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# Comparative Seismic Analysis of Multistory Structures Incorporating Floating Columns and Conventional Column Systems

Prof. Pallavi Bhende[1], Mr. Atul Kawde[2]
[1]*Assistant Professor, & Head Civil Engineering Department, Wainganga College of Engineering and Management, Nagpur, Dongargaon, Nagpur, MH.*
[2]*M-Tech Research Scholar (Structure), Civil Engineering Department, Wainganga College of Engineering and Management, Nagpur, Dongargaon, Nagpur, MH.*

***Abstract:*** ***Buildings are representation of modern city and as such are an achievement of structural engineering. The seismic behavior of a building during earthquakes depends on its shape, size and geometry, in addition to how the earthquake forces are carried to the ground. Hence, the structural engineers must work to make sure that the features which are not favorable are avoided and a good building configuration is chosen at the planning stage itself. Nowadays multi-storey buildings in urban cities are required to have column free space due to shortage of land, population and for functional and aesthetic requirements. Floating columns are an important feature in today's world of multi-storeyed buildings in urban India and are highly unsafe in buildings built in seismically active areas. In this paper analysis using response spectrum method is done for a multi-storeyed building with and without floating columns. This paper presents comparative study of a G+06 storied building with external and internal floating columns and regular columns with seismic behavior. This work includes the analysis and design of the floating column and regular column structures by using STAAD pro software.***
***Keywords: Earthquake, Floating column, STAAD Pro , Seismic Zones.***

## I. INTRODUCTION

Earthquake is movements within the Earth's crust which cause stress to build up at points of weaker zone and rocks to deform. Large scale damage occurs during several moderate earthquakes in recent years which indicate, despite such early gains, earthquake risk in the country has been increasing alarmingly. In high earthquake regions of the country most of the buildings continue to be built without appropriate earthquake resistant features.

India is divided into different seismic zones. As per IS 1893:1984 Code India is divided from Zone I to Zone V. But as per IS 1893:2002 Code it has been divided from Zone II to Zone V. Zone I has been discarded.

## II. MODEL OF THE PROJECT

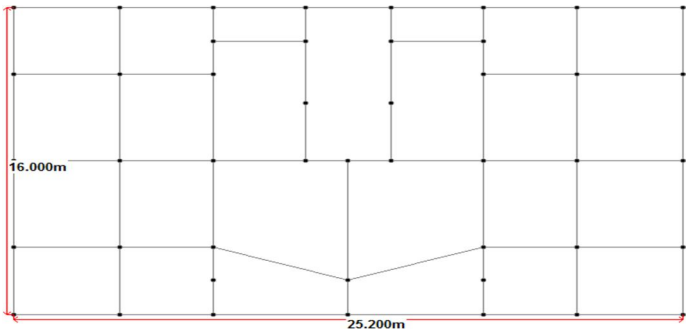


Figure-1 Plan of Structure

The above Fig. shows the plan of the structure in which the width of the building is 16m and length of the building is 25.2 m. (Fig-1) Table I: Details of the Structure

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| | |
|---|---|
| Type of Structure | RC G+6 Building |
| Length of Building | 25.2 m |
| Width of Building | 16.0 m |
| Storey Height | 2.8m |
| Height of Building | 16.8m |
| Base Area | 25.52 m X 16 m |
| Type of Soil | Medium |
| Earthquake Zone | II and III |
| Lateral Load Resisting System | Ordinary Moment Resisting frame (OMRF) |
| Response Reduction factor (R) | 3.0 (OMRF) |
| Live Load on Building | 3 KN/m2 |
| Dead Load | For 0.3 mm thick wall -16 KN/m<br>For 0.15 mm thick wall – 7 KN/m |

The following Fig. shows the elevation of the building in which length of the building is 25.2 m, total height of the building is 16.8 m and storey height at each floor is 2.8 m. (Fig-2)

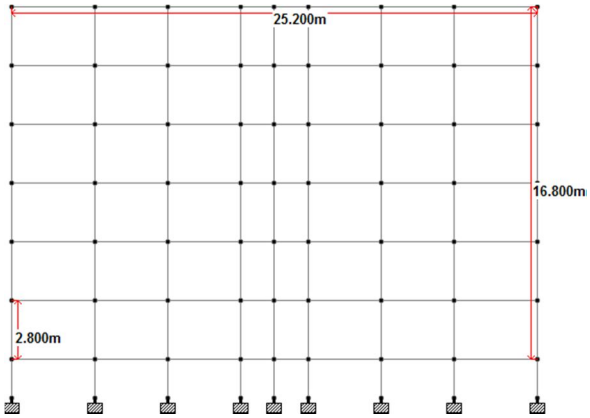



Figure-2 Elevation of Structure

The following Fig. shows the 3D model of the structure prepare in STAAD Pro. software. It is the normal RC building without Floating Column (Case 1) (Fig-3)

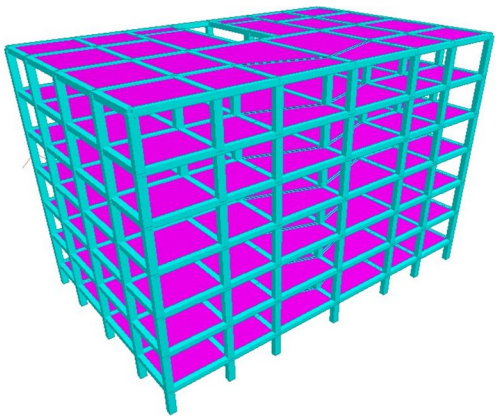


Figure-3 3D view of Structure (case 1)

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## III. METHODOLOGY

The building treated as OMRF .Response Reduction Factor 3. The analysis is carried out on the same configuration of building for all earthquake Zones as

