

# Critical Study of Behaviour of RC Structural Frame With Floating Column

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**Abstract-** The infrastructural boom during last decade as resulted in construction of many high rise structures in all mega cities. Due to the existence of architect and structural designer have provided floating column in many location in structure. The building become vulnerable to earthquake hazard due to improper way of flow of earthquake force to ground due to discontinuity in the form of floating column brought into structure. Floating column provided at some location such as balcony result in close loop and redistribution of moment and forces may prove to be beneficial in restricting dimension of beam and column it may also help in achieving in desire economy.

The present paper deals with comparison of forces and displacement in selected few columns in the structure with or without floating column through different graphs the comparison is explain in the paper.

**Keywords-** Floating Columns, Seismic Zones, Critical Load Combinations, response spectrum

## I. INTRODUCTION

A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is also a vertical element which ends (due to architectural design/ site situation) at its lower level (termination Level) rests on a beam which is a horizontal member. The beams in turn transfer the load to other columns below it such columns where the load was considered as a point load. Theoretically such structures can be analyzed and designed. In practice, the true columns below the termination level [usually the stilt level] are not constructed with care and more liable to failure. Hypothetically, there is no need for such floating columns – the spans of all beams need not be nearly the same and some spans can be larger than others. This way, the columns supporting beams with larger spans would be designed and constructed with greater care. A G+14 storied building with different Architectural complexities such as floating column at balcony is analyzed for various earthquake zones. Details of the structure are given in table 1.

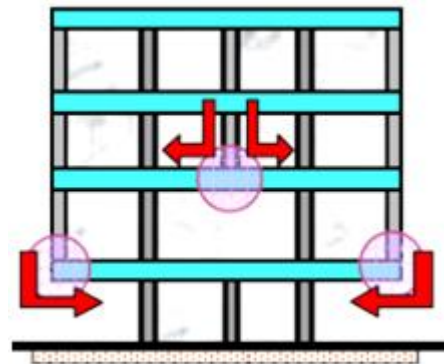


Fig. 1: Building with floating columns

Table 1

Type of Structure	R.C. G+14 Building
Storey Height	3 m
Earthquake Zone	II, III, IV, V
Type of soil	Medium
Lateral Load Resisting System	Special RC moment-resisting frame (SMRF)
Response Reduction Factor, R	5.0
Live Load	3 KN/m <sup>2</sup>
Dead load	1. Self Wt. of whole Structure 2. Wt. of Brickwork = 13.34 KN/m 3. Slab Load = 3 KN/m <sup>2</sup>

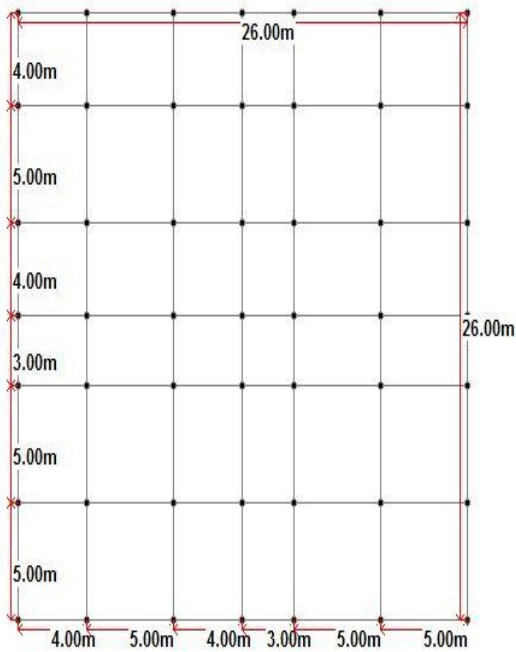


Fig . 1

## II. LITERATURE REVIEW

Seismic Response of RC Frame Buildings with Soft First Storey's: [Jaswant N. Arlekar] <sup>1</sup>. In this paper highlights the importance of explicitly recognizing the presence of the open first storey in the analysis of the building .This paper argues for immediate measures to prevent the indiscriminate use of soft first storey's in buildings, which are designed without regard to the increased displacement, ductility and force demands in the first storey columns.

Seismic Response Evaluation of RC frame building with Floating Column considering different Soil Conditions: [Perna Nautiyala] .<sup>2</sup> in this paper high rise building is analyzed for earthquake force by considering two type of structural system. Frame with only floating column and floating column with complexities for reinforced concrete building considering different Soil Condition. Finally, analysis results in the high rise building such as storey drifts, storey displacement, and storey shear were compared in this study.

Qualitative Review of Seismic Response of Vertically Irregular Building Frames: [Devesh P. Soni] <sup>3</sup>. This study summarizes state-of-the-art knowledge in the seismic response of vertically irregular building frames

Seismic Response of Vertically Irregular RC Frame with Stiffness Irregularity at Fourth Floor: [Shaikh Abdul Aijaj Abdul Rahman] <sup>4</sup> In this paper two frame having different irregularities but with same dimension have been

analyzed to study their behavior when subjected to lateral loads the frame The result remarks the conclusion that, a building structure with stiffness irregularity provides instability and attracts huge storey shear. A proportionate amount of stiffness is advantageous to control over the storey and base shear.

