Seismic Analysis of A Tall Structure With Floating Column Using Analysis Tool Staad.Pro

Shubham Pachori [1], Hitesh Kodwani[2]
[1]Dept of Civil Engineering
[2] Assistant Professor, Dept of Civil Engineering
[1, 2] Sam College of Engineering and Technology, Bhopal-462021, Madhya Pradesh, India.

Abstract- *According to the size, shape and geometry of building, the behavior of building at the time of earthquake dependent critically, in general way to how the load is transfer to the ground. In multi-storey building the earthquake load is dependent on the height of the floors. In this floor load on the building is transfer to the ground by shortest path of the building. If there is any problem to transfer the load in shortest path; it's shows the poor quality of building. At time of earthquake a sudden jump in vertical setback of building at the lever of discontinuity.*

A vertical member which start from the foundation level is known as column, this transfer the load to the ground and the floating column is also a vertical member which is started from the horizontal member called beam.i.e. floating column is not started from the ground. It isfooting less vertical member. It is rest upon the beam on multistory building.

In this paper we are analyzing a tall structure utilizing analysis tool staad.pro to determine the effect of floating column over a span of the structure.

Here we concluded that section with floating column results in deflection moreover this can be at the safe side as per the design condition, but as per the cost analysis it will be a costlier one.

Keywords- floating column, structural analysis, staad.pro, long span section, cost, forces.

I. INTRODUCTION

Now a days, in India having open first story in urban multi-storey building as an unusual feature. Primarily this space is adopted for parking purpose or used for reception lobbies in first storey, at the time of earthquake total seismic base shear is experienced by a building depend on its natural period, this seismic force distribution of building is dependent on the distribution of mass and stiffness along the height of building.

According to the size, shape and geometry of building, the behavior of building at the time of earthquake dependent critically, in general way to how the load is transfer to the ground. In multi-storey building the earthquake load is dependent on the height of the floors. In this floor load on the building is transfer to the ground by shortest path of the building. If there is any problem to transfer the load in shortest path; it's shows the poor quality of building. At time of earthquake a sudden jump in vertical setback of building at the lever of discontinuity.

In multi- storey building if there are some column and wall in a particular storey or any tell building is tend to damage the building storey at the time of Gujarat earthquake in 2001 in Bhuj. There are some buildings having ground basement for parking purpose is collapsed. Some building having floating column that hang on the beam and do not go all the way to foundation have variation in the path of load transfer.

Figure 1: Floating column

This floating column is provided in the building for removing irregularities in the building. If there are any changes in building in above floor, so floating column concept is required. In this process ground floor columns are made stronger compare to above storey columns, because this column takes more load of the building. This floating columns helps building to remove irregularities and give space at

ground floor for parking and hall purpose or used as a commercial purpose.

II. LITERATURE REVIEW

Nikhil and Pande(2014) – This paper is fully focused on the irregularities introduced in building with different position according to architectural requirement. The requirement of floating column is some time internal, external or may both internal and external. Then provide floating column to reduce irregularities. In this study G+6 model is made and applied earthquake load according to IS – 1893(part -1) – 2002. And this model is analysis for different earthquake zone. In this research critical combination of load are found out for seismic analysis of floating column for different load combination variation in various parameter such as displacement, forces and moments in column and beam. For different floor levels are compared and represented this value by graphs. This analysis is completed by STADD pro v8i software.

Bhensdadia and Shah(2015) –In this study seismic analysis in different earthquake zone soft storey and floating column effect is analysis. In this study push over analysis is adopted. In this analysis the yield performance level of building for displacement is done up to failure. This will help us to study about the ductility and collapse load of the structure. For this results, three RC bar frame structure with G+4, G+9, G+15 stories are compared with base force and displacement of RC bar frame structure with G+4, G+9, G+15 stories in different earthquake zones. Places Jamnagar, Rajkot and Bhuj using software SAP2000.

Ashfirahman(2015) – In this paper static and dynamic analysis is done with response spectrum method for a multi-storey with and without floating column. This analysis is done by using STAAD pro v8i software in this research floating column position is changed in a floor and the floating column is changed in a storey results are based on the fundamental time period, spectral acceleration, base shear, storey drift and storey displacement.