*1)* Zone II
*2)* Zone III

As per the IS 1893 (Part 1) – 2002, Analysis parameters considered in the comparison of Ordinary Moment Resisting frame (OMRF) in zone II and III are

*1)* Displacement in X and Z Direction
*2)* Shear in Z-direction (Fz)
*3)* Axial Force in X-direction (Fx)
*4)* Moment in X- direction (Mx)

Moment in Z- direction (Mz) For analysis of structure, 7 load combinations were considered

*1)* 1.5(DL+LL)
*2)* 1.2(DL+LL+EQX)
*3)* 1.2(DL+LL+EQZ)
*4)* 1.5(DL+EQX)
*5)* 1.5(DL+EQZ)
*6)* 0.9DL+1.5EQX
*7)* 0.9DL+1.5EQZ

Depending on orientation of columns, 1.5(DL+EQX) or 1.5(DL+EQZ) these 2 load combinations are critical for columns.

In the STAAD-Pro precautions is taken to take response reduction factors and adequate zone factor depending on case.
For the comparison, Following beams and columns are selected

*1)* Corner Column
*2)* Corner Beam
*3)* Internal Column
*4)* Internal Beam

The following Fig. shows the Building with external Floating column (Case 2) (Fig-4)

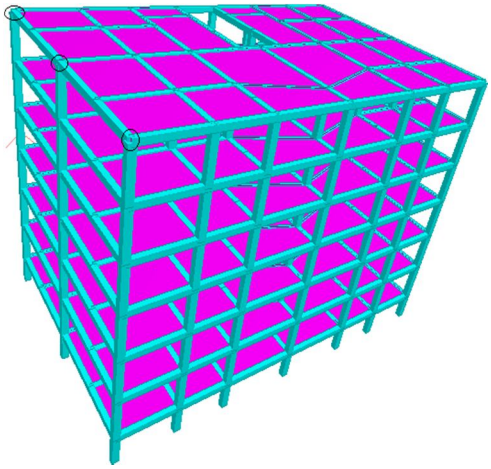


Figure-4 External Floating Column (case 2)

The following Fig. shows the structure where floating columns are placed at internal column.(Case 3) (Fig-5)

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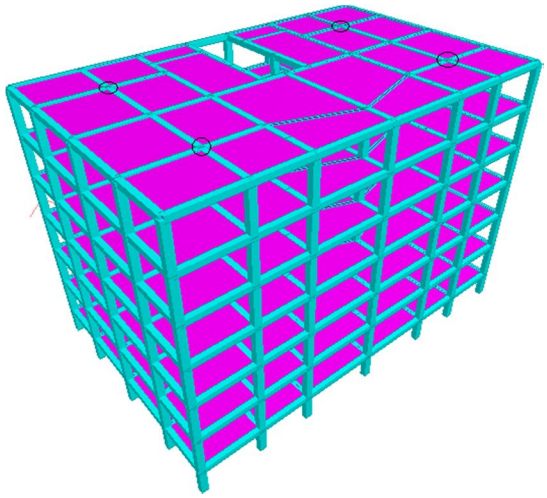


Figure-5 Internal Floating Column (case 3)

The following Fig. shows the building having external and Internal Floating column. (case 4) (Fig-6)

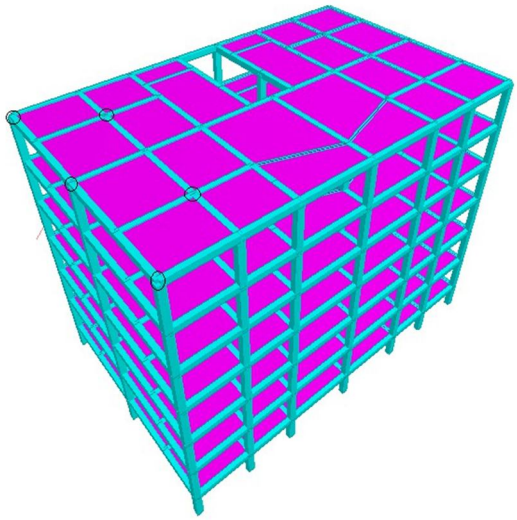


Fig-6 External and Internal Floating Column (case 4)

## IV. SEISMIC ANALYSIS RESULT

Exclusive data of analysis for these Beams and columns is exported to excel for further analysis and comparison. Based on the data graphs are plotted.

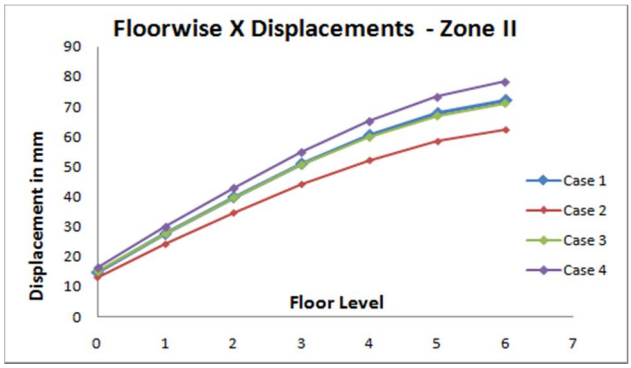



Figure-7 X displacement for Zone II (Corner Column)

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The above graph shows the variation in X displacement for the corner column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents X displacements in mm.
(Fig. 7)

