OPTIMUM LOCATION OF FLOATING COLUMN IN MULTISTOREY BUILDING WITH SEISMIC LOADING

Mr. Gaurav Pandey[1], Mr. Sagar Jamle[2]

[1]*M.Tech Scholar, Department of Civil Engineering, Oriental University, Indore, India*
[2]*Assistant Professor, Department of Civil Engineering, Oriental University, Indore, India*

Abstract - *In the present scenario various multistory building are constructed with floating column at various locations for appealing view, for getting more space in parking area for movement and for planning of different plan at different stories. This paper present comparative study about analysis of G + 14 story building with and without floating column at various location within the floors for periphery columns at various levels for seismic zone V. The motive of this paper is to compare the response of RC frame buildings with and without floating columns under earthquake loading and under normal loading. The effect of earthquake forces on various building models for various parameters is proposed to be carried out with the help of response spectrum analysis. A comparative study of the results obtained is carried out for all models. The building with floating columns at top stories will provide optimum results for four cases.*

Keywords- Floating column, multistory building, seismic response, staad pro, response spectrum, optimum case

1. INTRODUCTION

Now a day's construction of building are becoming more complex because of the requirement and usability of building. There are different architectural plans proposed for different floors in the same building because of multiple use and to accommodate such frames is becoming difficult as location of column will create problem. Sometimes in residential building when we need some aesthetic view or some extra space in various floor for balconies, terrace since they are not counted in Floor Space Index, also for portico in ground floor for lavish view and in parking area we need some extra column free space for easy movement of vehicles. Also in some case we need to construct columnless spaces in the lower stories and grid (residential arrangement) spaces in higher stories. For all the above scenario generally we will provide a cantilever type arrangement for frame which refers to as frame with floating column. But rational studies along with a knowledge regarding the performance of building in earthquakes reveals that such building would create maladjustments in building space forming elements that would not only decrease the seismoresistant capacity of the building but also become the cause of failure of the building.

1.1 Floating Column

A floating column also known as hanging column or stub column, which is likely to be supported on either joints or rest over the beam eccentrically without any support below it. Generally a column in framed structure is designed in such a way so as to transfer the load from column to column of different story then to foundation and finally to soil. While in case of floating column the load is not directly transferred. These column will be placed in such a way that it hangs on a base having no fixed support to transfer the load to foundation

2. OBJECTIVE

From the earlier studies it is observed that the optimum location of floating column in a building is not studied which may not cause any harm even in highly seismic prone areas. The prime objective of this work are:

1. To compare the Nodal displacement and Story drift for all the models with or without floating column.
2. To compare maximum shear force, bending moment in each story.
3. To compare the maximum axial force among all the models.
4. To find out the optimum location of floating column in a building frame.

3. METHODOLOGY AND STRUCTURAL MODELLING

A G+14 storied model of building is analyzed having 5 bays in x direction and 3 bays in z direction for a total of 13 cases with and without floating column at various locations within the floor level and in different stories as mentioned in table 1 and figure 1-13.

Using Indian Standard Code IS 1893 (part 1): 2002 various parameters are analyzed for various condition under seismic zone V by response spectrum method.
For examining below cases "STAAD Pro V8i" is used for analysis and following data is used for analyzing various parameters under certain conditions as mentioned below:

Table-1: Building Data

Parameter	Assumed data
Soil type	Medium Soil
Seismic zone	V
Response reduction factor	5
Importance factor	1
Height of building	45m
Floor to floor height	3m
Beam sizes	600mm X 550mm
Column sizes	600mm X 550mm
Material properties	Concrete