Rohilla and Gupta(2015) – In this paper study is done for seismic zone 2 and 5 for G+5 and G+7 RC building with critical position of floating column in vertical irregular buildings. There is some variation in supporting column and beam in building with effect the structure with floating column for the purpose of study 2 models are created with irregularities in vertical direction. Each models made with 2-ways which 5M and 6M respectively in X- direction and 5M height in Y – direction of each way. For the study purpose response factor is taken 5 and the importance factor is taken 1 in the analysis. The earthquake is considered only in X – directions by using ETABS software the results are obtained. That is storey drift, storey displacement, and storey shear. It gives result floating column provided in zone 2 but avoided in zone 5, because storey drift, displacement is increase in zone 5 due to presence of floating column in building structure.

Tamner and Talikoti (2016) - In this study results of multi-storey building with floating column for static and dynamic analysis is shown, in this floating column gives strength to the building when the horizontal beam designed safely. i.e. reinforcement is more compare to normal beam, than this gives 46.17% more strength to the building structure.

III. OBJECTIVES

The objective of present work is to study the behavior of multi-storey building with floating column for long span, remove irregularities from multi-storey building, calculation for base shear, overturning, drift on the multi-storey building. Analysis of frame with STAAD pro software which depend upon the FEM formulation. In this analysis we assume the base frame of building is fixed. Using STAAD pro we study the static and dynamic behavior of multi-storey building.

IV. METHODOLOGY

1. Breaking down the frame into smaller parts according to the X, Y, and Z co-ordinates.
2. Draw +ve forces, moments and points.
3. Numbering the forces, moments and points.
4. Now calculate the matrix element according to each force, moment and points.
5. Now assemble the stiffness matrix according to load and every point.
6. Use boundary condition in every row and columns.
7. Solve the equation and get the values of support reaction and internal forces.

Geometrical data

Base dimension = 18.520X31.200M
Depth of foundation = 2M

Height of storey

Height of ground floor = 3.660M
Height of 1^{st} and 2^{nd} floor =3.050M
Height of building = 9.760M

Size of column

Column type {C1} = 300X300MM

Column type {C2}
=400X300MM
Floating column{FC}
=400X400MM

Size of beam

Beam type 1{B1} = 300X200MM
Supporting beam {SB} =500X300MM
Type of frame = Ordinary moment resisting frame
Soil condition =Medium

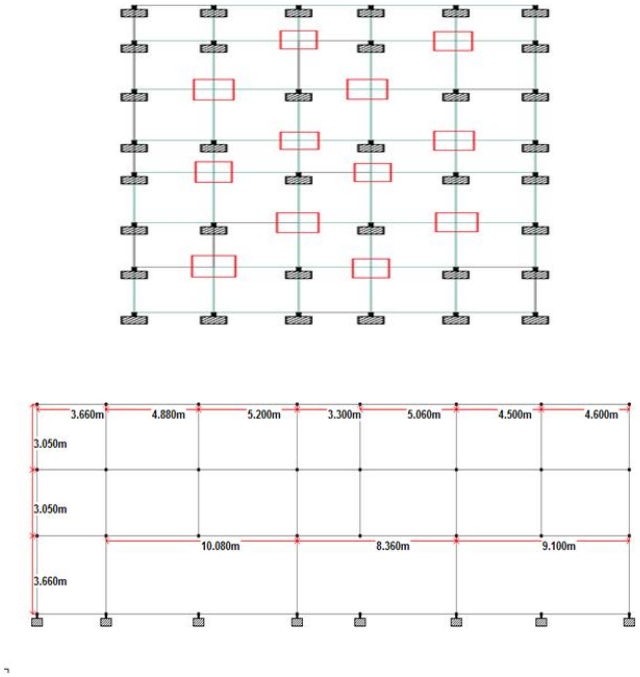

Figure 2: Plan & Elevation of the structure

V. ANALYSIS RESULTS

Displacement mm:

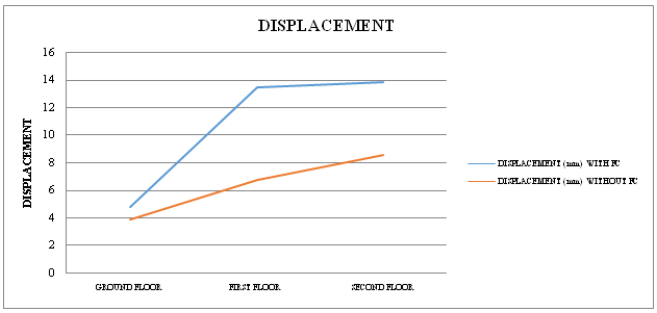

Figure 3: Displacement

Bending moment:

