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Seismic Analysis of Multistoried Buildings with Floating Columns

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Abstract: Column is supposed to be a vertical member starting from foundation level and transforming the load to the ground. The term floating column is also a vertical element whose end at its lower level rests on a beam which is a horizontal member. The beam in turn transfers the load to other columns below it. Load comings on a beam from a column of this type are considered as a point load. Construction of floating columns may be necessary due to architectural design or site situation. Theoretically such structures can be analyzed and designed. The beam on which a floating column rests is called as transfer beam. Floating columns are widely used in multistoried buildings. Buildings with floating columns are found both in residential and commercial sectors. Use of floating columns helps to alter the plan of the top floors to the convenience of planners and users. The transfer beam that supports the floating column must be designed very carefully and provided with necessary reinforcements. An ordinary column transfers the load to the foundation which in turn distributes the load to the subsoil. But a floating column transfers the load through the grid network which includes the beam it rests upon. Many famous building in different countries have been constructed providing floating columns.

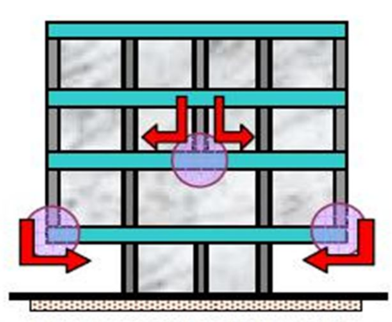
Keywords: Floating Column. Seismic Response, Bracing

I. INTRODUCTION

Numerous urban multi storey structures in India today have open first story as an unavoidable component. This is essentially being embraced to oblige stopping or gathering halls in the primary story. Though the aggregate seismic base shear as experienced by a working amid a tremor is subject to its regular period, the seismic power conveyance is reliant on the appropriation of solidness and mass along the tallness. The conduct of a working amid seismic tremors depends fundamentally on its general shape, size and geometry, notwithstanding how the quake powers are conveyed to the ground. The seismic tremor powers created at various floor levels in a building should be conveyed down along the structure to the ground by the most limited way; any deviation or intermittence in this heap move way brings about poor execution of the building. Structures with vertical difficulties (like the inn structures with a couple of story more extensive than the rest) cause a sudden hop in seismic tremor powers at the level of intermittence. Structures that have less segments or dividers in a specific story or with uncommonly tall story tend to harm or fall which is started in that story. Structures with sections that hang or buoy on bars at a middle of the road side story and don't go the distance to the establishment, have discontinuities in the heap exchange way.