## III. ANALYSIS

The Building with architectural complexities was analyzed for all the conditions including Earthquake load by STAAD.Pro. Linear Dynamic Analysis is done for multi storey frame. In this paper study of seismic analysis, critical load combinations are found out. The building chosen was 47 m high building. To study the effect of various loads in various Earthquake zone the building was modeled as per plan and floating column are provided at various location in building In analysis four cases consider first without floating column and second case is internal floating column third case is external floating column & fourth case is floating column at alternate floor level

## IV. LOAD COMBINATION

Following load combinations were considered in analysis of the building as per IS 1893(Part 1):2002

1. 1.5DL +1.5LL
2. 1.5DL +1.5EQX
3. 1.5DL -1.5EQX
4. 1.5DL +1.5EQZ
5. 1.5DL -1.5EQZ
6. 1.2DL +1.2LL+ 1.2EQX
7. 1.2DL +1.2LL -1.2EQX
8. 1.2DL +1.2LL+ 1.2EQZ
9. 1.2DL +1.2LL -1.2EQZ
10. 0.9DL +1.5EQX
11. 0.9DL -1.5EQX
12. 0.9DL +1.5EQZ
13. 0.9DL -1.5EQ

## V. ANALYSIS OF DATA GENRATED

The STAAD output generated was analysed in MS-Excel to determine relations between various parameters and develop mathematical models. Relations developed are given below

1. Case Wise variation in X and Y Displacement values for all Cases.
2. Case Wise variation in Axial Force Fx values for all Cases.

3. Case Wise variation in Shear Fz values for all Cases.
4. Case Wise variation in Moment Mx values for all Cases.
5. Case Wise variation in Moment Mz values for all Cases.

**VI. METHODOLOGY**

In this project, a plan of G+14 story building is selected with introduction of floating column.

To initiate the effect of floating column 4 different cases as detailed below were considered and for all these cases the structure was analyzed.

- (1) Normal column.
- (2) External floating.
- (3) Internal floating.
- (4) With internal & external floating column.

The analysis is carried out on the same configuration of building for all earthquake zones as

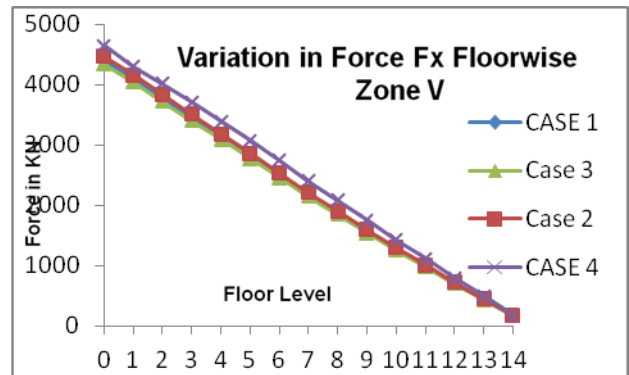
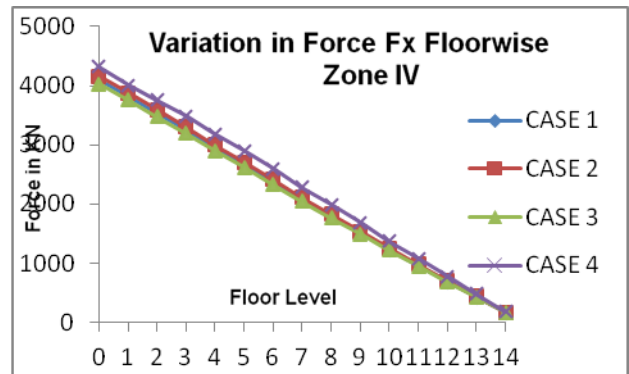
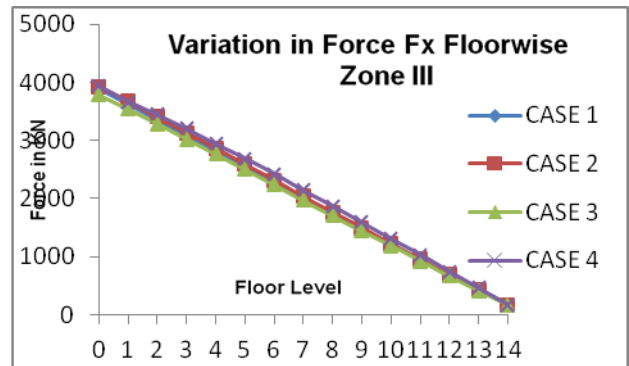
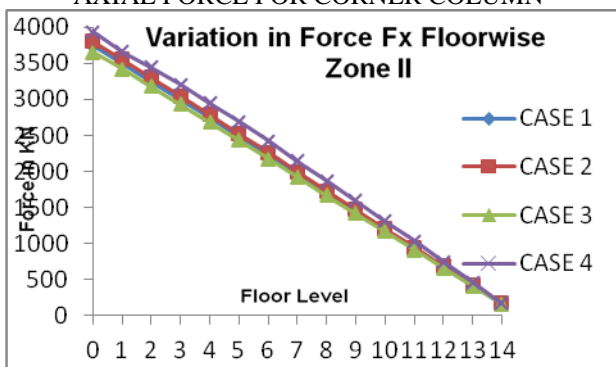
- 1) Zone II
- 2) Zone III
- 3) Zone IV
- 4) Zone V

Though as per the IS 1893 (Part 1) – 2002 analysis parameters considered in the comparison of Special Moment Resisting Frame are

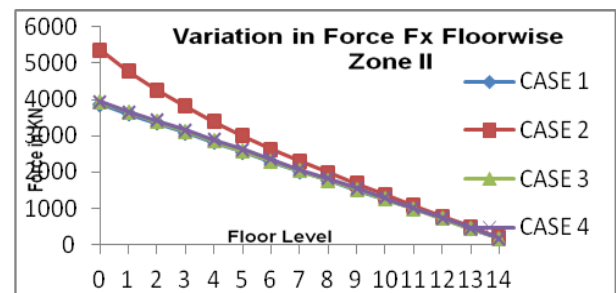
- 1) Displacement in X and Z Direction
- 2) Axial Force in X – direction (Fx).
- 3) Shear Force in Z – direction (Fz).
- 4) Moment in X – direction (Mx).
- 5) Moment in Z – direction (Mz)

