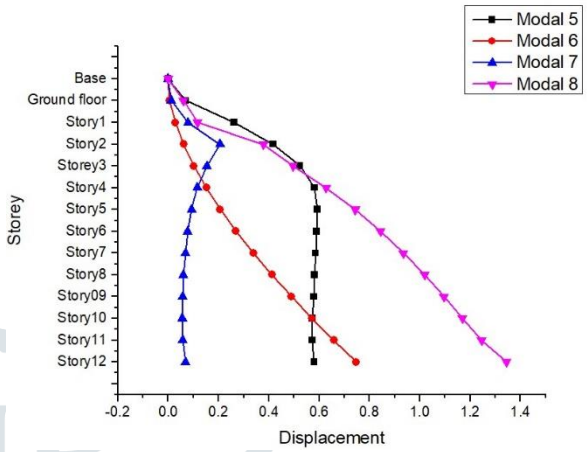

Figure 3.6: - Storey vs Displacement for G+12

This figure are different four modal combination on which first one is modal with symmetric and unsymmetrical G+8 modals result and in second image G+12 building's different four modal are include.

Storey shear

The lateral forces which are acting at each floor due to the forces such as Seismic and wind force during an earthquake are known as story forces. In this above graph the value of maximum Storey shear for a unsymmetric plan structure is more in comparative to the structure in symmetric plan. In case of floating column case with floating column is critical.

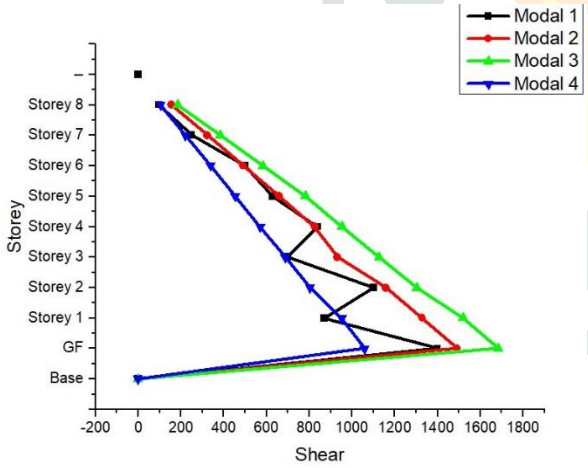

Figure 3.7: - Storey vs Shear for G+8

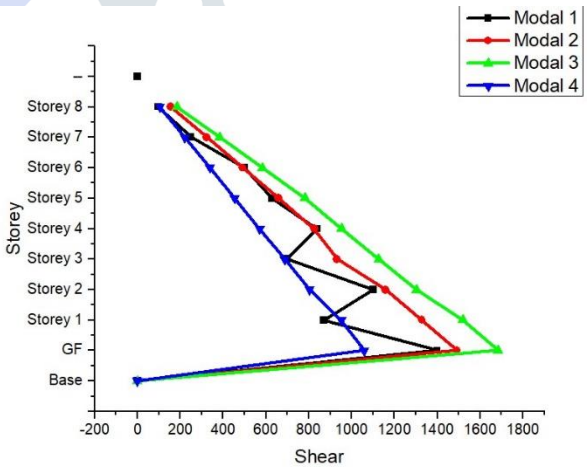

Figure 3.8: - Storey vs Shear for G+8

4. Conclusion

There is important increase in roof displacement for building with floating column as compared to RC building while not floating column. That means incorporation of floating column in building results in increase in roof displacement. Its show that the base shear will give more effect in unsymmetric plan building then Symmetric plan building for G+8 and G+12. Its show that the base shear value is more in without floating column building compare to floating column building in all two modal G+8, G+12. Base shear value is significantly increase with increasing in structure height. Results from all graphs shows that, buildings with provisions of floating columns, on floor shows the poor performance compare to other cases. Hence provisions of floating columns should be considered as critical case. It is show that storey shear value are very high in unsymmetric plan compare to regular plan In case of building with floating column same pattern are show. In future work this thing will compare with other structure components such as shear wall etc.

REFERENCES

[1] Y. Shirikanth M.k, "Seismic response of complex building with floating column and without floating column," *International journal of Engineering Research*, vol. Vol. 2, no. Issue.4, 2014.

[2] T. Sekhar, "Study of behavior of seismic analysis of multistory building with and without floating column," *SciTech*, vol. Vol2, 2014.

[3] S. S. A. P. Mundada, "Comparative seismic analysis of multi storey building with and without floating column," *International Journal of Current Engineering and Technology*, vol. Vol.4, no. No.5, 2014.

[4] S. S. Hardik Bhensdadia, "PUSHOVER ANALYSIS OF RC FRAME STRUCTURE WITH FLOATING COLUMN AND SOFT STORY IN DIFFERENT EARTHQUAKE ZONES," *International Journal of Research in Engineering and Technology* , vol. Volume: 04 , no. Issue: 04, Apr-2015.

[5] A. V. A. Nikhil Bandwal, "To study the seismic behaviour of RC building with floating columns," *International journal of Engineering Research-Online*, vol. Vol.03.

[6] P. P. P. D. V. R. J. Prof. Tejas N. Kothari, "EXPERIMENTAL STUDY OF FLOATING COLUMN FOR SEISMIC ANALYSIS," *International Research Journal of Engineering and Technology*, vol. Vol.06, no. 10, 2019.

[7] D. P. U. D. G. A. Mr. Shaikh Aasef Shaikh Nisar, "Seismic Analysis of a Multi-storeyed Building with Configuration of," *International Research Journal of Engineering and Technology*, vol. Vol.08, no. 12, 2021.

[8] S. P. M. N. S K Singh, "Analysis of G+5 Storeys Building With and Without Floating," *IOP Conference Series: Earth and Environmental Science*, 2021.

[9] D. K. Nikhil Dewani, "Study of Behavior of Seismic Evaluation of Multistoried Building with Floating Columns," *International Journal of Innovative Research in Science*, , vol. 8, no. 5, 2019.