A Study on Seismic Analysis of Multistorey Building With Floating Column Under Seismic Zone 3 And Zone 4

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Abstract- *Nowadays in this modern construction technology in India the demand for floating column structures is increasing day by day. But these type of structures are very difficult to be built in high seismic zones. This project helps to understand the behaviour of floating column structure in various zones as per Indian Standards.*

In this project 6 models of zone-3 and 6 models of zone-4 are created. Two models include building without floating column. 10 models include building with floating columns at various floor lavels in various models. These models are analysed and designed in zone-3 and zone-4 by pushover analysis using ETABS v9.5.0. Results are compared in terms of roof displacement, storey drift, column axial force, base shear and fundamental periods in all models and also the zone wise comparison is made and the graphs are plotted

Keywords- Etabs, Floating Column, Rcc Building, Pushover Analysis, Storey Drift, Roof Displacement, Column Axial Force,

I. INTRODUCTION

In many urban areas of India, most of the multistory building have provided their first storey for parking purpose. When an earthquake occurs, total base shear experienced by a building depends upon its natural period. The seismic force distribution depends upon the stiffness distribution and the mass along the heights.

During an earthquake behaviour of building depends upon overall Shape, size and the geometry. During an earthquake the forces which are developed at floor levels is to be carried down to the ground level by the shortest path and discontinuity in the transfer of load results in poor performance. Buildings such as hotel buildings in which few storey were wider than the other leads to a sudden jump at the time of earthquake due to forces of earthquake at the discontinuity level.

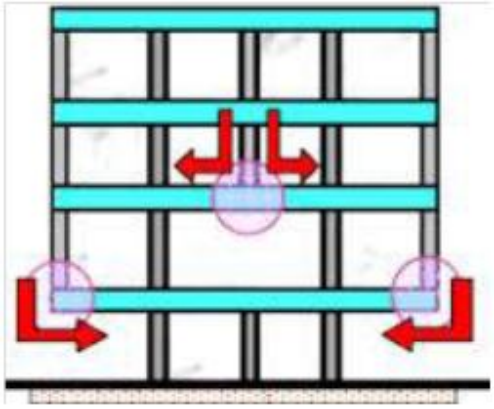


Fig. 1 : Floating Column Structure

Buildings that has less number of columns or the walls in that particular storey or in the tall storey tends to damage. Many of the buildings which are provided ground storey as for parking purpose were severely damaged or collapsed in Gujrat in 2011 by Bhuj earthquake. Buildings in which the columns hangs or floats at intermediate storey and do not carried out to the foundation leads to discontinuity in the load transfer.

OBJECTIVE OF THE STUDY

The main aim of this project is to compare the response of mulistorey building with and without floating column under various earthquake zones (zone-3 and zone-4). The major objectives of this project are

1) To compare the seismic behaviour of multistory building with and without floating column.
2) To compare the seismic behaviour of RC building in zone-3 and zone-4 with and without floating column.
3) To compare storey drift, base shear, column axial axial force, roof displacement and fundamental period under zone-3 and zone-4.

II. LITERATURE REVIEW

2.1 GENERAL:

REVIEW:

1) Maison and Neuss (1984)

Maison and Neuss (1984) are the members of ASCE who have carried out the computer analysis of fourty four storey existing steel framed high rise building to examine the influence of building which was modelled by various aspects on the predicted dynamic properties and computed the response of seismic behaviours. The dynamic properties which are predicted are compared to true properties of the building which was determined previously by experimental testing. The behaviour of the seismic response is computed by equivalent static load method and response spectrum method.

2) Shrikanth M.K, Yogendra.R.Holebau :

The study in this paper is to compare the behaviour of building having only the floating columns without any complexity and other with complexities. High rised building is analysed for the earthquake forces. Four models are created and are being analysed for higher zones and lower zones with medium soil condition. The analysis of which was done by Extended Three Dimensional Analysis of building system ETABS version 9.7.4 software. The results of these four models are shown in terms of storey drift, soft storey and displacement and are tabulated on the basis of linear seismic analysis.