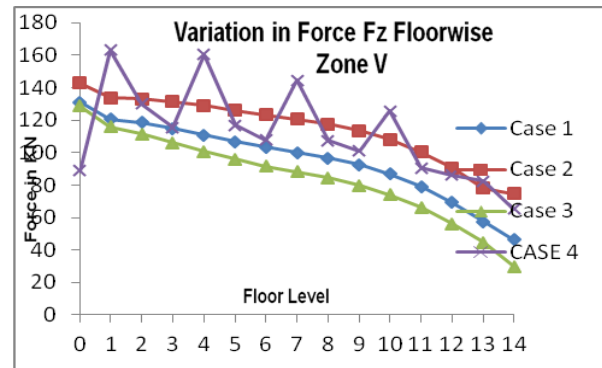
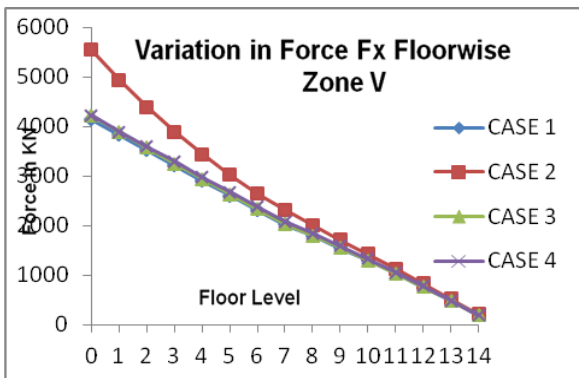
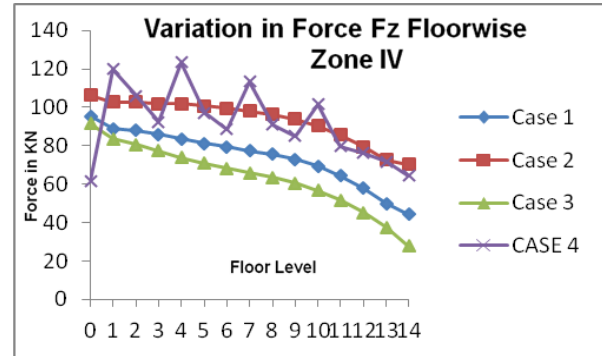
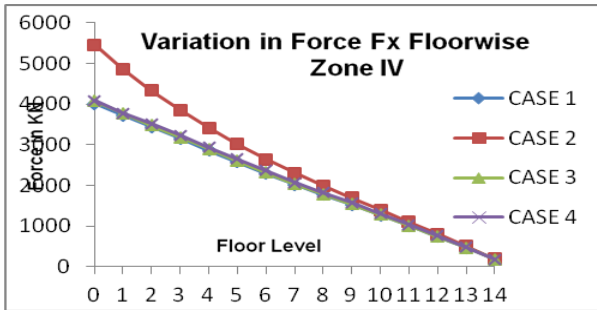
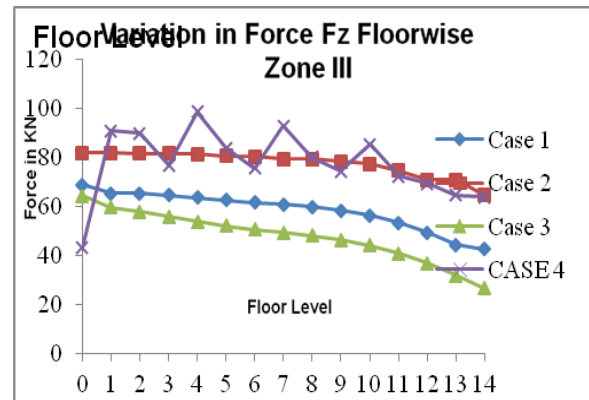
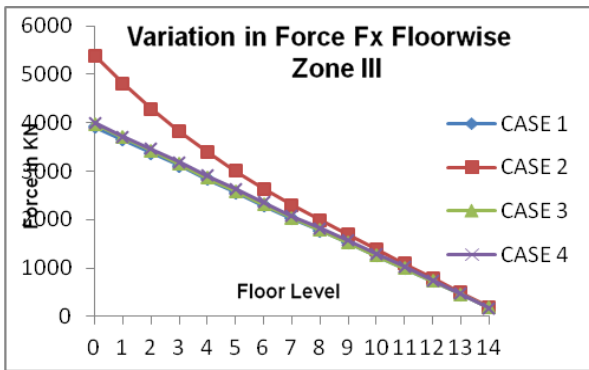
**VII. DETAILS OF GRAPHS PLOTTED:**

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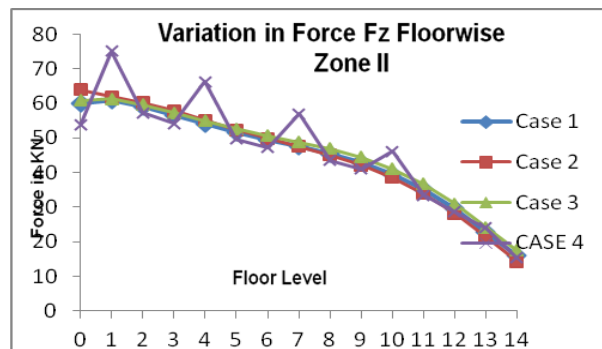
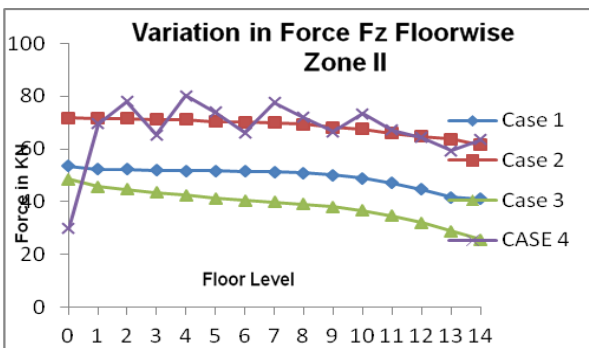
**AXIAL FORCE FOR INTERMEDIATE COLUMN**