II. 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 or 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.

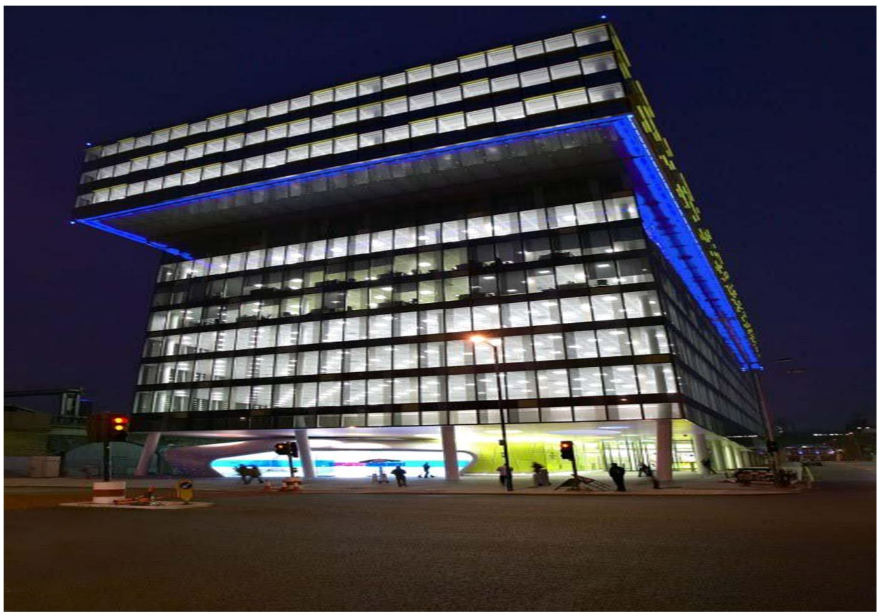


Hanging or Floating Columns

There are many projects in which floating columns are adopted, especially above the ground floor, where transfer girders are employed, so that more open space is available in the ground floor. These open spaces may be required for assembly hall or parking purpose. The transfer girders have to be designed and detailed properly, especially in earthquake zones. The column is a concentrated load on the beam which supports 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. STAAD Pro, ETABS and SAP2000 can be used to do the analysis of this type of structure. Floating columns are competent enough to carry gravity loading but transfer girder must be of adequate dimensions (Stiffness) with very minimal deflection.

III. THE BUILDINGS BUILT WITH FLOATING COLUMNS

240 Park Avenue South in New York, United States



Palestra in London, United Kingdom

One-Housing-Group-by-Stock-Woolstencroft-in-London-United-Kingdom

IV. THE MODELLING DETAILS OF THE BUILDINGS ARE AS DISCUSSED BELOW.

A. For analysis and study purpose there are few models developed in this study such that a multi-storey building that is Stilt+G+4 building is considered and modelled into two types mainly.

B. They are a multi-storey building without floating column that is a normal building and the other type is multi-storey building with floating columns at different positions in it.

C. Among these two types of models, the multi-storey building without floating column is considered constant comparing it with the models developed as multi-storey building with floating column where these floating column are present at different portions of the building analysing it at different zones as zone 5 to zone 2 as per codal provisions.

D. And the analytical models of the building include all the component that influence the mass, strength, stiffness and deformability of the structure.

The models details are,

1) *Model 1:* Stilt+G+4 building without floating column i.e. normal building analysed from zone 5 to zone 2,
2) *Model 2:* Stilt+G+4 building with floating column at Edge column position, analysed from zone 5 to zone 2,
3) *Model 3:* Stilt+G+4 building with floating column at Centre portion, analysed from zone 5 to zone 2,
4) *Model 4:* Stilt+G+4 building with floating column at parallel positions, analysed from zone 5 to zone 2,

V. RESULTS AND DISCUSSIONS

A comparative study and analysis is performed between a normal column building that is the building with all regular columns and other structural and non-structural members in it and on the other hand a floating column building at various zones as per the specifications in IS- 1893(2002)part 1. A detail study is carried out on the floating column building to find out the variations in the structural response of the building with floating columns at “parallel positions, at one edge column position and at the centre portion”, observed from the parameters like maximum displacements in the building at each floor, story drifts and the results obtained are beyond the deformation limits. Then such a floating column building tend to fail in extreme earthquake zones, thus some recommendations are performed to analyse the building response in that case.