3) Hardik Bhonsdadia, Siddhart Shah :

The study in this paper is to show the effects of the floating columns and soft storey by seismic analysis under various zones. In order to obtain the performance level of the building for the design capacity, pushover analysis method is selected and is carried out upto the failure. To reach these objectives, three RC bare framed structures such as G+4, G+9 and G+15 stories are selected respectively and these will be analysed and compared with the displacement and base force of G+3, G+9 and G+15. RC bare framed structures were analysed under various earthquake zones such as Rajkot, Jamnagar and Bhuj by using SAP 2000 14 analysis.

4) Er. Ashfi Rahman :

In this the multistoreyed building with and without floating column is analysed by using static analysis and dynamic analysis using response spectrum method. By altering the location of floating column floor wise and within the floor the building with different cases is studied. The structural response of building model under different cases with respect to spectral acceleration, storey drift, fundamental time period, storey displacement and base shear is investigated. The analysis was carried out by STAAD Pro V8i software.

III. ANALYTICAL MODELING

3.1 General:

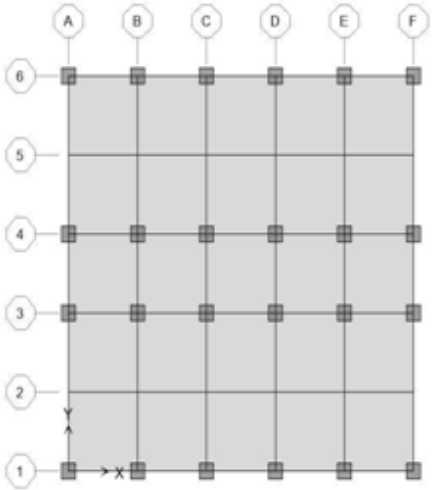
In this project the analysis of all the models were carried out as per Indian standard codes and ETABS v9.5.0 is used for analysis.

Description of the Models :

My project includes G+15 storey building with 6 models under zone-3 and zone-4 with and without floating column.

1) **Model 1:** It includes G+15 storey building without any floating column i.e normal building in zone-3 and zone-4.
2) **Model 2 :** It is a G+15 storey building with floating column at ground floor in zone-3 and zone-4. In this model column and beam sizes are increased from bottom to second floor.
3) **Model 3** : In this model floating column is provided in first floor under zone-3 and zone-4 by increasing sizes of beams and columns from ground floor to third floor.
4) **Model-4 :** In this model floating column is provided in second floor under both zones. Larger sizes of beams and columns are used from ground floor to fifth floor.
5) **Model-5 :** In this model floating column is provided in eighth floor in both zones without changing sizes of beams and columns .
6) **Model-6** : In this model floating column is provided from ground floor to third floor by increasing the size of surrounding columns.

Type of structure	RC framed structure
Type of model	Non floating column
Plan	15m x15m
Number of bays	5
Size of each bay	3m
Number of storeys	G+15
Storey Height	3.2m
Grade of concrete :	M40
Grade of steel	Fe500
Size of beam	450x450
Size of column	400x400
Slab thickness	150mm
Wall thickness	230mm
Load calculation	
Self weight of wall on each floor	11.38 KN/Sq.m
Live load	3 KN/Sq.m
Floor finish	1 KN/Sq.m
Earthquake analysis using IS:1893:2002 for zone-3	
Seismic zone	III
Zone factor	0.16
Importance factor	1
Response reduction factor	5
Soil type	Medium
Earthquake analysis using IS:1893:2002 for zone-4	
Seismic zone	IV
Zone factor	0.24
Importance factor	1
Response reduction factor	5
Soil type	Medium



In all the models, floating columns are provided at same locations in different floors