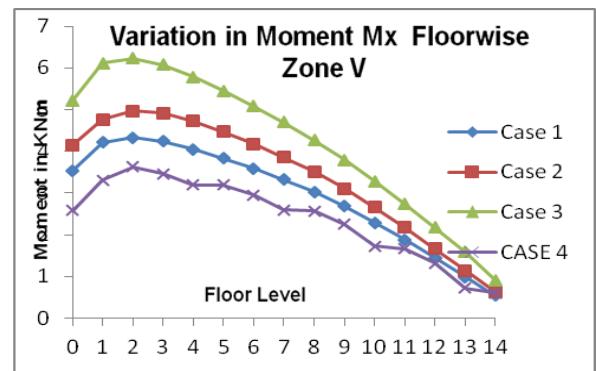
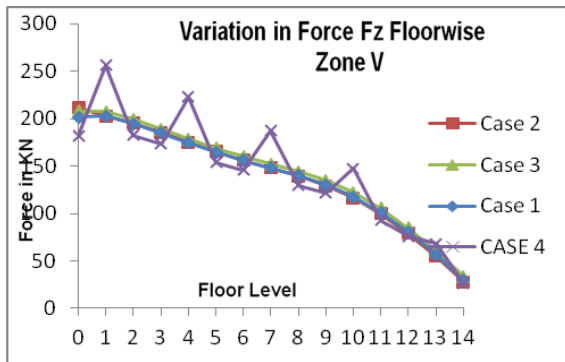
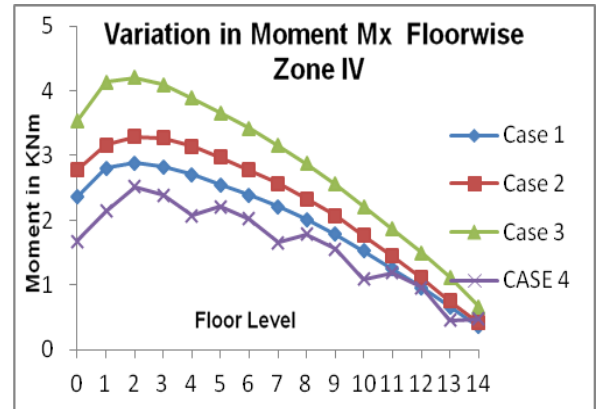
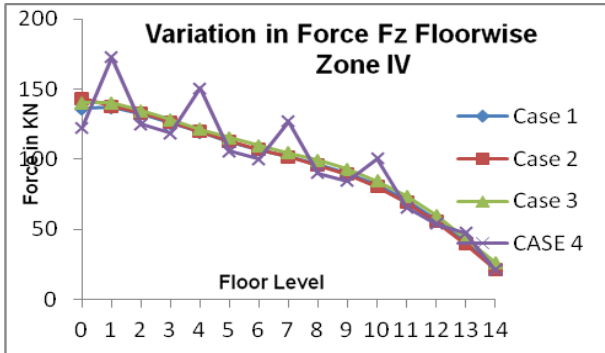
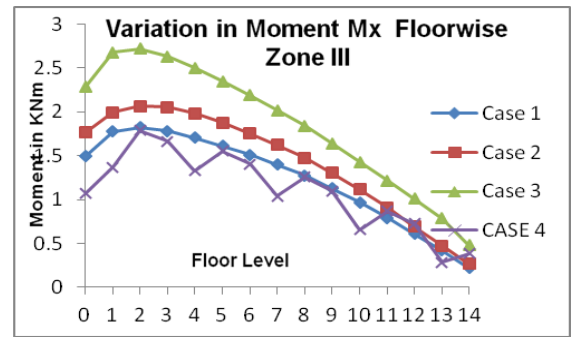
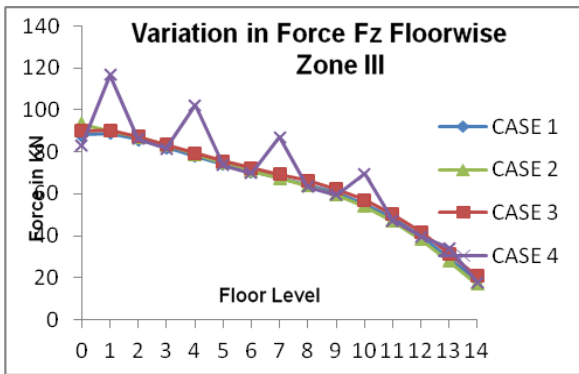