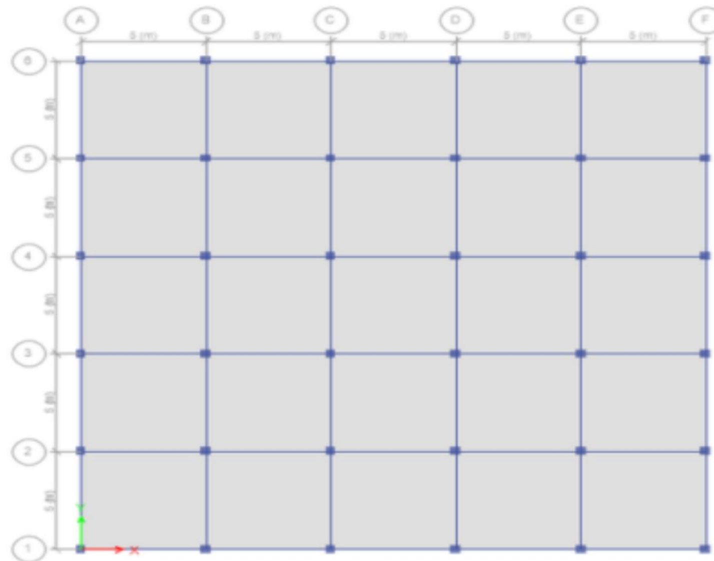


Fig 1: plan view of the normal building

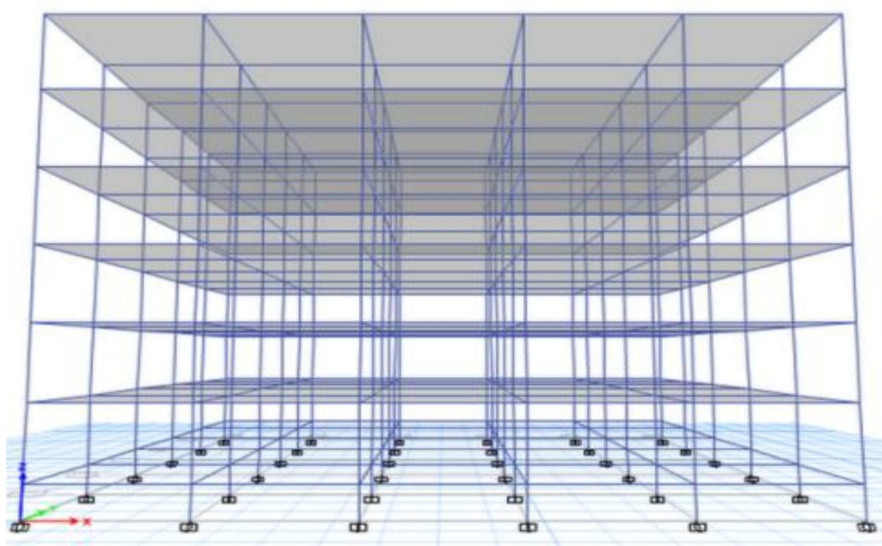


Fig 2: elevation view of the normal building

Table 3:Maximum displacements of the normal building at zone 5 to zone2

Story	Elevation	Location	ZONE 5	ZONE 4	ZONE 3	ZONE 2
Base	0	Top	0	0	0	0
Story1	1.28	Top	0.6	0.4	0.3	0.2
Story2	4.28	Top	4.9	3	2.2	1.4
Story3	7.28	Top	9.5	5.8	4.2	2.6
Story4	10.28	Top	13.5	8.2	6	3.7
Story5	13.28	Top	16.6	10.2	7.4	4.6
Story6	16.28	Top	18.6	11.5	8.3	5.2
Story7	19.28	Top	19.6	12.2	8.7	5.5