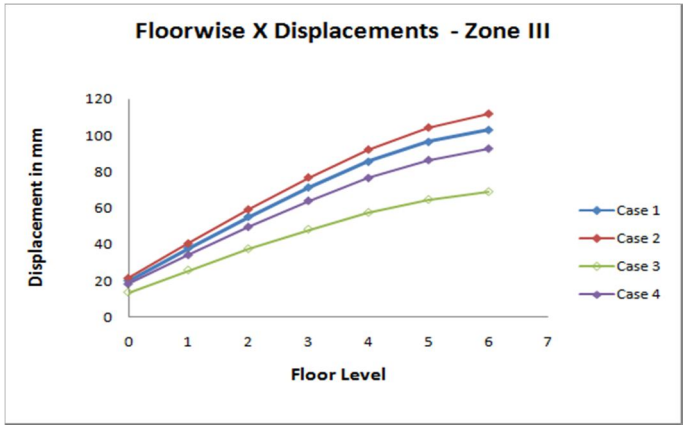



Figure-8 X displacement for Zone III (Corner Column)

The above graph shows the variation in X displacement for the corner column in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents X displacements in mm.
(Fig. 8)

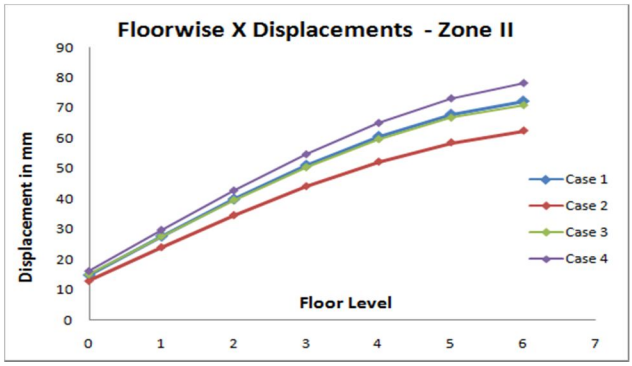



Figure-9 X displacement for Zone II (Intermediate Column)

The above graph shows the variation in X displacement for the Intermediate column in zone II with respect to all the floors in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents X displacements in mm. (Fig. 9)

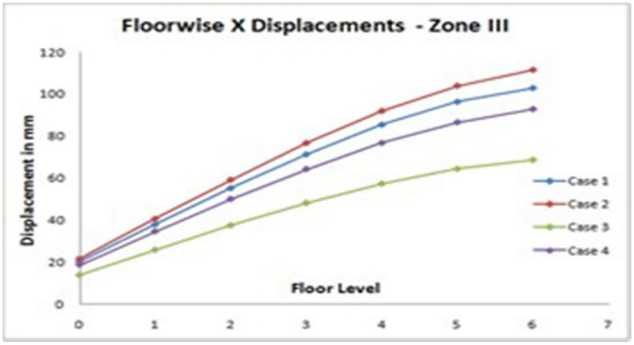



Figure-10 X displacement for Zone III (Intermediate Column)

The above graph shows the variation in X displacement for the Intermediate column in zone III with respect to all the floors in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents X displacements in mm. (Fig. 10)

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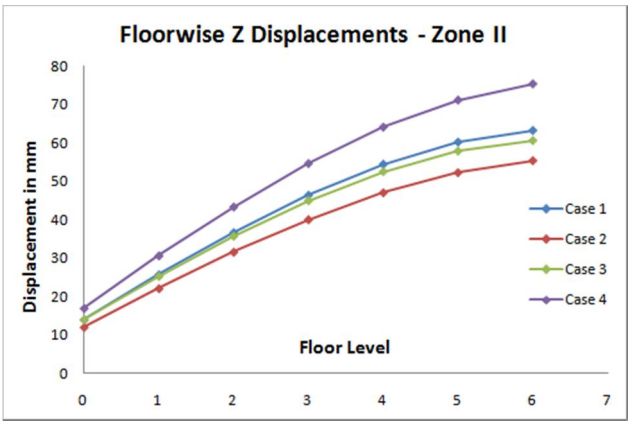



Figure-11 Z displacement for Zone II (Corner column)

The above graph shows the variation in Z displacement for the corner column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Z displacements in mm.
(Fig. 11)

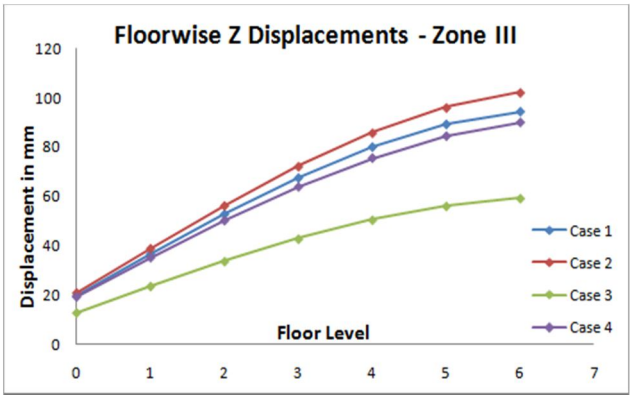



Figure-12 Z displacement for Zone III (Corner column)

The above graph shows the variation in Z displacement for the corner column in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Z displacements in mm. (Fig.12)

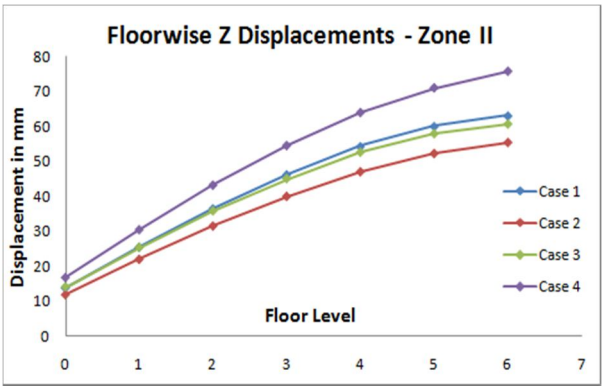



Figure-13 Z displacement for Zone II (Intermediate Column)