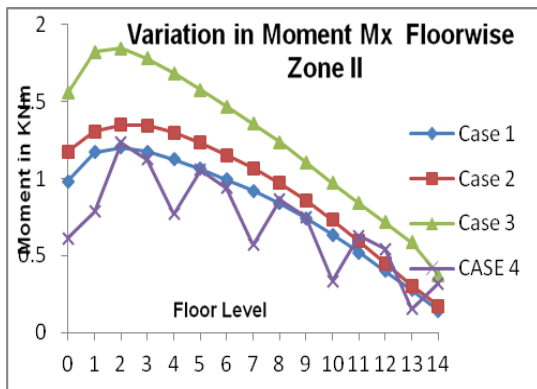
SHEAR FORCE CORNER COLUMN

SHEAR FORCE INTERMEDIATE COLUMN

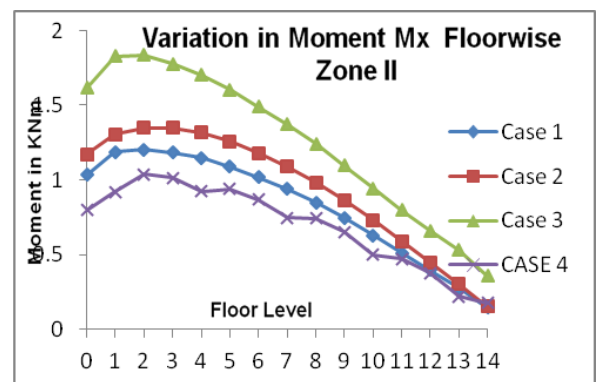


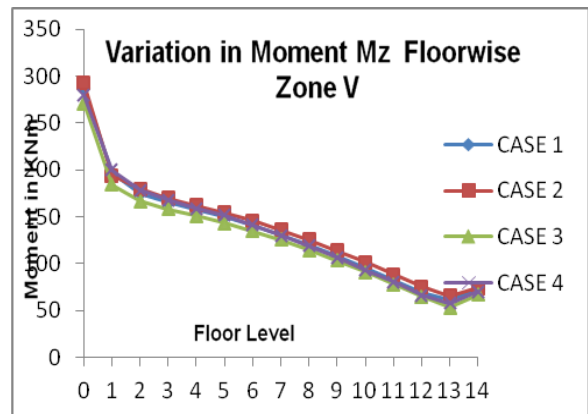
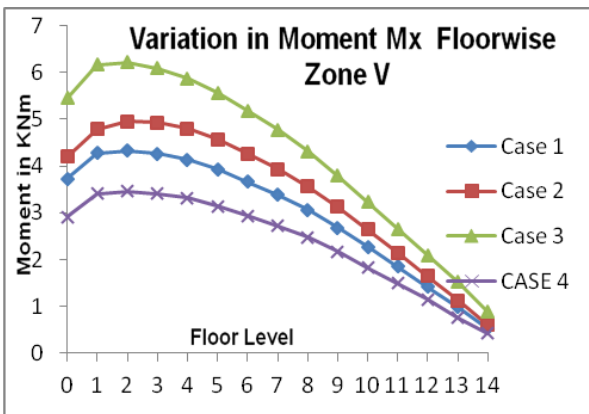
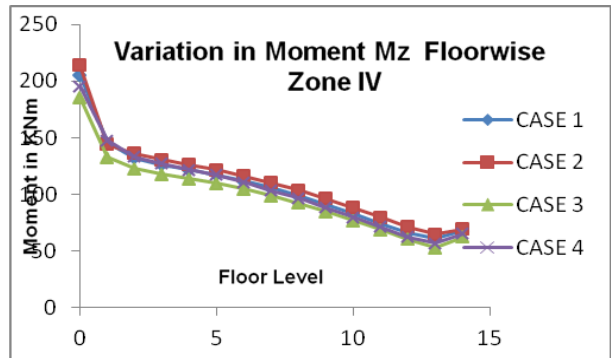
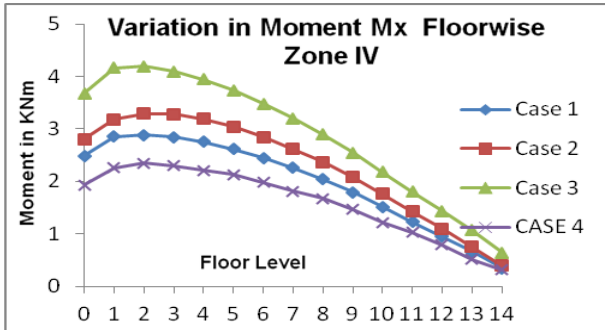
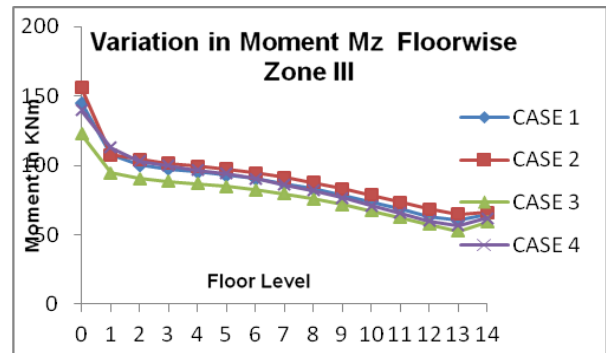
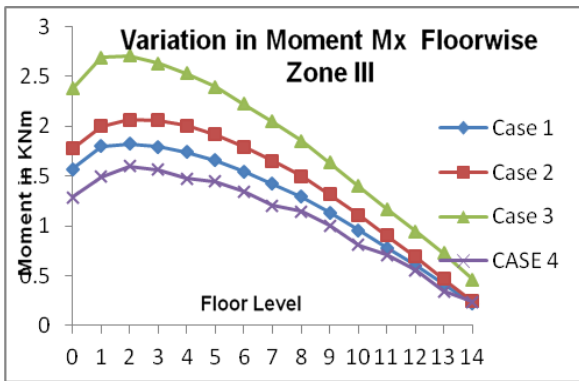