Table-2: Different cases with respect to building configurations

S.No.	Building Configuration Cases	Abbre-viation
1	Modelling and analysis of G+14 building without floating column.	A
2	Modelling and analysis of G+14 building with floating column at all four corners in ground floor only.	B
3	Modelling and analysis of G+14 building with floating column at all four corners in G+3 only.	C
4	Modelling and analysis of G+14 building with floating column at all four corners in G+6 only.	D
5	Modelling and analysis of G+14 building with floating column at all four corners in G+9 only.	E
6	Modelling and analysis of G+14 building with floating column at all four corners in G+12 only.	F
7	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in ground floor only.	G
8	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in G+3 only.	H
9	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in G+6 only.	I
10	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in G+9 only.	J
11	Modelling and analysis of G+14 building with floating column at center of outer periphery all around in G+12 only.	K

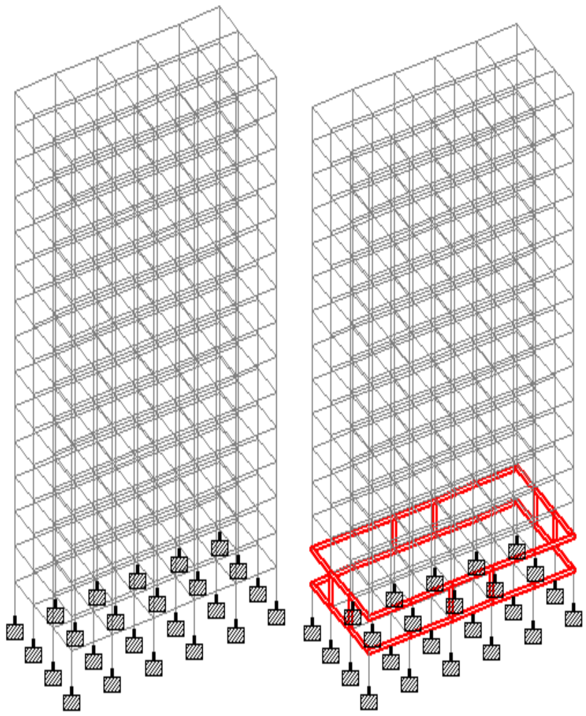


Fig. 1: *Case A & Case B*

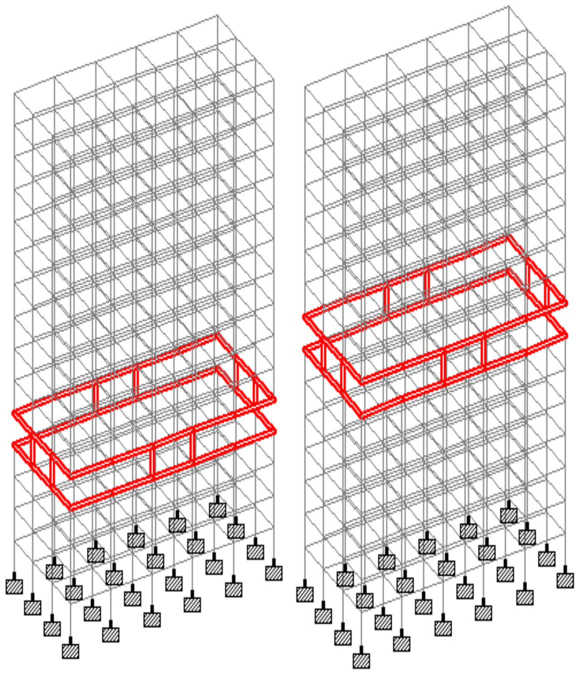


Fig. 2: *Case C & Case D*

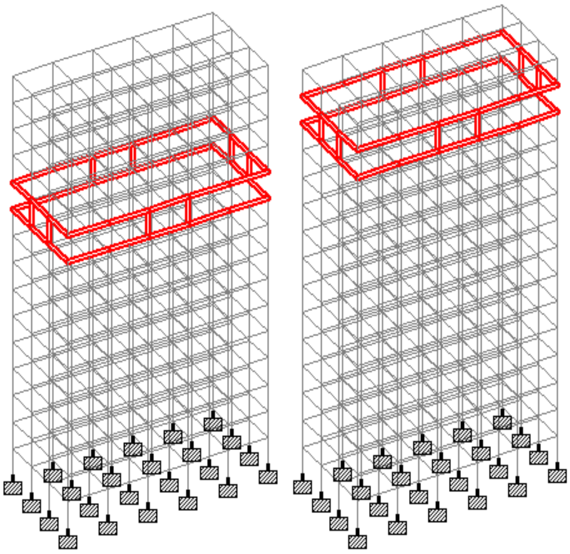


Fig. 3: *Case E & Case F*

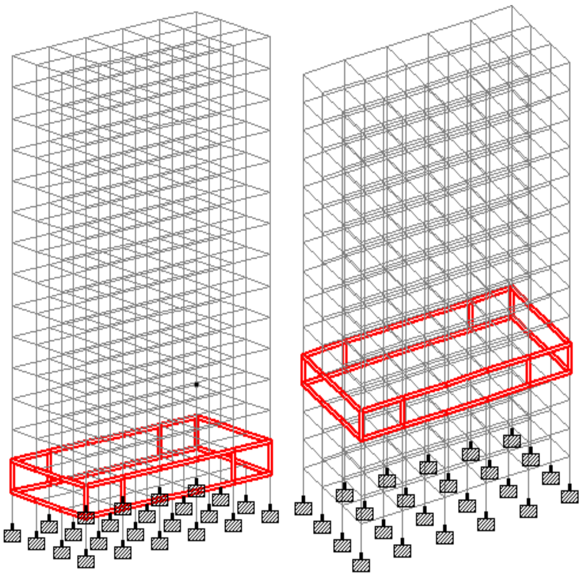


Fig. 4: *Case G & Case H*

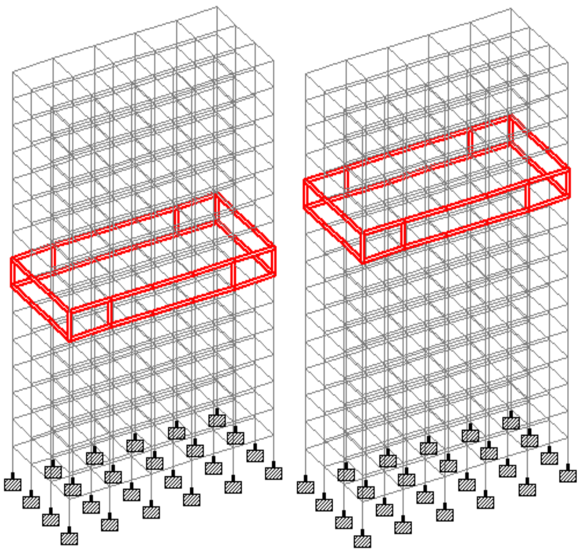


Fig. 5: *Case I & Case J*

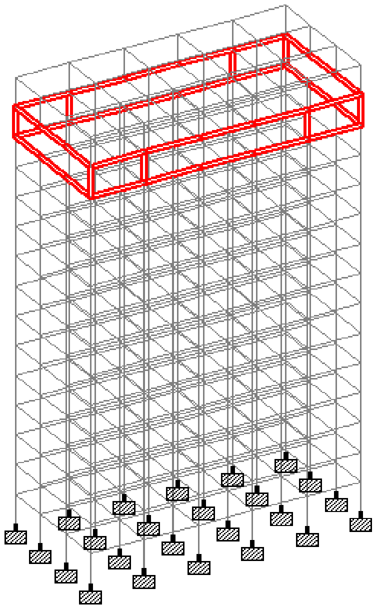


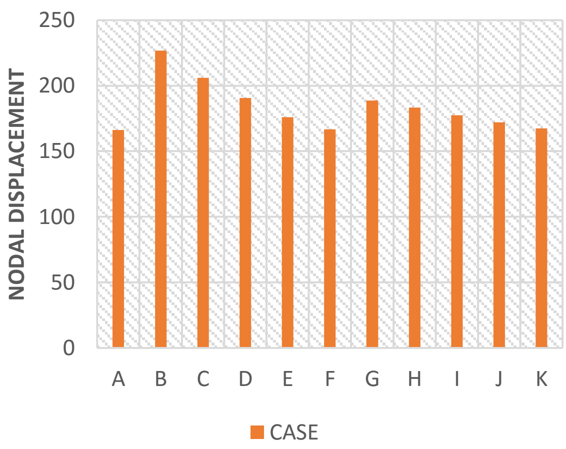
Fig. 6: *Case K*

4. RESULTS AND DISCUSSION

In the present study models are examined with longitudinal as well as transverse direction of seismic load as per Response Spectrum method of IS 1893:2002(part-1). Response spectrum analysis was performed against various load with multiple load combinations on all the model comprises of normal structure and all the