

Analysis & behavior of RC Building Frame with Different Locations of Floating Columns

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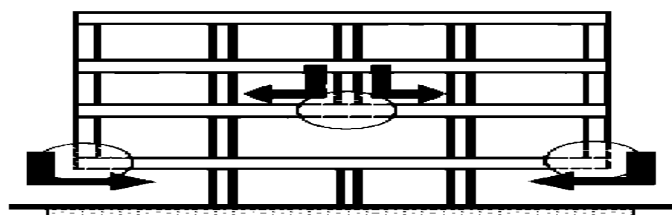
ABSTRACT: This paper represents a comparative analysis carried out to evaluate the performance of RCC frame building with different position of floating column along with the seismic analysis. Different models are structured up, each being sub-divided into various sub-models, showing the different positions of floating column at each storey. Through this analysis, the best position of the floating column is located in each case on the basis of Parameters taken. Also the equations are formulated such that the Maximum Displacement (in X & Z direction) along with Minimum Reaction (in Y direction) can be calculated up to 6 storeys SMRF (Special moment resisting frame) Building. The above building models are generated using the software STAAD Pro V8i.

KEYWORDS: Floating Column, STAAD-Pro, RCC frame, SMRF (Special moment resisting frame), FC (Floating column), ND (Node Displacement), NR (Node Reaction).

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 (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. As far as analysis is concerned, the column is often assumed pinned at the base and is therefore taken as a point load on the transfer beam. The transfer girders have to be designed and detailed properly, especially in earth quake zones. Here seismic analysis is carried out using simple equivalent static method.



International Journal of Innovative Research in Science, Engineering and Technology

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II. LOADING CONSIDERATION

A. LOADS ACTING ON THE STRUCTURE

Table 1: Loads on structure

LOADING	DESCRIPTION
Dead Load (DL) and live load (LL)	As per IS 875 (Part 1) (1987) and IS 875 , respectively.
DL	Self weight : Floor load (5 kN/m ²) and Wall load (20.9kN/m ²)
LL	3 KN/m ² (except terrace) and 2 kN/m ² for roof (terrace)

B. SEISMIC SPECIFICATIONS :

Table 2: Seismic Parameters

SEISMIC PARAMETERS	DESCRIPTION
Code used	IS 1893-2002/2005
Zone	V (0.36)
Response reduction factor	5
Importance factor	1.5
Rock and soil site factor	2
Damping Ratio	5%
Depth of foundation	2.5m

III. LITERATURE REVIEW

Ms. Priyanka D. Motghare [10]. has studied “Numerical studies of RCC frame with different position of floating column”. Srikanth.M.K & Yogeendra.R.Holebagilu [11] researched on “Seismic response of complex buildings with floating column for zone II and zone V”. Also Pratyush Malaviya & Saurav [12] have done “Comparitive study of effect of floating columns on the cost analysis of a structure designed on stadd pro v8i”. Ashwin Sanjay Balwaik’s [13] “Comparative Analysis of G+1 Structure With and Without Floating Column”. A theisis has been worked over [14] “Seismic analysis of multistorey building with floating column” by Sukumar Behera. Although nobody has concluded any equations in this term.

International Journal of Innovative Research in Science, Engineering and Technology

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IV. OBJECTIVE OF STUDY

- 1) To analyze an R.C. building frame using Staad pro. Software setup.
- 2) To study the behavior of multistory buildings with floating columns at different locations along with seismic forces.
- 3) To locate the best position of Floating column in the SMRF.

V. PROBLEM STATEMENT

- The entire work consists of four Cases (Case A, Case B, Case C, Case D). And these are modeled for the different position of floating columns. The results are analyzed using Node Displacement and Node Reactions as parameters.
- Each model is sub-divided into different cases with different positions of floating column.
- Every case is analyzed separately on the basis of node displacement and node reaction, taking the maximum values in each model.
- The height of basement is kept 2.5m while height of each storey is 3m.

