Influence of Flouting Column on the Seismic Analysis of High Rise Building

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Abstract— Now a day's lots of multistory buildings are constructed with floating column for aesthetic point of view and for getting more space at parking areas for movement. But such building are highly get damaged during earthquake in highly seismic zone as compared to normal building. In this paper present study about analysis of the building considered is a multistory building having G+4, G+7 and G+9 structures. Building with and without floating column in highly seismic zone III and IV. Models are created such as floating column 4 Bay & 15 Story Structure. Linear static and time history analysis are carried models of seismic parameter such as Analysis results in the form of base shear, displacements, bending moment and support reactions at the ends have been drawn. Comparative analysis of results in terms of maximum moments in columns and beams, base shear, displacements, support reactions at the ends, story drift and CPU time. Modeling and analysis done by using STADD-PRO. software.

Key words: Floating Column, Linear Static, Base Shear, Displacements, Bending Moment, Support Reactions, STADD-PRO

I. INTRODUCTION

Many urban multi storey buildings in India today have open first storey as an unavoidable feature. This is primarily being adopted to accommodate parking or reception lobbies in the first storey. Whereas the total seismic base shear as experienced by a building during an earthquake is dependent on its natural period, the seismic force distribution is dependent on the distribution of stiffness and mass along the height.

The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path; any deviation or discontinuity in this load transfer path results in poor performance of the building. Buildings with vertical setbacks (like the hotel buildings with a few storey wider than the rest) cause a sudden jump in earthquake forces at the level of discontinuity. Buildings that have fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey. Many buildings with an open ground storey intended for parking collapsed or were severely damaged in Gujarat during the 2001 Bhuj earthquake. Buildings with columns that hang or float on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer path home, think of the hull as the foundations of a house. It needs to be strong, require little or no maintenance, and be financially viable. Whether it be for a residential floating home, office, restaurant, clubhouse or other commercial structure there are many benefits in using a floating Column built using materials that are already used in the construction industry for the rest of the superstructure. In Canada, floating foundations made with concrete and EPS are not classed as vessels so they are insured as standard buildings.

A. What is floating column

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 In recent times, multi-storey buildings in urban cities are required to have column free space due to shortage of space, population and also for aesthetic and functional requirements. For this buildings are provided with floating columns at one or more storey. These floating columns are highly disadvantageous in a building built in seismically active areas.

B. Objective

The objectives of this study are as follows:

1) To compare the modal response of all the models (Mode shapes, Time period, Frequency).
2) To Analysis results in the form of base shear, displacements, bending moment and support reactions at the ends have been drawn.

II. LITERATURE REVIEW

Current literature survey includes earthquake response of multi storey building frames with usual columns. Some of the literatures emphasized on strengthening of the existing buildings in seismic prone regions.

Ms. Waykule. S. B et al [14] (2016) studied about analysis of G+5 Building with and without floating column in highly seismic zone v. four models are created such as floating column at 1st ,2nd,and 3rd floor buildings and without floating column building. Linear static and time history analysis are carried out of all the four models .from linear static analysis compare all the of models result obtained in the form of seismic parameter such as time period, base shear, storey displacement, storey drift .and from time history analysis plot the response of all the models .modeling and analysis done by using sap 2000v17 software.

Shiwli Roy, Gargi Danda de[15] (2015) Studied about RCC concrete column means cement concrete reinforced with steel bars, steel plates, steel mesh etc. to increase the tension withstanding capacity of the structure. The term floating column means that the column is floated between two floors. Various types of structures G+3, G+5

and G+10 for RCC column and floating column are analyzed. The difference between G+3, G+5 and G+ 10 structures are shown by graphs and charts. Comparison will be done on bending moment and shear force between these structures. This paper presents the analysis of floating column and RCC column by using STAAD PRO V8i.

Niroomandi, Maheri, Maheri & Mahini [13] (2010) retrofitted an eight-storey frame strengthened previously with a steel bracing system with web- bonded CFRP. Comparing the seismic performance of the FRP retrofitted frame at joints with that of the steel X-braced retrofitting method, it was concluded that both retrofitting schemes have comparable abilities to increase the ductility reduction factor and the over-strength factor; the former comparing better on ductility and the latter on over-strength. The steel bracing of the RC frame can be beneficial if a substantial increase in the stiffness and the lateral load resisting capacity is required. Similarly, FRP retrofitting at joints can be used in conjunction with FRP retrofitting of beams and columns to attain the desired increases.

III. Research Methodology and Experimental Program

This study includes the study of behavior of high-rise structure having different configuration of building having different floating condition under static and seismic parameters explained in IS-standards. Analysis results in the form of base shear, displacements, bending moment and support reactions at the ends have been drawn.

The study is carried out on a building with floating columns. The layout of the building is shown in the figure. The building considered is a multistory building having G+4, G+7 and G+9 structures.

S. No.	Description	G+3 Structure	G+5 Structure	G+6 Structure
1.	Number of storey in building	4	6	7
2.	Building Configurations	10 m x 10 m	20 m x 20 m	10 m x 10 m
				20 m x 20 m
3.	Total Height of Structure	12 m	18 m	21 m
4.	Length and Width of Each Bay	5 m	5 m	5 m
5.	Considered Load Case Details for the analysis of floating column	Seismic Zone III and IV With dead and live load	Seismic Zone III and IV With dead and live load	Seismic Zone III and IV With dead and live load

Table 1: Study building with floating columns.

IV. Results and Discussions

We have considered 4 frames of different geometrical shape and different story, which are going to be analyses for seismic considerations. The final process of the structural analysis is the post processing of the building frame response with different floating column conditions. As per the solution, we can check the analyses results of a framed structure in different aspects of building like Nodal displacement, Support reaction, Shear force, Base shear value and CPU time.