Type of structure	RC Framed structure
Type of model	Floating column in ground floor under zone-3 and zone-4
Plan	15m x15m
Number of bays	5
Size of each bay	3m
Number of storeys	G+15
Storey Height	3.2m
Grade of concrete :	M40
Grade of steel	Fe500
Size of beam	1) 450x450 2) 600x700
Size of column	1) 400x400 2) 600x600
Slab thickness	150mm
Wall thickness	230mm
Load calculation	
Self weight of wall on each floor	11.38 KN/Sq.m
Live load	3 KN/Sq.m
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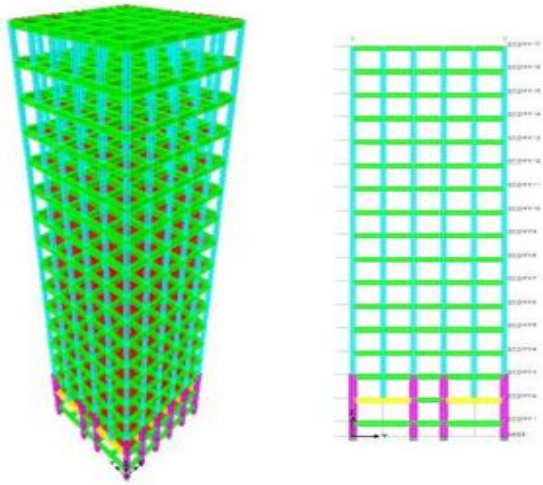
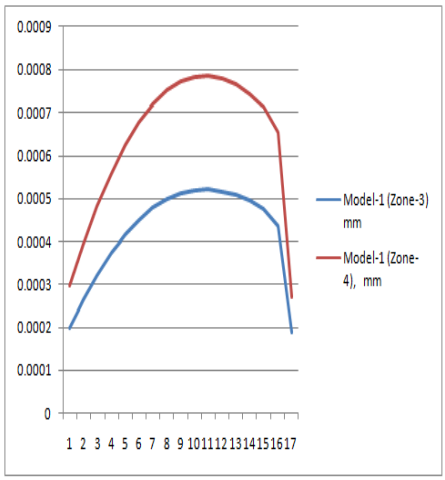
Seismic zone	IV
Zone factor	0.24
Importance factor	1
Response reduction factor	5
Soil type	Medium