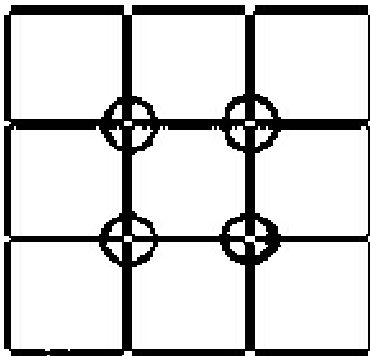


Fig. 2 (Plan) Position of Floating column

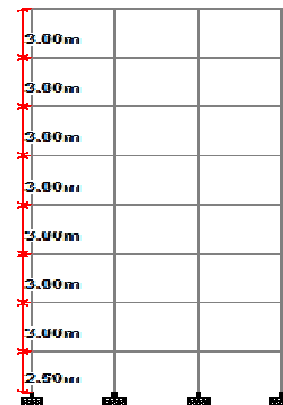


Fig.3 Elevation of structure considered

PRELIMINARY DATA:

Table 3: Preliminary data

SPECIFICATIONS	DESCRIPTION
Wall thickness (including Plaster)	300mm
Number of storey's	G+3 , G+5 , G+6 & G+10
Plan size	9m x 9m (Each grid size 3m x 3m)
Size of columns	400mm × 300 mm
Size of beams	350mm × 250 mm
Depth of slab	120mm
Floor to floor height	3.0m
Support condition	Fixed

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▪ MODELS:

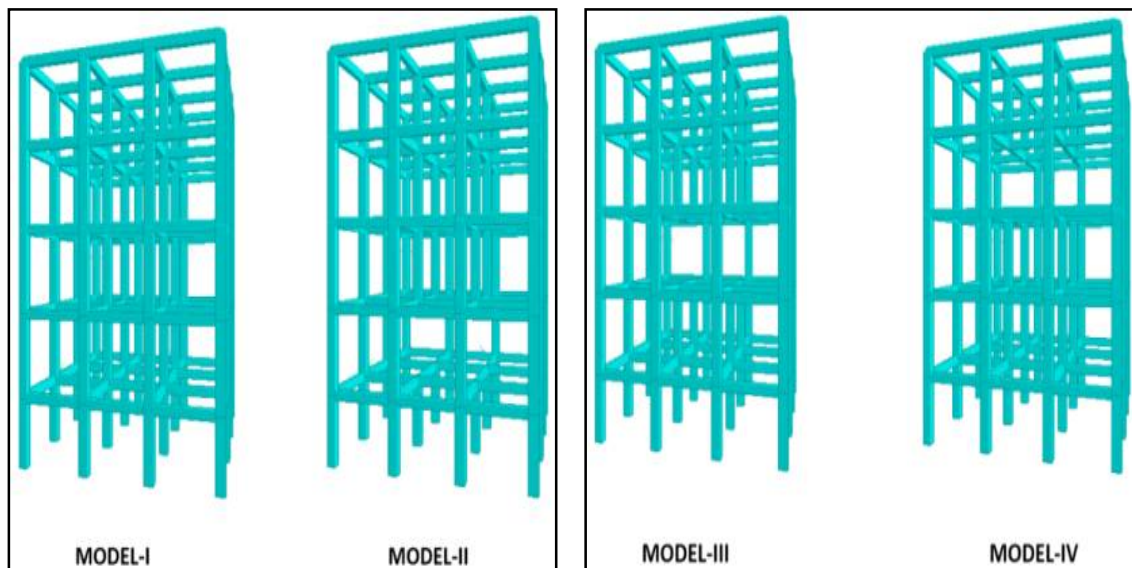


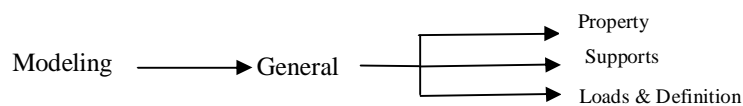
Fig 4 Basic G+3 storey framed

- Model I : Building with no FC
- Model II : FC at 1st floor
- Model III : FC at 2nd floor
- Model IV : FC at 3rd floor & similar for all other models.