The above graph shows the variation in Z displacement for the Intermediate column in zone II with respect to all the floors in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Z displacements in mm. (Fig. 13)

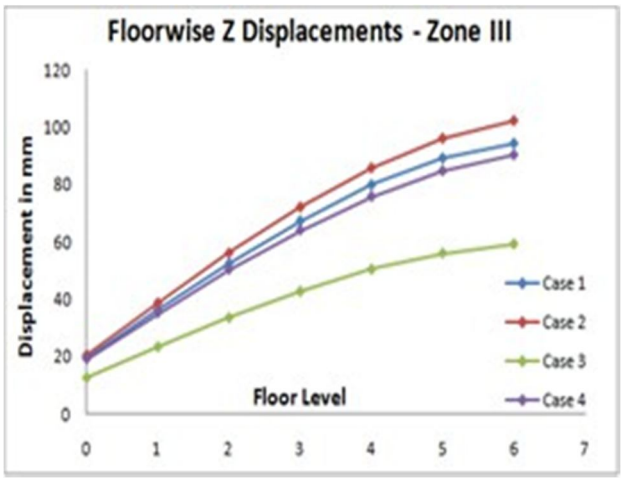



Figure-14 Z displacement for Zone III (Intermediate Column)

The above graph shows the variation in Z displacement for the Intermediate column in zone III with respect to all the floors in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Z displacements in mm. (Fig. 14)

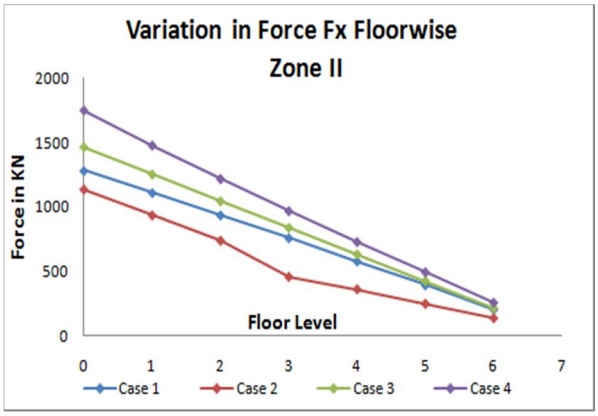



Figure-15 Axial Force Fx for Zone II (Corner Column)

The above graph shows the variation in Axial force Fx for the corner column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Force in kN.
(Fig.15)

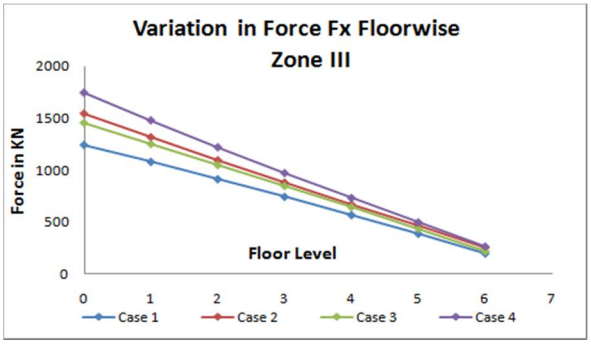



Figure-16 Axial Force Fx for Zone III (Corner Column)

The above graph shows the variation in Axial force Fx for the corner column in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Force in kN.(Fig.16)

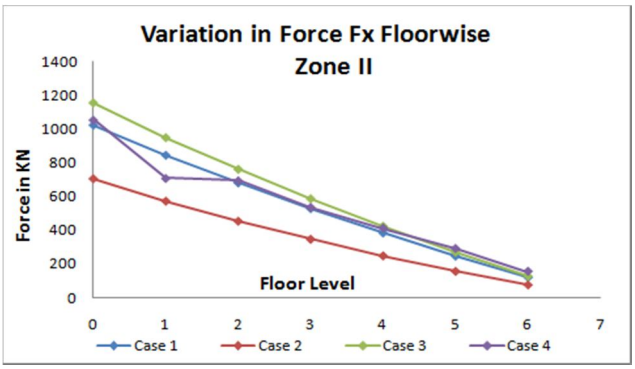



Figure-17 Axial Force Fx for Zone II (Intermediate Column)

The above graph shows the variation in Axial force Fx for the intermediate column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Force in kN.(Fig.17)

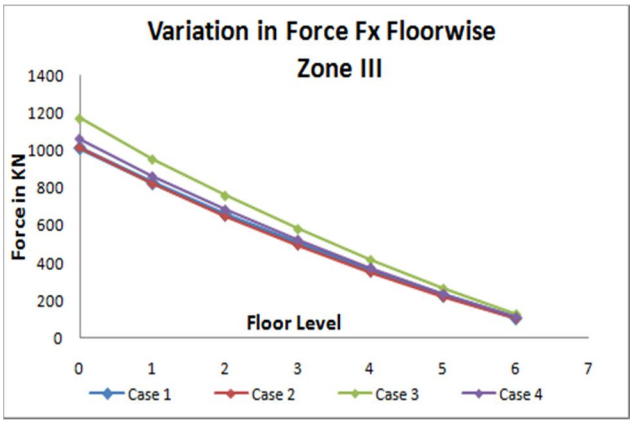



Figure-18 Axial Force Fx for Zone III (Intermediate Column)

The above graph shows the variation in Axial force Fx for the intermediate column in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Force in kN.(Fig.18)