cases of structure with floating column at various locations. Nodal displacement, story drift, maximum shear force, maximum bending moment and maximum axial forces was analyzed and compared for various cases and result is shown in tables as well as in graphical form also.

Table 3: Maximum Nodal displacement for various cases

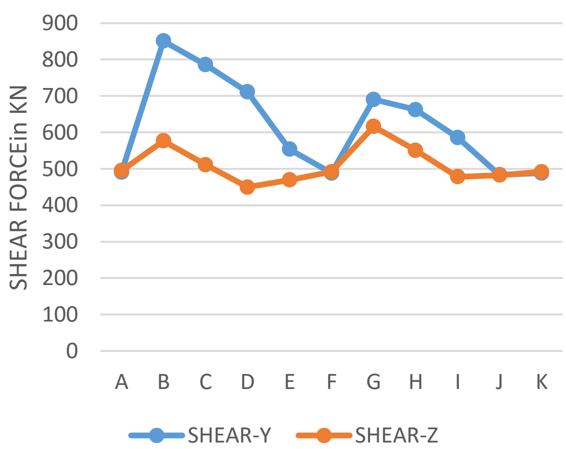
CASE	NODE	DISPLACEMENT
A	93	166.266
B	91,379	226.705
C	91	205.946
D	91	190.496
E	91	175.903
F	94	166.815
G	94	188.649
H	93	183.230
I	93	177.37
J	93	172.003
K	93	167.446



***Graph 1:** Graphical representation of Nodal Displacement for all cases*

Table 4: Maximum Shear Force in Y & Z direction for various cases

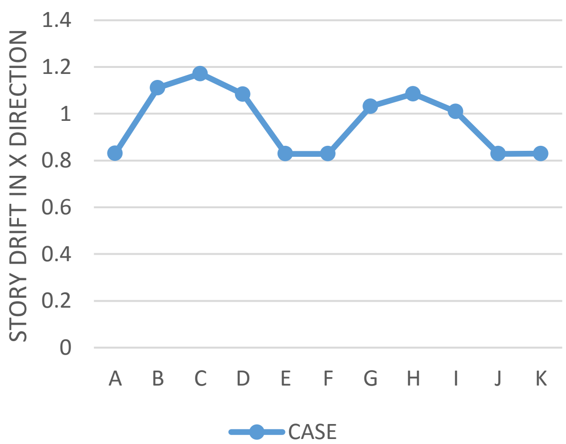
CASE	SHEAR Y	SHEAR Z
A	490.306	494.955
B	850.843	576.76
C	785.548	510.97
D	710.925	449.791
E	553.785	469.254
F	488.327	491.827
G	690.477	616.002
H	662.266	550.682
I	585.886	478.274
J	483.683	482.783
K	488.5	492.015