VI. METHODOLOGY

Steps to model and analyze the R.C.C. building frame:-

- Firstly go to Run structure wizard and select bay frame. Then follow the steps given below:-



- Post-processing

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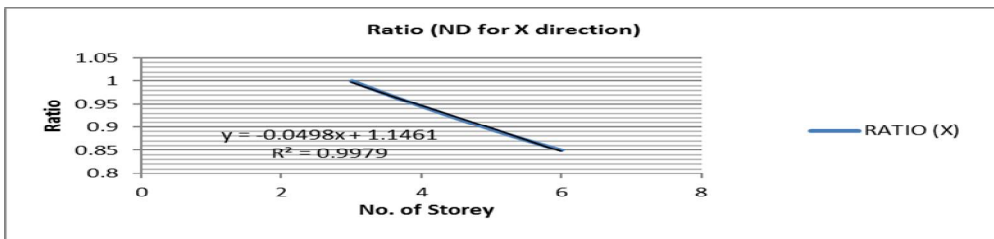
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VII. RESULT AND GRAPHS

➤ $X = \frac{\text{Total Height}}{\text{Max. Node displacement (in X direction)}}$

Table 4: Equation of y with variable x



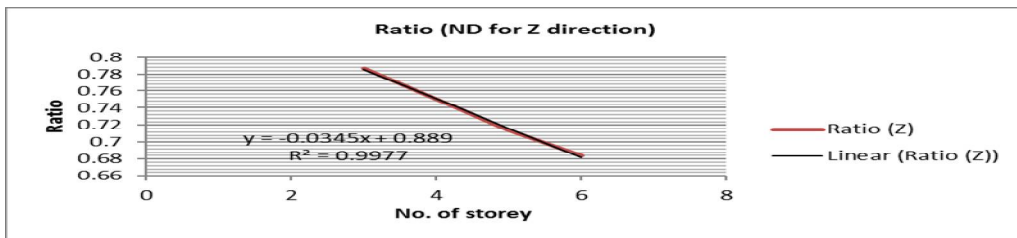
$y = -0.0498x + 1.1461$

Storey	Ratio (X)
3	0.999
4	0.945
5	0.894
6	0.85

Fig.5: Graph of node displacement equation for X direction

➤ $Z = \frac{\text{Total Height}}{\text{Max. Node displacement (in Z direction)}}$

Table 5: Equation of y with variable x



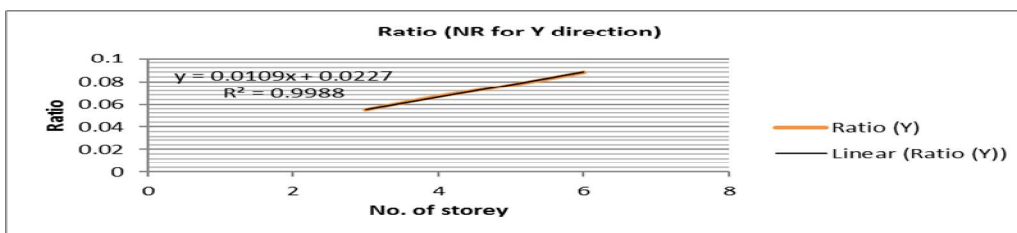
$y = -0.034x + 0.889$

Storey	Ratio (Z)
3	0.787
4	0.75
5	0.714
6	0.684

Fig.6: Graph of node displacement equation for Z direction

➤ $Y = \frac{\text{Total Height}}{\text{Max. Node Reaction (in Y direction)}}$

Table 6: Equation of y with variable x



$y = 0.010x + 0.022$

Storey	Ratio (Y)
3	0.055
4	0.067
5	0.077
6	0.088

Fig.7: Graph of node reaction equation for Y direction

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A. Maximum Node Displacement

Table 7: Node displacement values for case (A)

CASE-A (G + 3)		
Node displacement		
Description	X (91)	Z (82)
MODEL-I	13.140	16.594
MODEL-II	14.414	18.349
MODEL-III	14.511	18.419
MODEL-IV	14.295	18.101