Fig 3: Maximum displacements of the normal building at zone 5 to zone 2

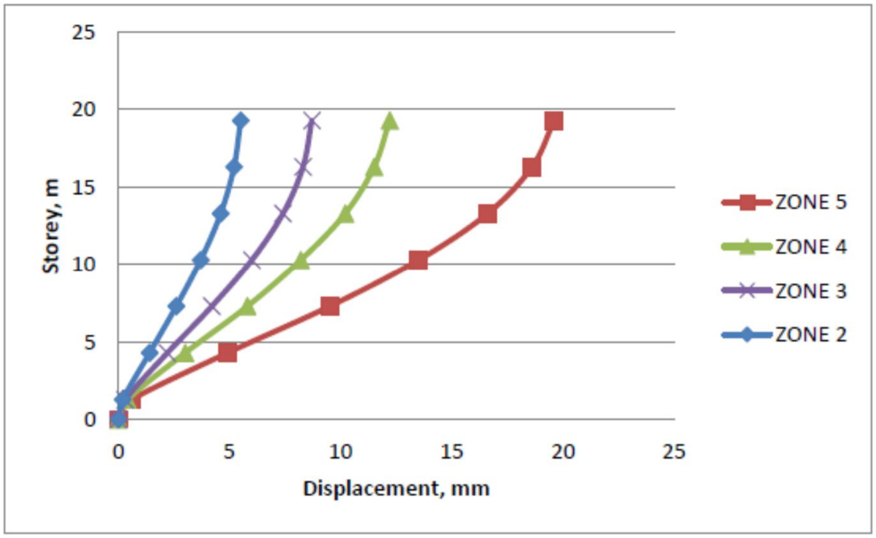
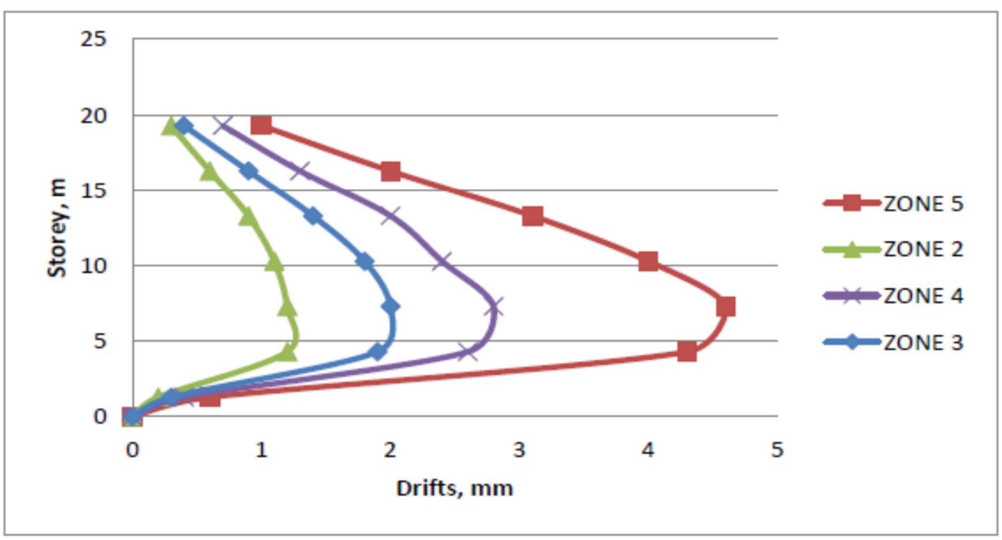


Table 4: Maximum Storey drifts of the normal building at zone 5 to zone 2

Story	Elevation	Location	ZONE 5	ZONE 4	ZONE 3	ZONE 2
Base	0	Top	0	0	0	0
Story1	1.28	Top	0.6	0.4	0.3	0.2
Story2	4.28	Top	4.3	2.6	1.9	1.2
Story3	7.28	Top	4.6	2.8	2	1.2
Story4	10.28	Top	4	2.4	1.8	1.1
Story5	13.28	Top	3.1	2	1.4	0.9
Story6	16.28	Top	2	1.3	0.9	0.6
Story7	19.28	Top	1	0.7	0.4	0.3

Fig 4: Maximum Storey drifts of the normal building at zone 5 to zone 2



VI. CONCLUSIONS

The study in this paper mainly comprises the difference between a normal column building and a floating column building and then followed with the recommendations that can be recommended for a safe and economical design of a floating column building which can be defined as an earthquake resistant design, and following conclusions are drawn from the analysis,

A. Generally, a building becomes expensive if it is designed to sustain any damage during an strong earthquake shaking.
B. In the present study, it is observed that the normal column building is more efficient when compared with other models i.e. floating column buildings.
C. From the results it is observed that the building with floating column at Zone 2 and Zone 3 can be safe designed by increasing the dimensions of the beams and columns, whereas in Zone 4 and Zone 5 the Recommendations are ultimately to be followed in the design.
D. Hence the recommendations such as shear walls, infill walls bracings are considered in the modelling and analysis and observed that they can also be designed as an rthquake resistant up to an extent, such that on introduction of floating columns in the RC frames increases the time period of bare frames due to decrease in the stiffness.
E. On comparison of the results obtained for each model, it is observed that the building with normal column building have lesser displacements and story drifts when compared with the floating column models.