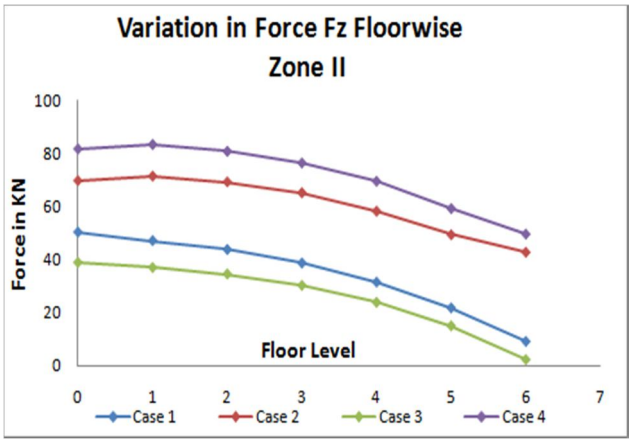



Figure-19 Shear Force Fz for Zone II (Corner Column)

The above graph shows the variation in Shear force Fz for the corner column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Force in kN.(Fig.19)

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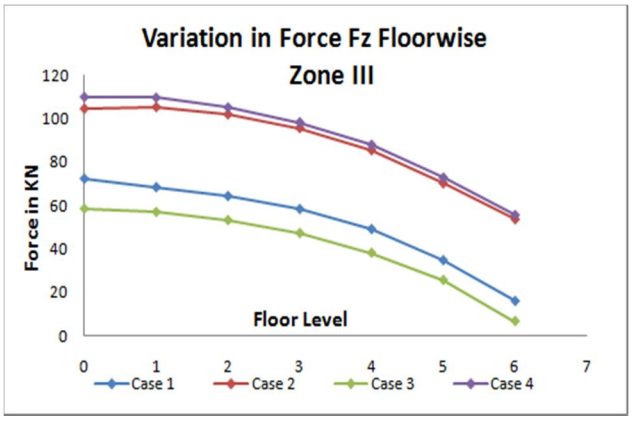



Figure-20 Shear Force Fz for Zone III (Corner Column)

The above graph shows the variation in Shear force Fz for the corner column in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Force in kN.(Fig.20)

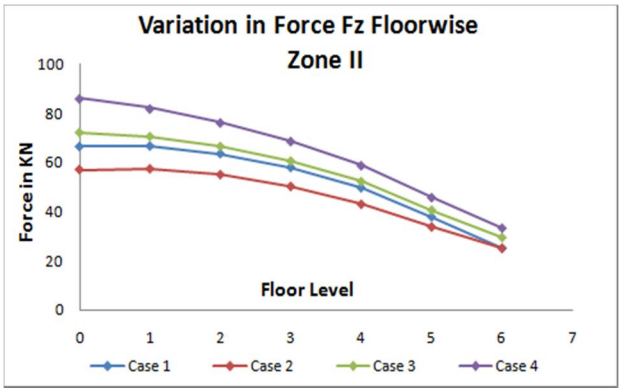



Figure-21 Shear Force Fz for Zone II (Intermediate Column)

The above graph shows the variation in Shear force Fz for the Intermediate column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Force in kN.(Fig.21)

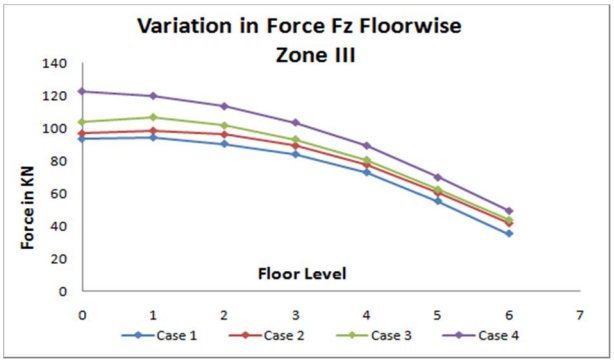



Figure-22 Shear Force Fz for Zone III (Intermediate Column)

The above graph shows the variation in Shear force Fz for the Intermediate column in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Force in kN.(Fig.22)

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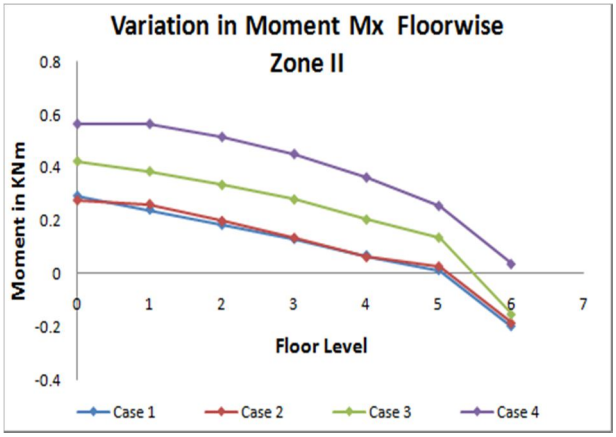



Figure-23 Moment Mx for Zone II (Corner Column)

The above graph shows the variation in Moment Mx for the Corner column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.23)

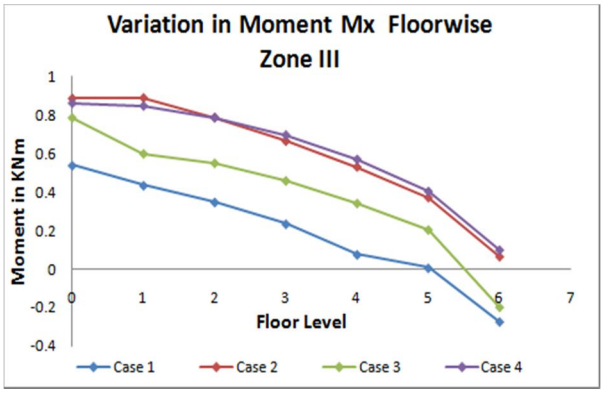



Figure-24 Moment Mx for Zone III (Corner Column)