A. Comparative Results of above Considered Cases in Seismic Zones (Zone III & Zone IV)

In this section, the study is carried out to compare the analysed results of structure under seismic loading of zone III & IV.

1) Static analysis result of 10m×10m, G+3 story structure

These cases are analysed seismicaly and their analysis results on the basis of various parameters are compared below

a) Base Shear

The maximum base shear under seismic loading is shown in Figure 1.

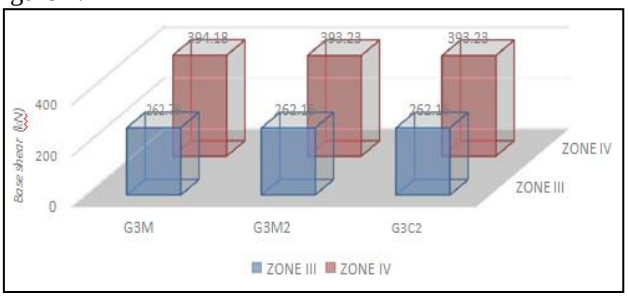

Fig. 1: Maximum Value of base shear in floating column condition (kN)

The value of base shear under static loading is approximately same (262.15 kN) in Zone III and (393.23 kN) in Zone IV condition.

b) Support Reaction

The maximum reaction under seismic loading as shown in Figure 2.

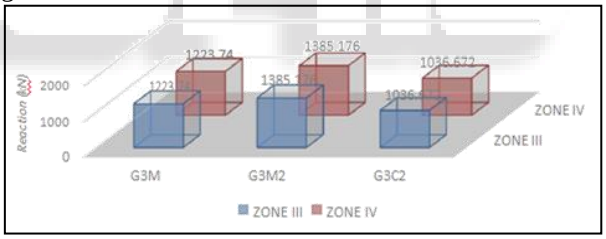

Fig. 2: Maximum Value of support reaction in floating column condition (kN)

The maximum value of support reaction under seismic loading is found to be greater in G3M2 condition followed by G3M and then by G3C2. This depends on the positioning of floating column and maximum value was obtained when floating column was found, at the middle of the structure and lesser value is required to be balanced at the corners.

c) Displacements

The maximum joint displacement under static loading is shown in Figure 3, Figure 4 and Figure 5.

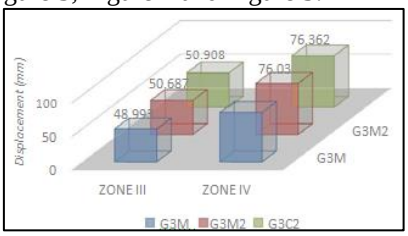

Fig. 3: Max. Value of joint displacement in X-Direction under different Diaphragm condition (mm)

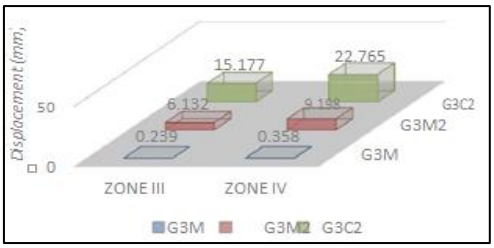

Fig. 4: Max. Value of joint displacement in Y-Direction under different diaphragm condition (mm)

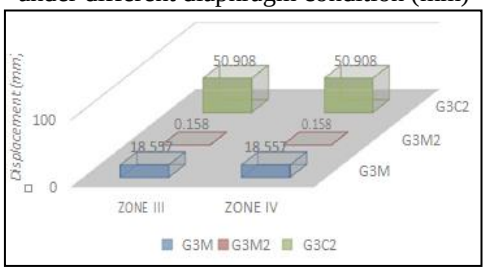

Fig. 5: Max. Value of joint displacement in Z-Direction under different diaphragm condition (mm)

The value of displacement drawn in X and Y-direction goes on increasing in case of floating column positioned from middle to corner of structure, but in case of Z direction maximum displacement was found to be at corner.

d) Elapses time

The maximum time taken by the software to run the analysis is shown in Figure 6.

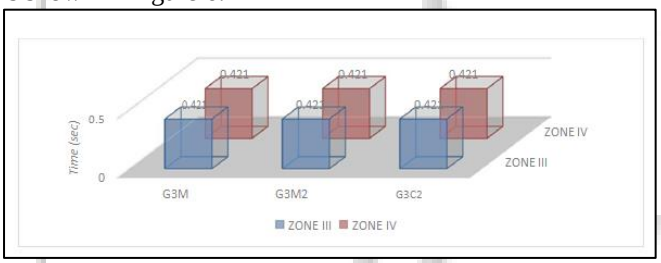

Fig. 6: Max. Value of elapsed time in different diaphragm condition (mm) floating column condition

The value of elapsed time drawn was found to be same in all the cases

V. Conclusion

The behavior of multistory building with floating column is studied under different earthquake excitation. The dynamic analysis of frame is studied by using software. It is concluded that with increase in ground floor column the maximum displacement, inter storey drift values are reducing. The base shear and overturning moment vary with the change in zone.

- The value of base shear under static loading is approximately same (262.15 kN) in Zone III and (393.23 kN) in Zone IV condition.
- The maximum value of support reaction under seismic loading is found to be greater in G3M2 condition followed by G3M and then by G3C2.
- The value of displacement drawn in X and Y-direction goes on increasing in case of floating column positioned from middle to corner of structure

VI. Future Scope

- Applying the different ground motions in Lateral direction.
- Removing the columns at different floors of the building.
- Applying the Pushover Analysis and Response Spectrum Analysis the behavior of building.

Applying the stooge cut and try and reaction Spectrum Analysis the process of building

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