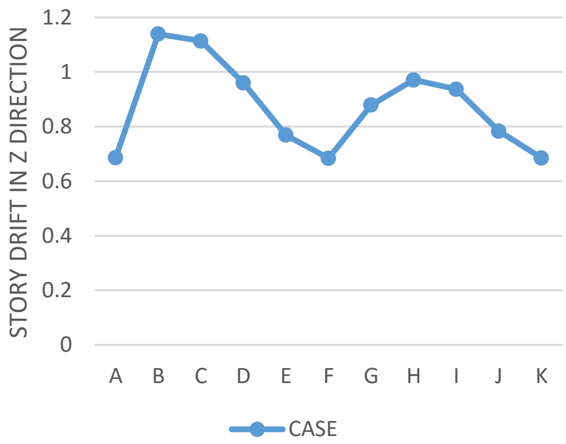
***Graph 2:** Graphical representation of Shear Force in Y & Z direction*

Table 5: Maximum Story Drift in X & Z direction for various cases

CASE	FLOOR	HEIGHT	MAXIMUM STORY DRIFT	
			X DIRECTION	Z DIRECTION
A	**G+4**	**15**	0.8308	
	G+6	**21**		0.6865
B	**G+1**	**6**	1.1111	
	G+5	**18**		1.1391
C	**G+4**	**15**	1.1709	
	G+6	**21**		1.1137
D	**G+7**	**24**	1.0836	
	G+8	**27**		0.9601
E	**G+4**	**15**	0.8283	
	G+10	**33**		0.7688
F	**G+4**	**15**	0.8289	
	G+6	**21**		0.6841
G	**G+1**	**6**	1.0316	
	G+1	**6**		0.8789
H	**G+4**	**15**	1.0851	
	G+4	**15**		0.9709
I	**G+7**	**24**	1.009	
	G+7	**24**		0.9368
J	**G+4**	**15**	0.8284	
	G+10	**33**		0.7832
K	**G+4**	**15**	0.8291	
	G+6	**21**		0.6848



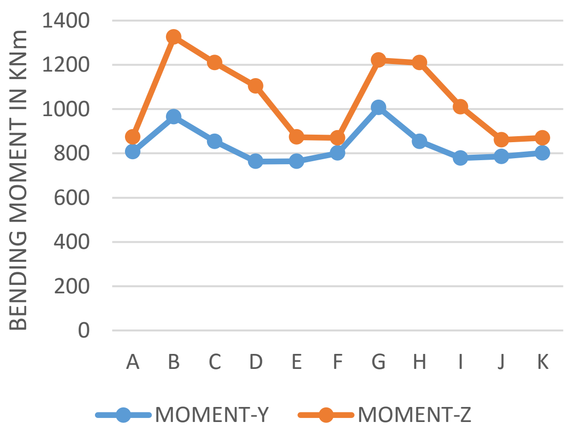
***Graph 3:** Graphical representation of Story Drift in X direction for all cases*



Graph 4: *Graphical representation of Story Drift in Z direction for all cases*

Table 6: Maximum Moment in Y & Z direction for various cases

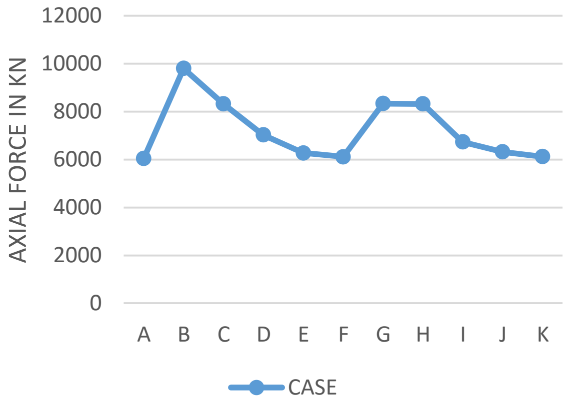
CASE	MOMENT Y	MOMENT Z
A	806.669	873.288
B	964.396	1324.449
C	853.436	1208.783
D	763.157	1103.196
E	764.224	873.232
F	801.271	869.578
G	1006.105	1220.33
H	853.436	1208.783
I	778.758	1010.272
J	785.817	860.838
K	801.624	869.987