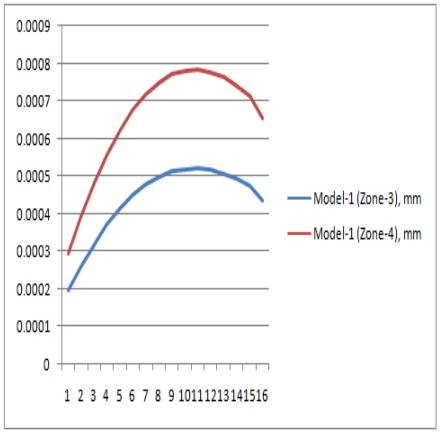


3D and Elevation view

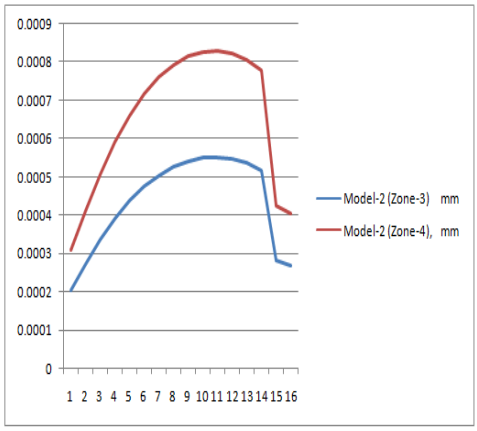
STOREY DRIFT



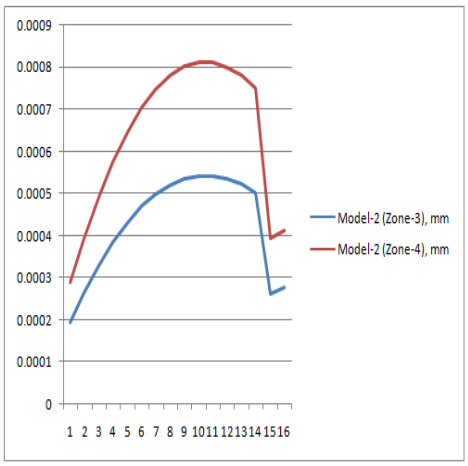
Storey drift for model-1 in x direction



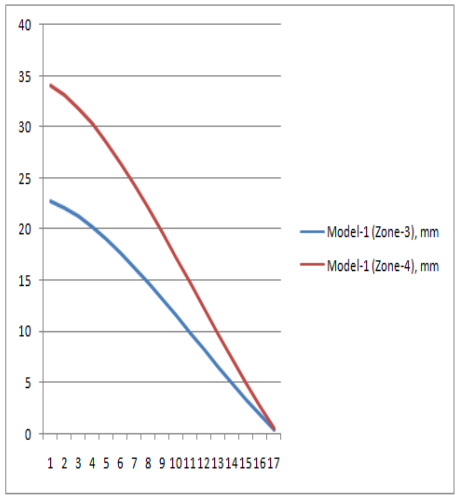
Storey drift for model-1 in y direction



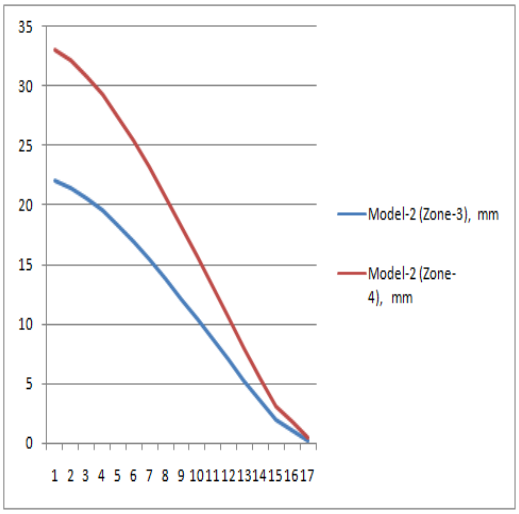
Storey drift for model-2 in x direction



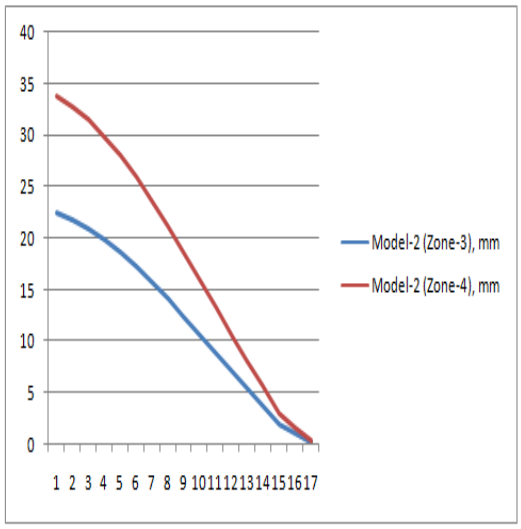
Storey drift for model-2 in y direction



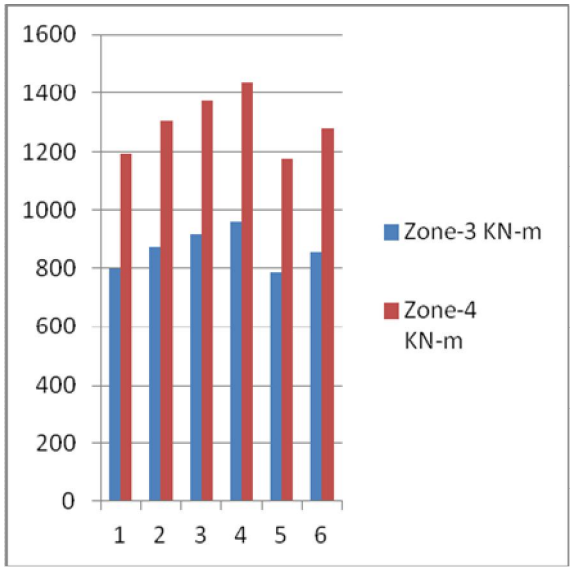
Storey displacement for model-1 in x direction