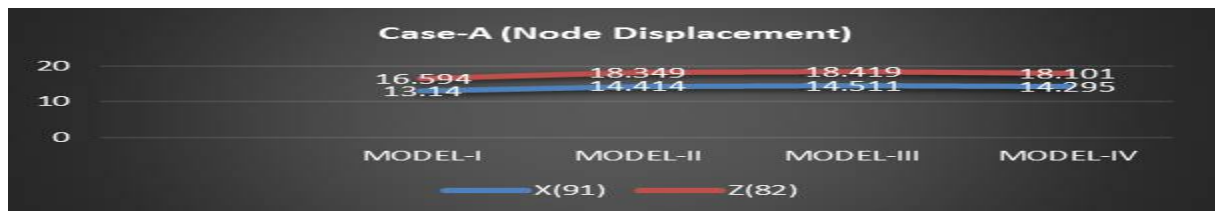


Fig. 8: Graph of node displacement for case (A)

Table 8: Node displacement values for case (B)

CASE-B (G + 4)		
Node displacement		
Description	X (107)	Z (99)
MODEL-I	17.103	21.416
MODEL-II	18.393	23.212
MODEL-III	18.528	23.338
MODEL-IV	18.425	23.174
MODEL-V	18.126	22.752

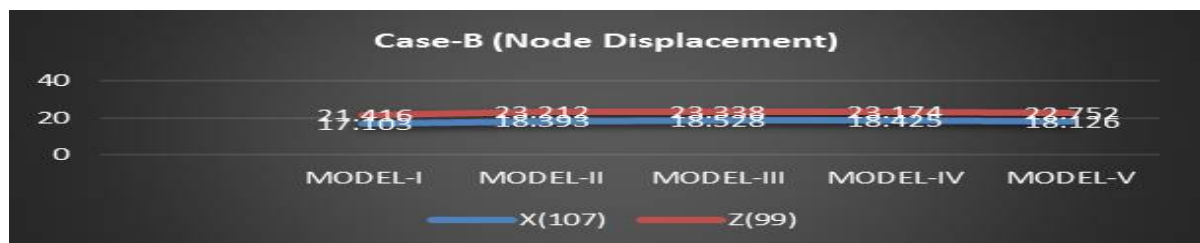


Fig.9: Graph of node displacement for case (B)

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Table 9: Node displacement values for case (C)

CASE-C (G + 5)		
Node displacement		
Description	X(123)	Z(114)
MODEL-I	21.468	26.701
MODEL-II	22.772	28.534
MODEL-III	22.932	28.694
MODEL-IV	22.884	28.611
MODEL-V	22.702	28.352
MODEL-VI	22.338	27.856

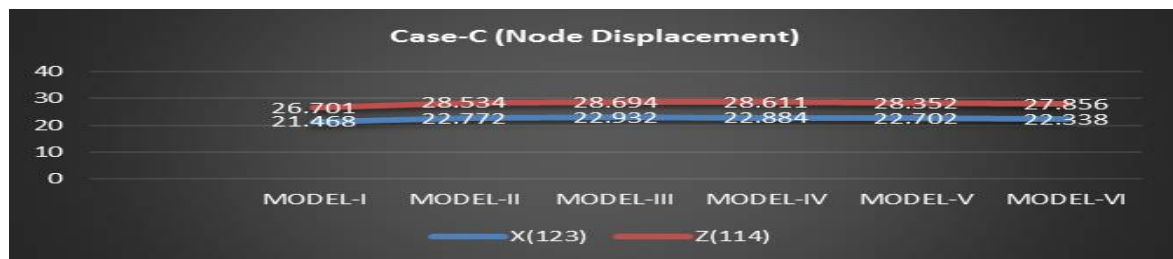


Fig.10: Graph of node displacement for case (C)

Table 10: Node displacement values for case (D)

CASE-D (G + 6)		
Node displacement		
Description	X(139)	Z(130)
MODEL-I	26.138	32.316
MODEL-II	27.461	34.184
MODEL-III	27.640	34.369
MODEL-IV	27.630	34.339
MODEL-V	27.521	34.183
MODEL-VI	27.286	33.858
MODEL-VII	26.891	33.324