Graph 5: *Graphical representation of Moment in Y & Z direction*

Table 7: Maximum Axial forces for various cases

CASE	AXIAL FORCE	CASE	AXIAL FORCE
A	6046.366	**G**	8331.71
B	9800.924	**H**	7427.260
C	8314.849	**I**	6728.995
D	7026.771	**J**	6317.072
E	6272.933	**K**	6115.475
F	6109.898		



Graph 6: *Graphical representation of Axial Force for all cases*

5. CONCLUSIONS

Since till now studies has been carried out for general condition of floating column but there had not been any such case which gives the optimum location of floating column within the building. On the basis of above parameters following results are obtained from this comparative study.

1. It has been concluded in this study, when columns as a floating column are eliminated in G + 14 story building at various location within the floors at various levels for seismic zone V that Cases E, F, J & K are seems to be most efficient case among all 11 cases.

2. On comparing it has been concluded that the maximum Nodal displacement obtained for Cases F & K with a minimum value of 166.815mm & 167.446mm respectively.

3. Comparing the Story drift for all cases in both longitudinal and transverse direction, Cases E, F, J & K are observed as most efficient.

4. On analyzing shear force and bending moment values, Case "J" i.e. floating column at center of outer

periphery all around in G+9 only found to be optimum for both X & Z direction among all cases.

5. As per comparative results, Cases E, F, J & K for axial forces values are found to be nearly equal among all the models.

REFERENCES

1. Badgire Udhav S., Shaikh A. N., Maske Ravi G., (2015), "Analysis of Multistorey Building with Floating Column", Volume 4, Issue No.9, ISSN:2319-6890 pp : 475-478.

2. Jayashri Sarode, Mr. Amol S. Pote, (2016), "Analysis Of Floating Column Building Of Composite and R.C.C Beam Girder & Comparison with R.C.C Frame Structure by Using Etabs V9.7.0.", ISSN: 2320-5407, pp 1464-1469.

3. Deekshitha R., Dr. H.S.Sureshchandra, (2017), "Seismic analysis of multistory building with and without floating column", Volume 4, Issue 6, ISSN: 2395-0056, pp 2546-2550.

4. Hardik bhensdadia, Siddharth Shah, (2015), "Pushover Analysis of RC Frame Structure with Floating Column and Soft Story in Different Earthquake Zones", Volume 4, Issue 4, ISSN: 2319-1163, pp 114-121.

5. Keerthi Gowda B. S, Syed Tajoddeen, (2014) "Seismic Analysis of Multistorey Building with Floating Columns", pp 528-535

6. Nakul A. Patil, Riyaz Sameer Shah, (2016) "Comparative Study of Floating and Non-Floating Columns With and Without Seismic Behaviour", ISSN: 2348 – 8352, pp 29-33.

7. Pradeep D., Chethan V. R., Ashwini, B. T., (2017), "Seismic Analysis of Multistory Building with Floating Column using Etabs", Volume 2, Issue 9, ISSN: 2455-263, pp 110-116

8. S. B. Waykule et. al., (2016), "Study of Behaviour of Floating Column for Seismic Analysis of Multistorey Building", Volume 7, Issue 6, ISSN Print: 0976-6308, pp 676-685.

9. Snehal Ashok Bhoyar, (2017), "Effect of Floating Column on Building Performance Subjected to Lateral Load", Volume 1 Issue 2, ISSN: 2456-8465, pp 134-143.

10. Srikant.M.K.,Yogeendra.R.holebagilu,(2014), "Seismic Response of Complex Building with Floating Column for Zone II and Zone V ", Volume 2, Issue 4, ISSN: 2321-7758.

11. Waykule S. B., Kadam S. S, Lale S. V, (2016), "Review on Study of Behavior of Floating Column For Seismic Analysis of Multistorey Building", International Journal of Engineering Applied Sciences and Technology, Volume. 1, Issue 10, ISSN No. 2455-2143, pp 39-42.