The above graph shows the variation in Moment Mx for the Corner column in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.24)

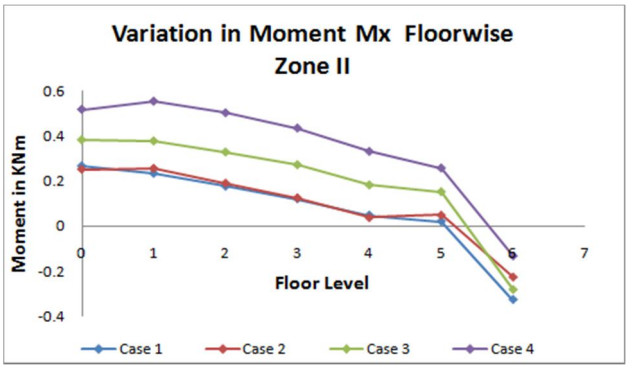



Figure-25 Moment Mx for Zone II (Intermediate Column)

The above graph shows the variation in Moment Mx for the Intermediate column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.25)

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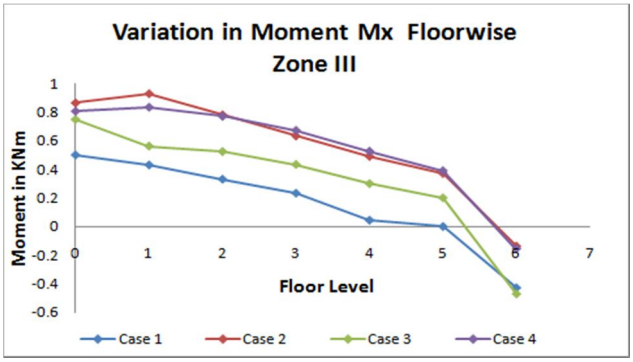


Figure-26 Moment Mx for Zone III (Intermediate Column)

The above graph shows the variation in Moment Mx for the Intermediatecolumn in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.26)

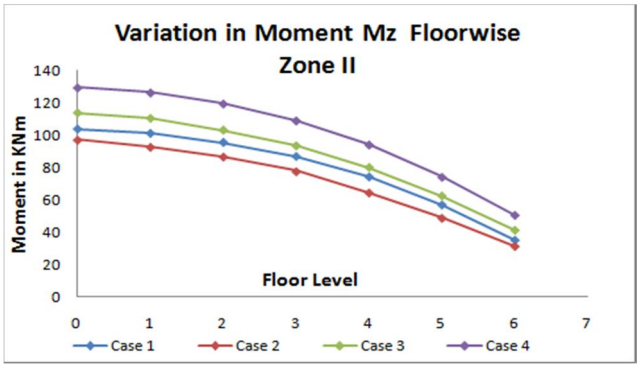


Figure-27 Moment Mz for Zone II (Corner Column)

The above graph shows the variation in Moment Mz for the Corner column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.27)

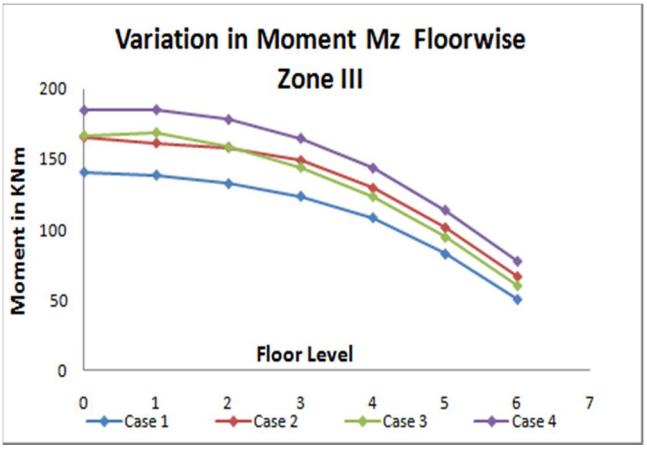


Figure-28 Moment Mz for Zone III (Corner Column)

The above graph shows the variation in Moment Mz for the Corner column in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.28)

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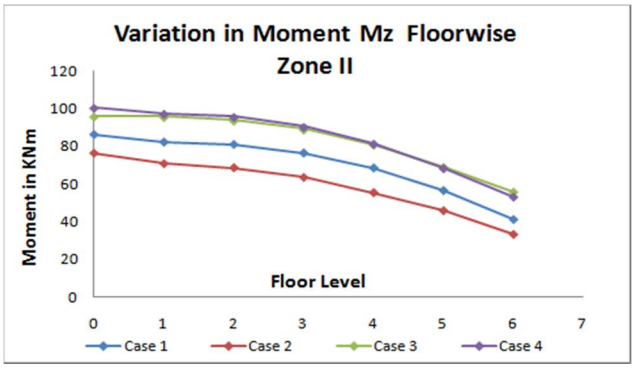



Figure-29 Moment Mz for Zone II (Intermediate Column)

The above graph shows the variation in Moment Mz for the Intermediate column in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.29)

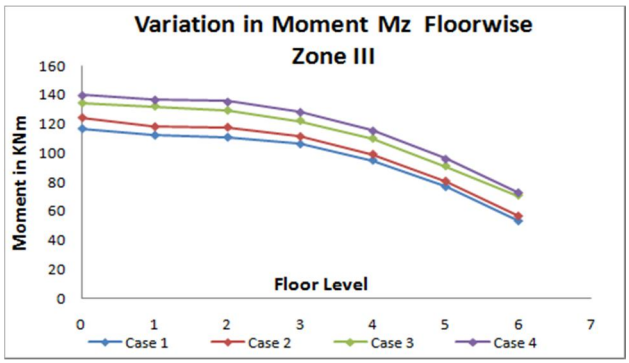



Figure-30 Moment Mz for Zone III (Intermediate Column)