TORSION FOR CORNER COLUMN



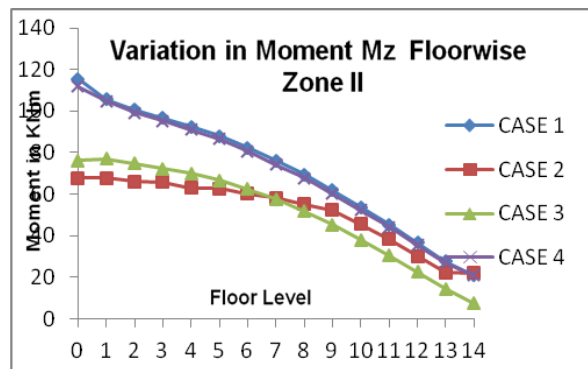
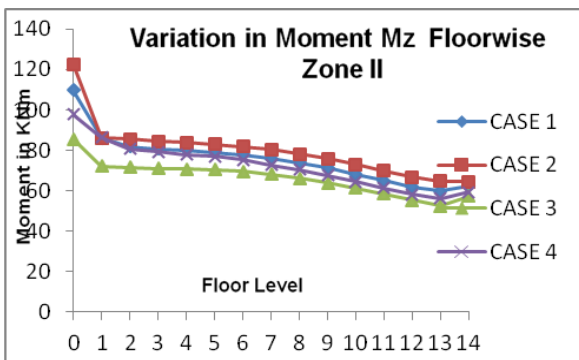
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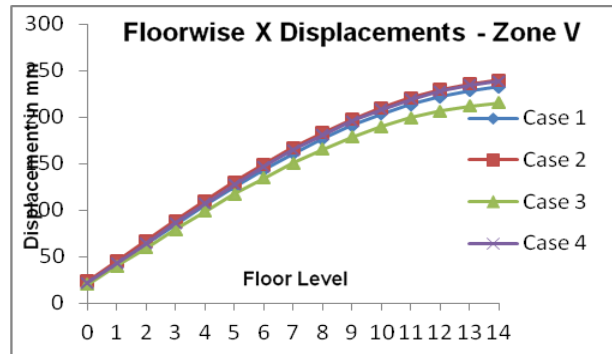
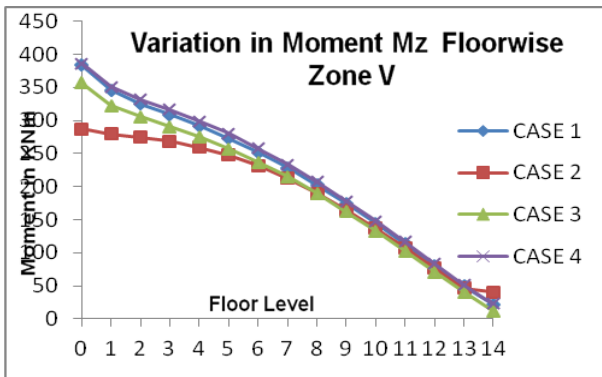
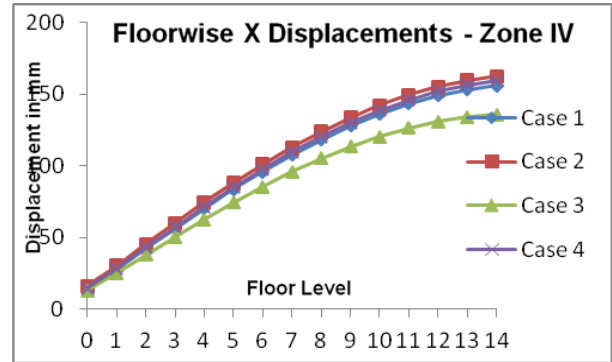
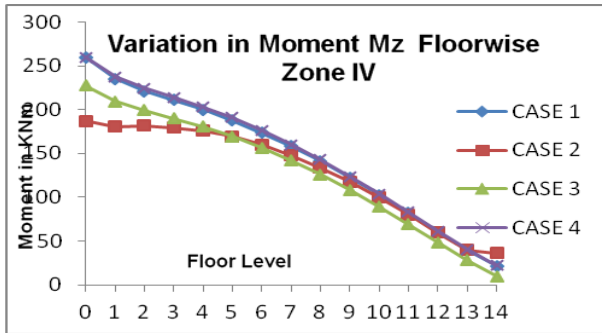
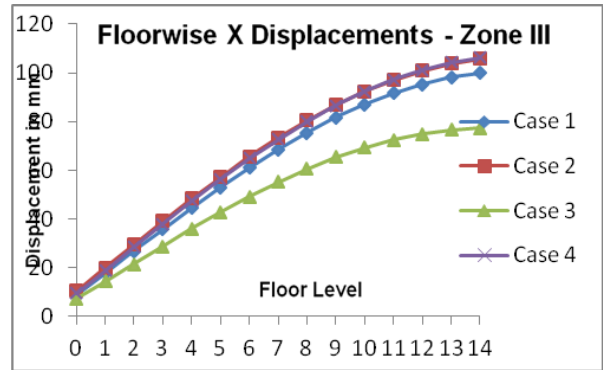
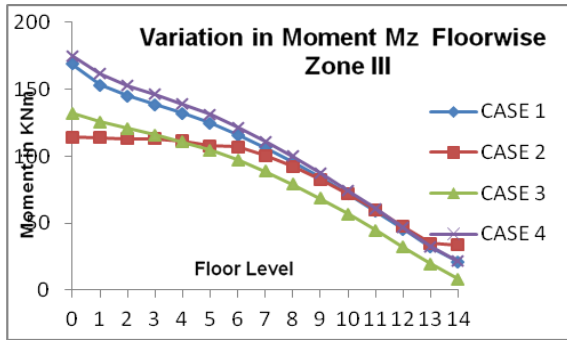