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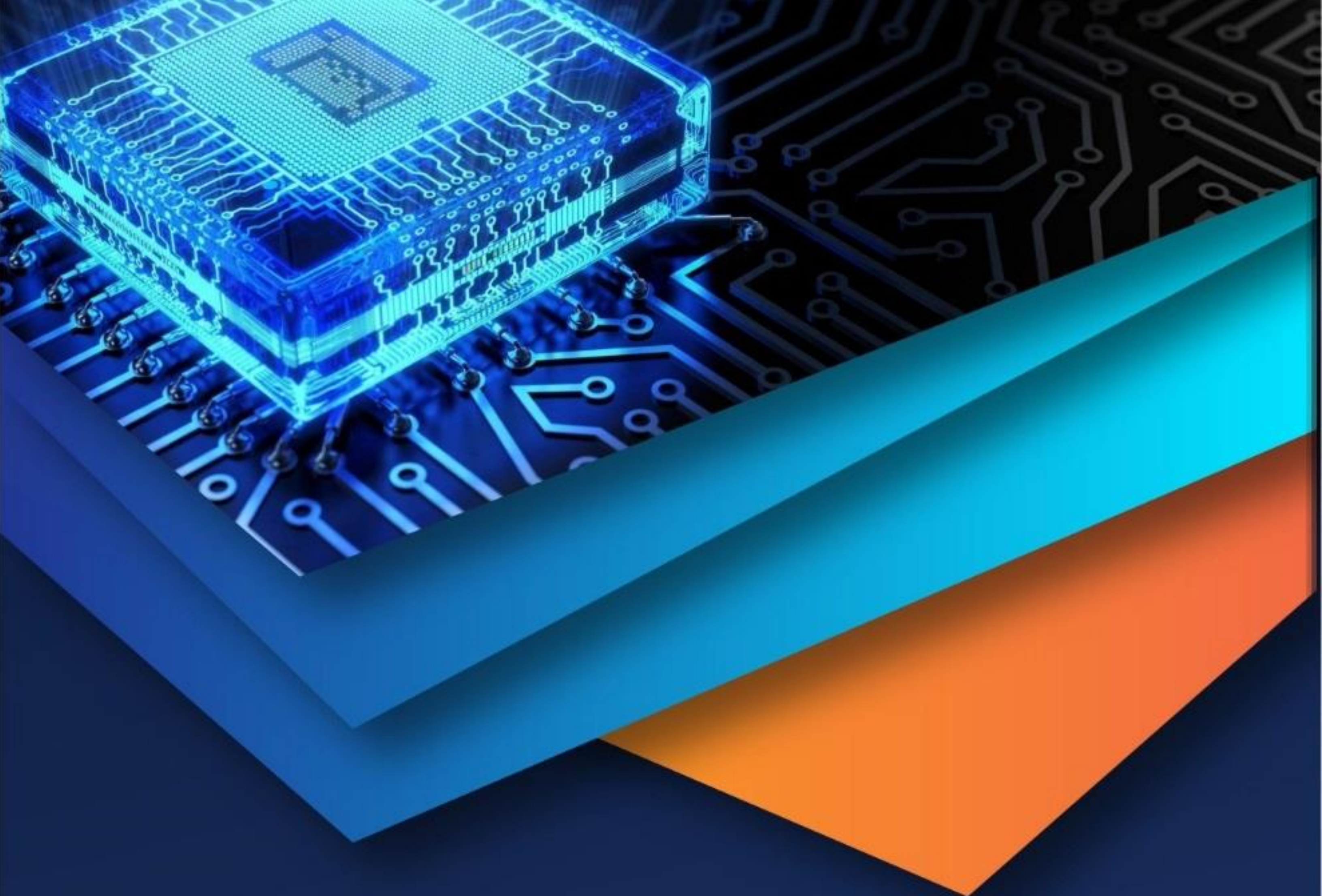

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