The above graph shows the variation in Moment Mz for the Intermediate column in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.30)

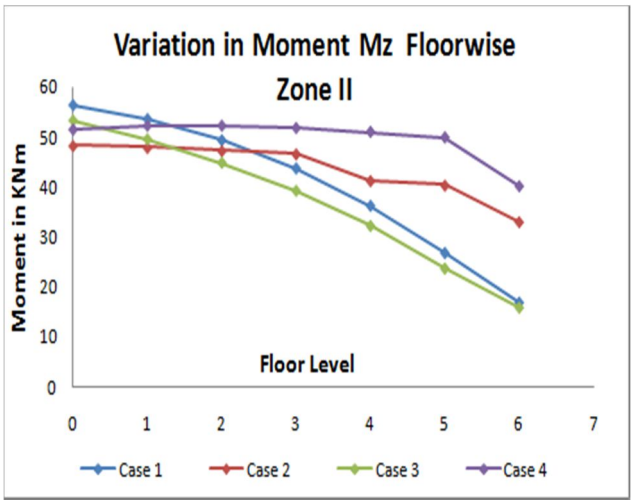



Figure-31 Moment Mz for Zone II (Corner Beam)

The above graph shows the variation in Moment Mz for the Corner Beam in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig31)

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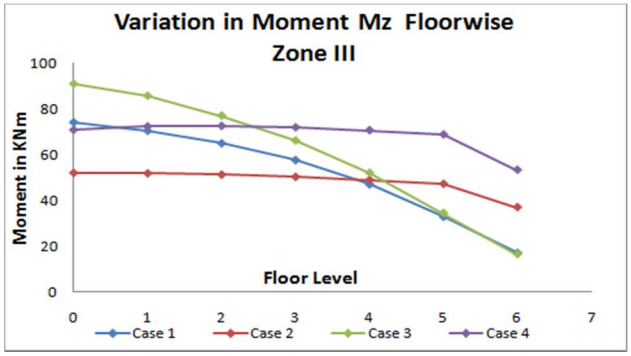


Figure-32 Moment Mz for Zone III (Corner Beam)

The above graph shows the variation in Moment Mz for the Corner Beam in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.32)

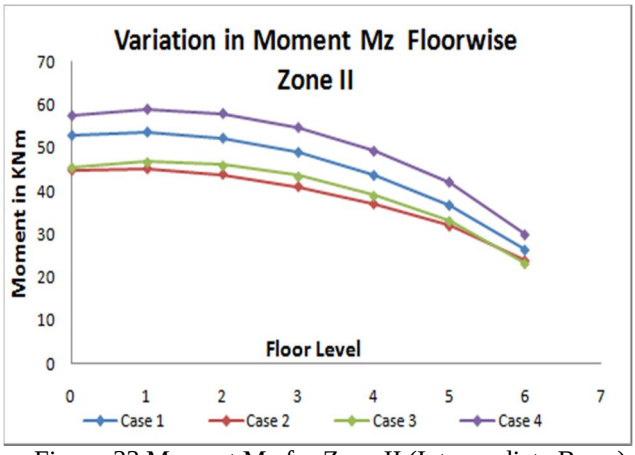


Figure-33 Moment Mz for Zone II (Intermediate Beam)

The above graph shows the variation in Moment Mz for the IntermediateBeam in zone II with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.33)

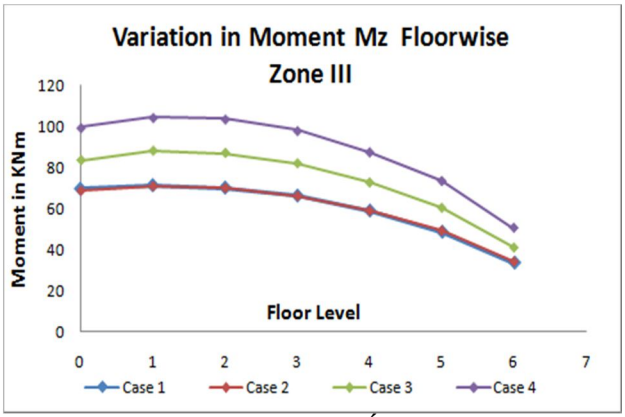


Figure-34 Moment Mz for Zone ÍII (Intermediate Beam)

The above graph shows the variation in Moment Mz for the Intermediate Beam in zone III with respect to all the floors and in all the 4 cases. X axis represents the floor levels of the structure and Y axis represents Moment in kN-m. (Fig.34)

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## V. CONCLUSIONS

*1)* In case 4(External and Internal Floating column), increases the Mx and Mz value at all the floor for both the zones i.e. Zone II and Zone III.

*2)* Provision of Case 4 (External and Internal Floating columns) and case 3(Internal Floating Columns) may increase Axial Force Fx and Shear in z direction (Fz) at all floors.

*3)* 1.5(DL+EQZ) or 1.5(DL+EQX) these load combinations are found critical, depending on position of floating columns.

*4)* Provision of Case 2 (External Floating columns) and Case 4 (External with Internal Floating columns) may increase displacements at various nodes.

## REFERENCES

[1] Mr. P.V. Prasad ,T.Raja Sekhar, "Study Of Behaviour Of Seismic Analysis Of Multi Storied Building With And Without Floating Column", Caribbean Journal of Science and Technology, 2014, Vol2, 697-710 .