MOMENT MZ FOR CORNER COLUMN

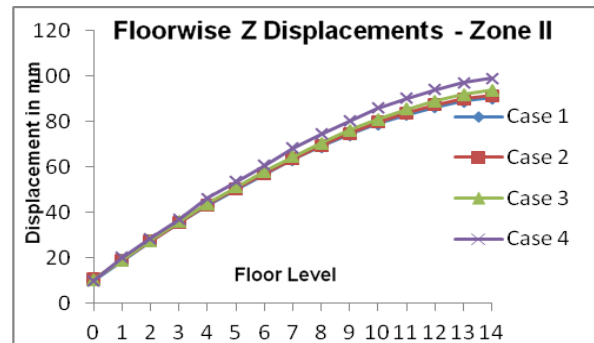
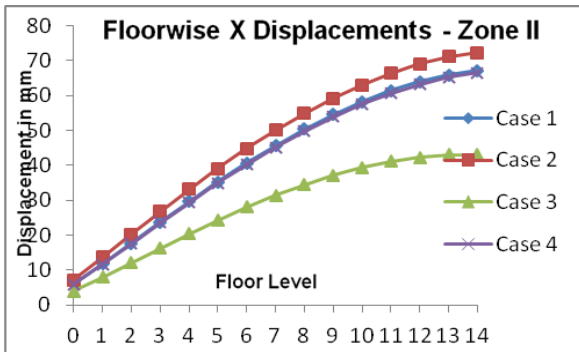
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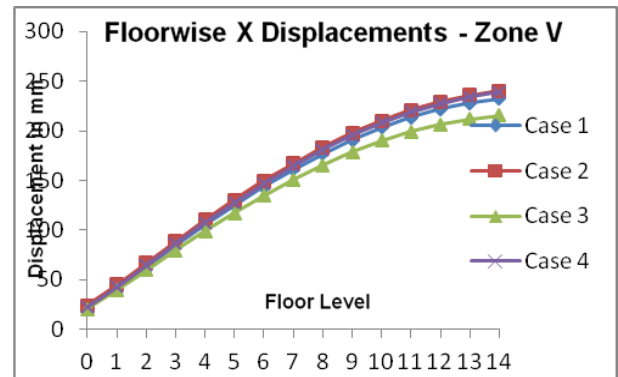
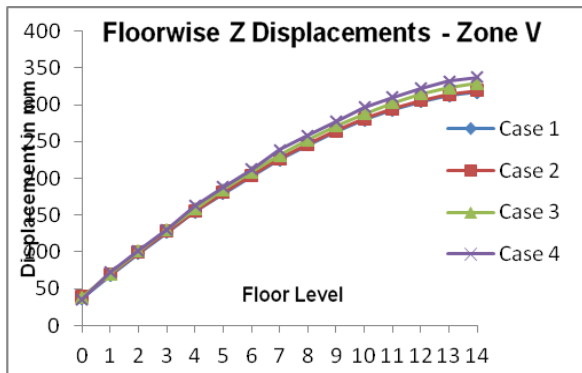
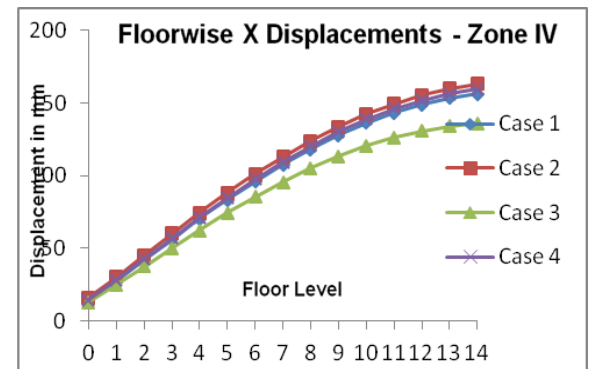
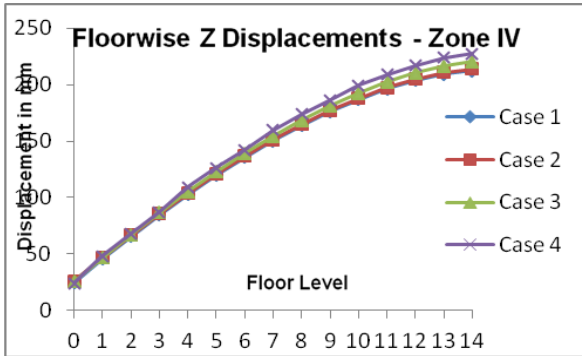
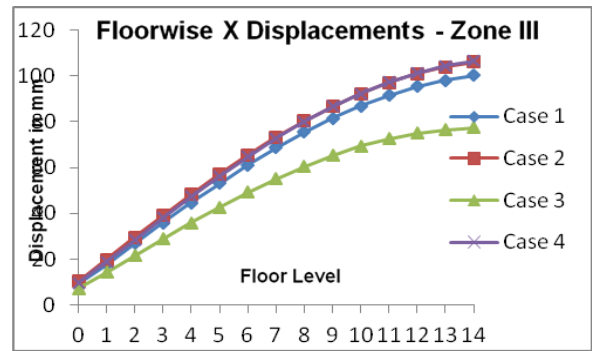
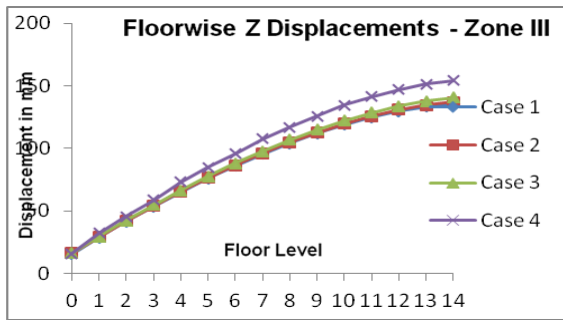