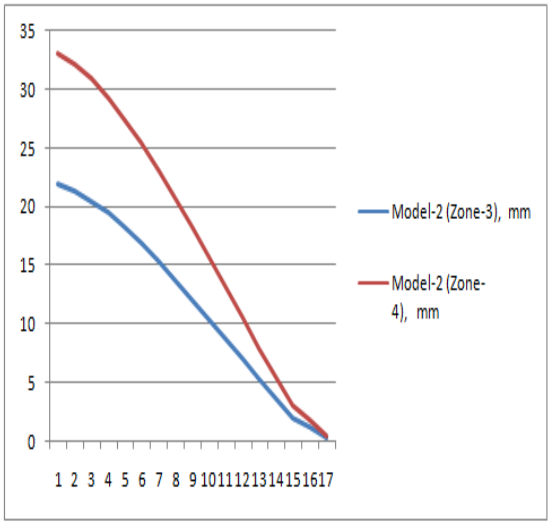
Storey displacement for model-1 in y direction



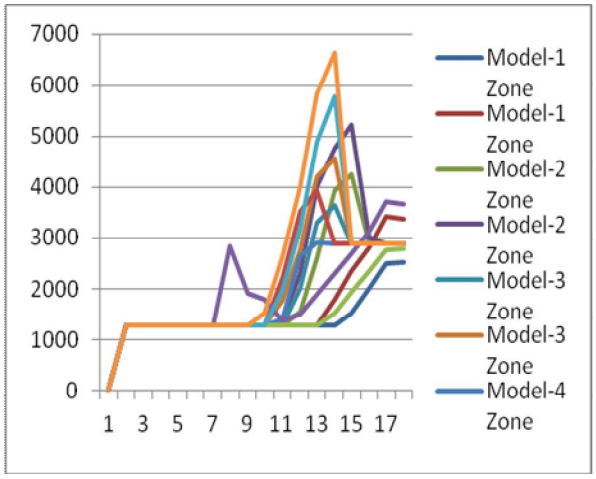
Storey displacement for model-2 in x direction



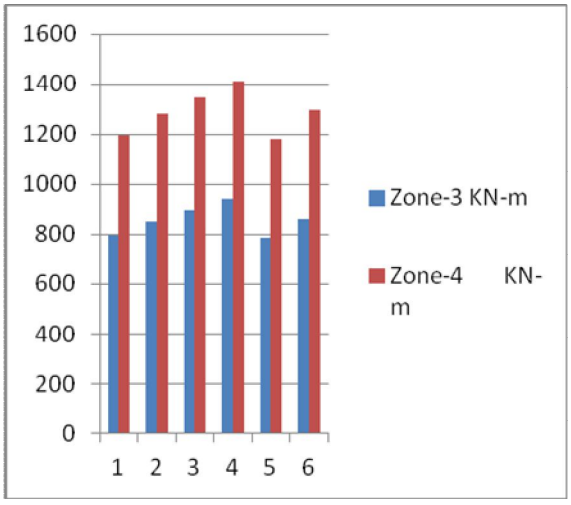
Comparision of base shear in y direction



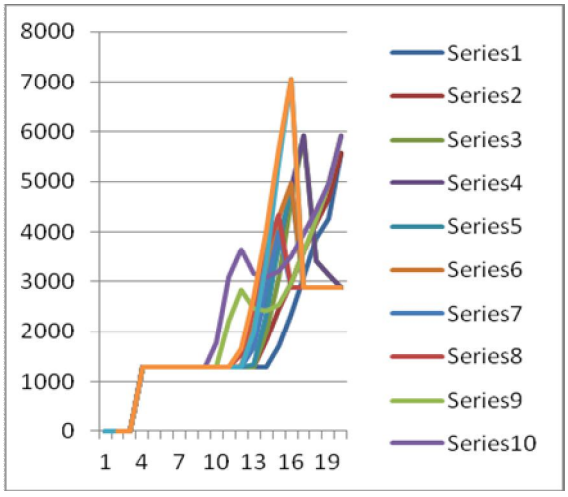
Storey displacement for model-2 in y direction