[2] Isha Rohilla1, S.M. Gupta2,"Seismic Response Of Multi- Storey Irregular Building With Floating Column", IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | ISSN: 2321-7308.

[3] Onkar V.Sapate, "Inter-Relationship between Moment Values of Columns in a Building with Different Architectural Complexities and Different Seismic Zones", International Journal of Engineering Research and Development, Volume 5, Issue 2 (December 2012), PP. 55-59, e-ISSN: 2278-067X, p-ISSN : 2278-800X

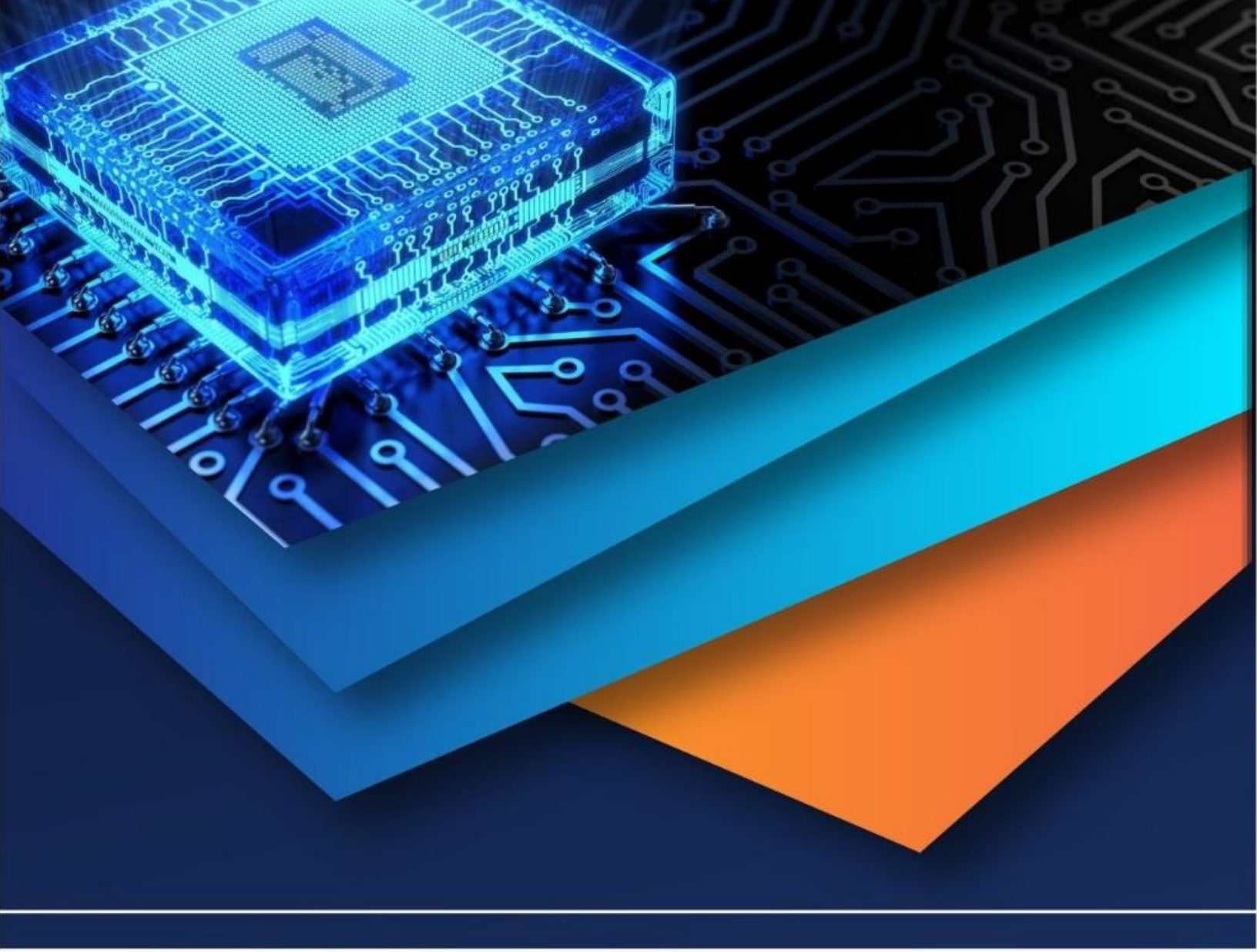
[4] Sabari S, Mr.Praveen J.V, "Seismic Analysis of Multistorey Building with Floating Column", International Journal of Civil and Structural Engineering Research Vol. 2, Issue 2, October 2014

[5] Kavya N., Dr. K.Manjunatha , Sachin.P.Dyavappanavar, " Seismic Evaluation of Multistorey RC Building with and Without Floating Column", International Research Journal of Engineering and Technology, e-ISSN:2395-0056,p- ISSN:2395-0072 Volume:02, Issue: 09, Sept-2015.

[6] Badgire Udhav S., Shaikh A.N., Maske Ravi G., "Analysis of Multistorey Building with Floating Column", International Journal of Engineering Research, Vol. 04,Issue 09, 2014.

[7] Nikhil Bandwal, Anant Pande, Vaishali Mendhe,Amruta yadav, "To Study Seismic Behaviour of RC Building with Floating Columns"", International journal of scientific engineering and technology and research. ISSN 2319-8885 Vol.03, Issue.08, May-2014, Pages: 1593-1596.

[8] Prof. Sarita Singla, Er. Ashfi Rahman, "Effect of Floating Columns on Seismic Response of Multi-Storey RC Framed Buildings", International Journal of Engineering Research & Technology (IJERT) eISSN: 2278-0181 IJERTV4IS060933 www.ijert.org Vol. 4 Issue 06, June-2015 1131



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