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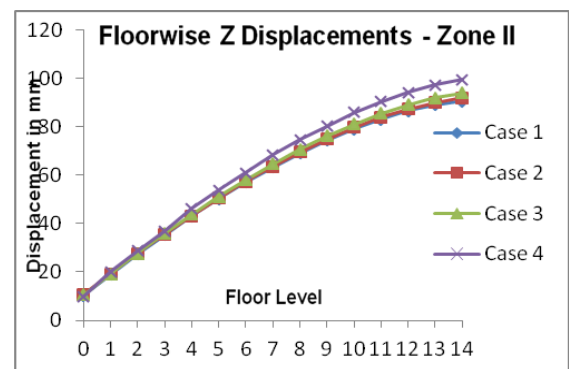
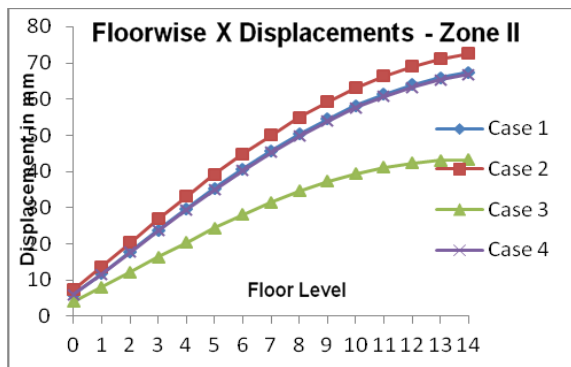
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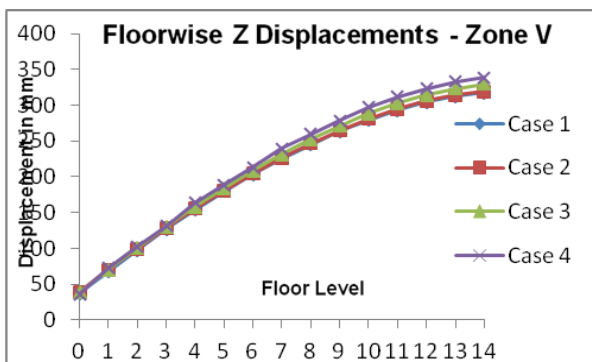
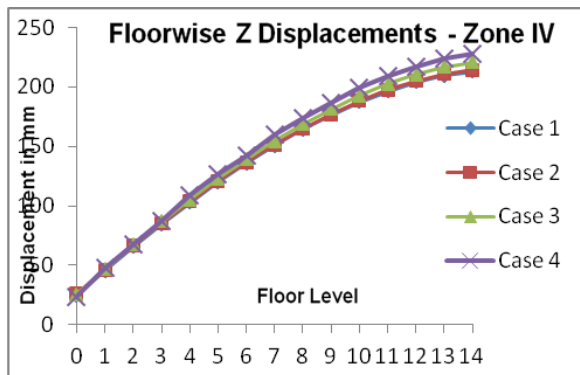
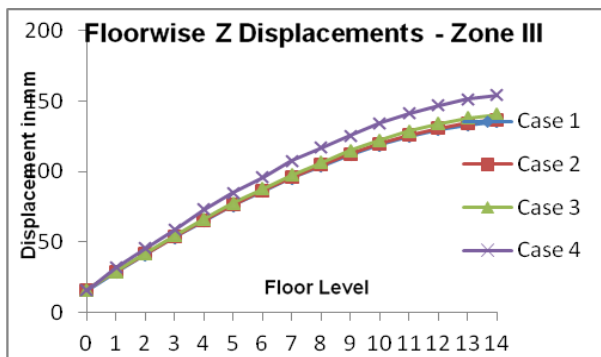


X DISPLACEMENT FOR INTERMEDIATE COLUMN

Z DISPLACEMENT FOR INTERMEDIATE COLUMN







### VIII. CONCLUSIONS

1. Provision of Case 2 (External Floating columns) and Case 4 (Alternate Floor Floating columns) may Increase Axial Force. And Shear in z direction (Fz) at all floors.
2. Critical load combinations were found, are  $1.5(DL+EQX)$  or  $1.5(DL+EQZ)$  Depending on position of floating columns.
3. With the provision of case 3 (External Floating Columns) and case 2 (Internal Floating Columns) May Increase  $M_x$  at all floors. & provision of case 4 (Alternate Floor Floating columns)  $M_x$  is less at all floor
4. With the provision of case 2 (Internal Floating Columns)  $M_z$  are very large at all floors & provision of case 3 (External Floating Columns) & case 4 (Alternate Floor Floating columns) may decreases  $M_z$  at all floor
5. Provision of Case 2 (External Floating columns) and case 4 (Alternate Floor Floating columns) may Increase displacements at various nodes.

### REFERENCES

- [1] Agarwal Pankaj, Shrikhande Manish (2009), Earthquake resistant design of structures, PHI learning private limited, New Delhi.
- [2] Jaswant N. Arlekar, Sudhir K. Jain and C.V.R. Murty, "Seismic Response of RC Frame Buildings with Soft First Storey's", Proceedings of the CBRI Golden Jubilee Conference on Natural Hazards in Urban Habitat, 1997, New Delhi.
- [3] Perna Nautiyal, Saleem Akhtar and Geeta Batham, "Seismic response evaluation of RC frame building with floating column considering different soil conditions", International Journal Of Current Engineering And Technology, E-ISSN: 2277 – 4106, (February 2014), Pp.132-138.
- [4] Awkar J.C. and Lui E.M (1997), Seismic analysis and response of multistory semi rigid frames, Journal of Engineering Structures, Volume 21, Issue 5, Page no: 425-442, 1997
- [5] Shaikh Abdul Aijaj Abdul Rahman<sup>1</sup>, Girish Deshmukh Seismic Response of Vertically Irregular RC Frame with Stiffness Irregularity at Fourth Floor International Journal of Emerging Technology and Advanced Engineering Volume 3, Issue 8, August 2013
- [6] IS 1893-2002 (Part I) Indian Standard Criteria for Earthquake Resistant Design of Structures (New Delhi, 2002)