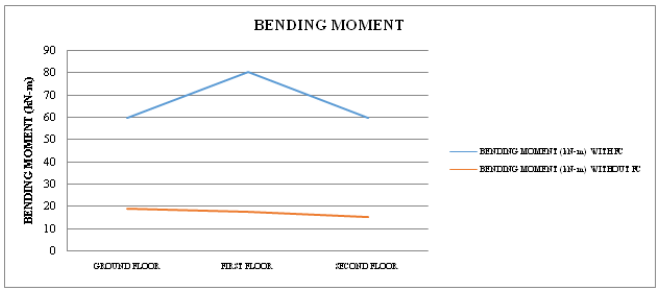

Figure 4: Bending moment

Axial Force:

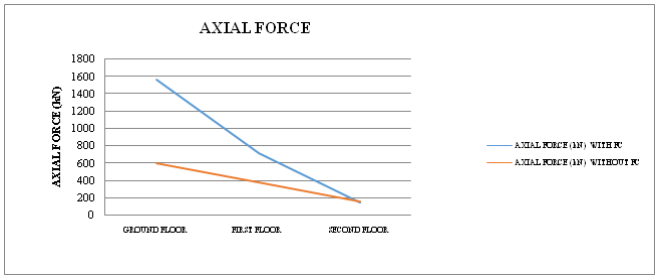

Figure 5: Axial Force

VI. CONCLUSION

In this analysis we get the following conclusion-

1. When we applied static load on both buildings; then both buildings are found safe.
2. In dynamic load; with floating column structure is found unsafe. i.e. In earthquake this building found unsafe. So to make the structure safe beams and columns size are to be increased.
3. With the increase in size the quantity of concrete material is increased by 27.40%.
4. With the increase in displacement, bending moment, shear force and axial force in beams and columns in the structure reinforcement increased by 15.05%.
5. Increase in quantity of concrete and reinforcement building cost is increased by 16.02%.
6. After increasing size and providing reinforcement; building found safe in dynamic load in stadd pro analysis. Thickness of supporting beam is reducing up to 500mm.
7. In column at which supporting beam is rest, no. of reinforcement is find more. so reinforcement is increases and cross sectional area is increases.
8. By introducing floating column, irregularities are removed from the structure.

9. By applying floating column in structure building make serviceable for utilization purpose.

REFERENCES

[1] **Agarwal Pankaj, Shrikhande Manish (2009),** "Earthquake resistant design of structures", PHI learning private limited, New Delhi edition 1st-2009.

[2] **ArlekarJaswant N, Jain Sudhir K. and Murty C.V.R, (1997**), "Seismic Response of RC Frame Buildings with Soft First Storey". Proceedings of the CBRI Golden Jubilee Conference on Natural Hazards in Urban Habitat, 1997, New Delhi.

[3] **James L. Stratta**, Manual of seismic design, published by Pearson education, first edition, ISBN 81-297-0180-4, 2003.

[4] **B.c.Punmia, Ashok ku. Jain, at.el.** Theory of structure, Laxmi publication (p) LDT.2013.

[5] **Awkar J. C. and Lui E.M**, "Seismic analysis and response of multistory semi-rigid frames", Journal of Engineering Structures, Volume 21, Issue 5, Page no: 425-442, 1997.

[6] **Prasannan and matew (2017**)- seismic performance of rc floating column considering different configuration. IJERT, vol.6, issue 9, may 2017, pp. 100-107.

[7] **Sukumarbehera, NIT, ROURKELA (2012)-** report about floating column in seismic zone, dept. Of civil engineering, NIT, Rourkela, 769008, may 2012.

[8] **Waykule and pise (2016)**-study of behavior of floating column for seismic analysis of multi-storeybuilding.IJCIET, vol.7 issue 6, nov.-dec. 2016, pp. 676-685.

[9] **Nanabala and ramancharla (2004**)- seismic analysis of a normal building and floating column building. IJERT, vol. 3, issue 9, sep. 2014, pp. 981-987.

[10] **SOR PWD** for taking values of concrete and reinforcement rate. Addendum no. 05, chapter 13, w.e.f. 01-08-2014.

[11] **IS456- 2000**, plain and reinforced concrete - code of practice, fourth revision, July 2000.

[12] **IS1893-2002**, criteria for earthquake resistant design of structures, part 1, fifth revision, BIS 2002.