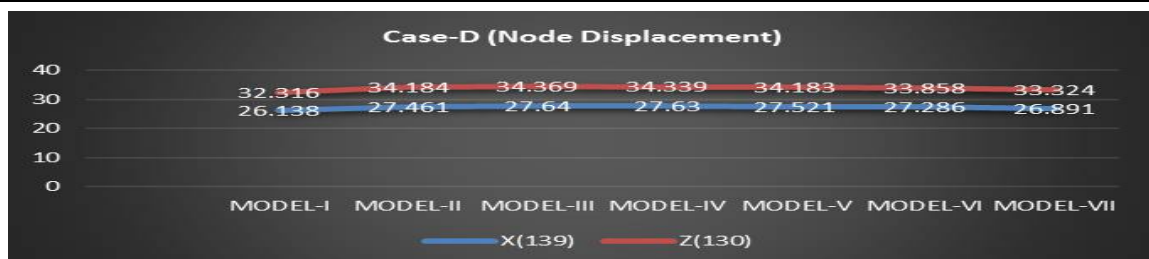


Fig.11: Graph of node displacement for case (D)

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B. Maximum Reaction

Table 11: Maximum Reaction values for case (A)

CASE-A	
Node reaction	
Description	Y(31)
MODEL-I	1148.269
MODEL-II	260.826
MODEL-III	533.706
MODEL-IV	792.934

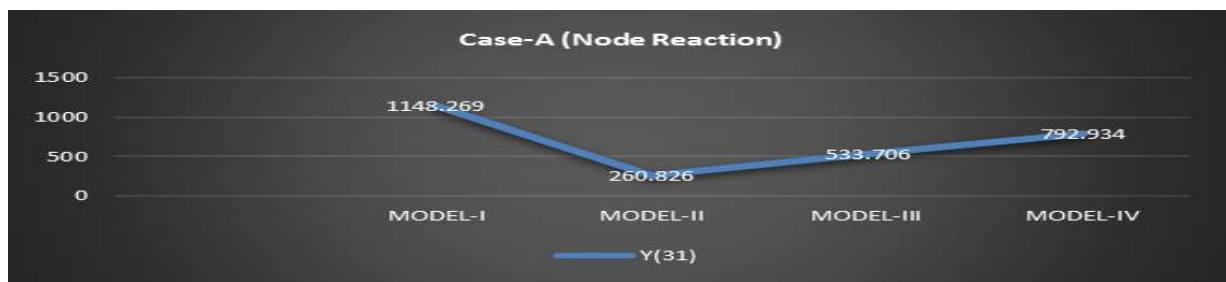


Fig.12: Graph of Maximum Reaction for case (A)

Table 12: Maximum Reaction values for case (B)

CASE-B	
Node Reaction	
Description	Y(29)
MODEL-I	1381.093
MODEL-II	263.130
MODEL-III	542.502
MODEL-IV	810.704
MODEL-V	1057.046

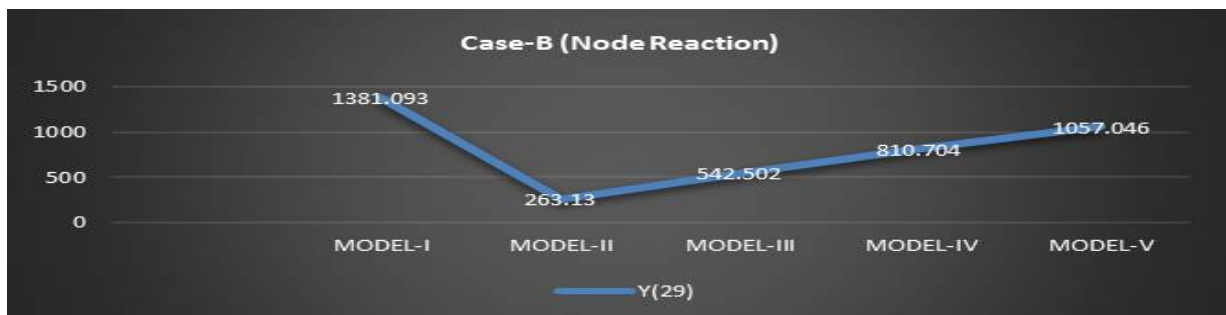


Fig.13: Graph of Maximum Reaction for case (B)

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Table 13: Maximum Reaction values for case (C)

CASE-C	
Node reaction	
Description	Y (31)
MODEL-I	1569.915
MODEL-II	265.440
MODEL-III	550.574
MODEL-IV	827.314
MODEL-V	1083.781
MODEL-VI	1311.737