Comparision of axial force of corner column in zone 3 and zone 4

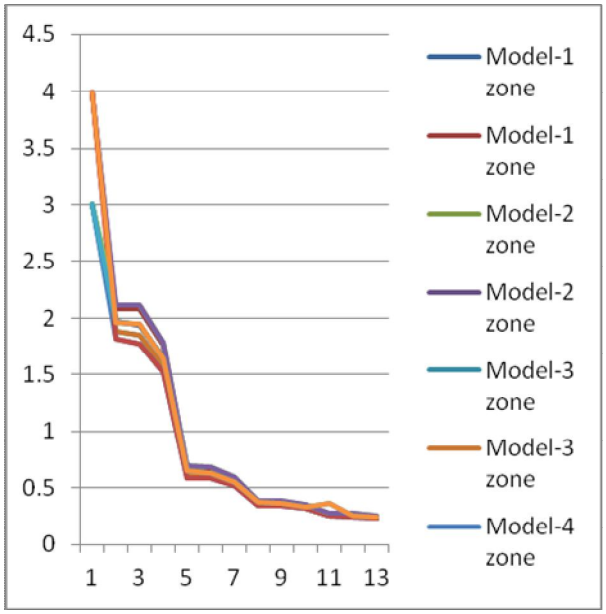


Comparision of base shear in x direction



Comparision of axial force of intermediate column in zone 3 and zone 4

FUNDAMENTAL PERIOD



Comparison Of Fundamental Period Of All Models In Zone-3 And Zone-4

IV. CONCLUSION

1) In model-1 i.e, structure without floating column, displacement is lesser in zone-3 as compared to zone-4. In models 2,3,4,5,6 displacement is lesser in zone-3 and higher in zone-4
2) In case of floating column structure fundamental period is lower as compared to that of normal structure. It is higher in model-5 as compared to all other models.
3) In all the models under zone 3 base shear and column axial force is lesser as compared to the zone 4. Base shear slightly decreases by providing floating columns in middle floors. Axial force is higher in the column above the floating column floor.
4) By providing floating columns in middle floor i.e, in model 5, the structure behaves well in terms of storey drift, column axial force, base shear, roof displacement, fundamental period as compared to the floating columns in lower floors.
5) Performance point of the building is less in zone-3 as comapared to zone-4
6) In zone 3 displacement at first hinge is slightly more as compared to zone 4.
7) Base force at first hinge is more in zone 3 as compared to zone 4.

REFERENCES

[1] Maison Bruce F. and Neuss Carl F. : "Dynamic analysis of a fourty four storey building," Journal of structural engineering, Vol. 111, No. 7, page No. 1559-572, July 1985
[2] Srikanth M.K. Yogendra.R.Holebagilu, "Seismic Response of complex buildings with Floating column for zone II and zone V", International journal of Engineering Research-online, Vol.2., Issue.4, 2014, ISSN:2321-7758.
[3] Hardik.Bhansdadia Pushover analysis of RC structure with floating column and soft storey in different earthquake zones, frame International Journal of Research
[4] Er. Ashfi Rahman Special class of open ground storey RC building built in India unsafe during earthquake 67 Department of Civil Engineering, IIT Madras
[5] Prerna Nautiyal (2014)- Seismic Response evaluation of RC framed building with floating column considering different soil conditions, International Journal of Current Engineering and Technology, Vol.4. No.1.
[6] Criteria for Earthquake Resistant design of structures part1: General provisions and buildings, IS 1893:2002 Bureau of Indian Standards, New Delhi.
[7] IS 875 (Part-I) Bureau of Indian Standards (1987) Code of practice for Design Loads (other than Earthquake) for Buildings and Structures: Dead loads-Unit weights of Building Materials and Stored Materials (Recond Revision).
[8] IS 875 (Part-I) Bureau of Indian Standards (1987) Code of practice for Design Loads for Buildings and Structures: Imposed loads (Recond Revision).
[9] IS 456-2000 Code of practice for general structural use of plain and Reinforced concrete.