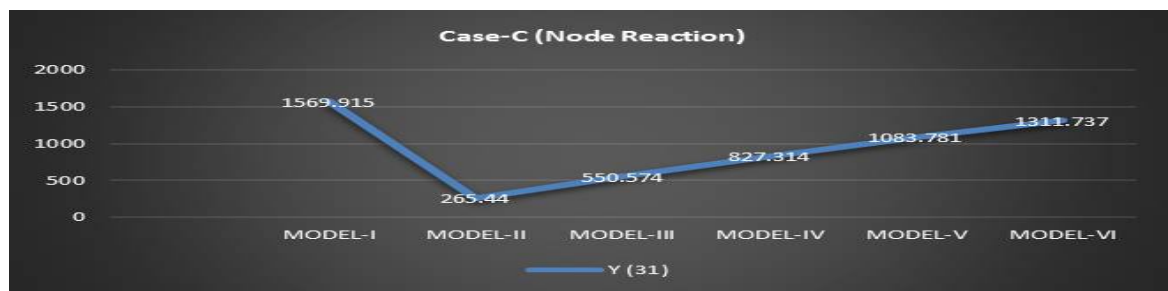


Fig.14: Graph of Maximum Reaction for case (C)

Table 14: Maximum Reaction values for case (D)

CASE-D	
Node reaction	
Description	Y(29)
MODEL-I	1790.623
MODEL-II	267.592
MODEL-III	558.963
MODEL-IV	844.861
MODEL-V	1112.816
MODEL-VI	1353.345
MODEL-VII	1561.623

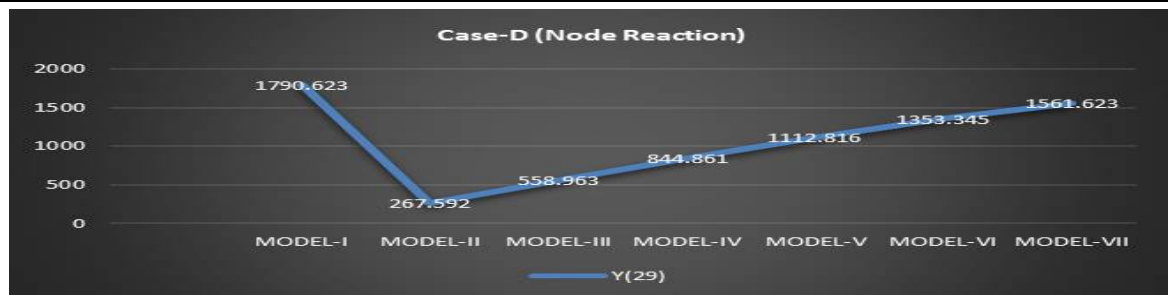


Fig.15: Graph of Maximum Reaction for case (D)

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VIII. DISCUSSIONS

A. Node Displacement

- The structure with floating column is subjected to maximum displacement comparative to the structure without floating column.
- It is found that in every case as the storey increases, the maximum node displacement is found in Model III (i.e., floating column at 1st storey).
- Most reduced node displacement is found in the last model for every case, when FC is provided at the top storey.

B. Node Reaction

- In every case model II has minimum reaction.
- Apart from model I, last model has max. Reaction.

IX. CONCLUSION

Following conclusion can be drawn from the analysis of R.C. frame building with the different position of floating column upto 6 storeys considering the specifications taken are similar:

- ✓ Since node displacement is maximum in Model III and the reaction is minimum in model II, so it shows that the floating column when provided near ground level is most hazardous. Therefore the best position of floating column is the top storey.
- ✓ From the analysis, following 3 equations are found :

$$1. y = -0.049x + 1.146 \quad \text{----- (for node displacement in x-direction)}$$

$$2. y = -0.034x + 0.889 \quad \text{----- (for node displacement in z-direction)}$$

$$3. y = 0.010x + 0.022 \quad \text{----- (for node reaction in y-direction)}$$

With the help of above equations we can find the maximum node displacement and the minimum node reaction for any building up to 6 storey provided that the specifications are similar.

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ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

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