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SEISMIC EVALUATION OF MULTISTORIED BUILDING WITH AND WITHOUT FLOATING COLUMN

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ABSTRACT

Structural Engineering is that branch of Civil Engineering which deals with the analysis and the design of the structures. The analysis and design of a building with floating column is typical. The various forces which are developed in building have a discontinuous path in load transformation during seismic effect.

This paper deals with the analysis of a seven storey building. The analysis is done by dynamic method using Response Spectrum Method. The various structural responses such as storey displacement, storey drift, and storey forces have been calculated. The buildings are analyzed for two different zones i.e. zone III and zone V. The analysis is done using the software ETABS.

Keywords: dynamic analysis, floating column, ETABS, response spectrum method

I. INTRODUCTION

1.1 **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 member which at its lower level rests on a beam which is a horizontal member. The beams in turn transfer the load to other columns below it [1]. The building can be categorized into two type, regular building and irregular building. Building containing floating column comes into irregular type of building.

In India, now a days many multi-storeyed have keep their ground storey open as an unavoidable feature. The main purpose of opening ground storey is to accommodate parking or reception lobby. This type of building is mainly known as irregular building

When an earthquake occurs, the forces generated by earthquake need to be brought down through the height of the building. In every building the load transfer takes from horizontal member (beams and slabs) to vertical member i.e. columns and walls which transfer the load to the foundation [6]. So building with floating column, there will be discontinuity in load transfer path. The forces which are generated will be transferred to the ground through the shortest possible path. Figure1 shows the model of building with floating column and load transfer path.

In this paper a normal building containing seven storeys is considered. In order to convert it into a building with floating column, some of the columns at storey one is removed and two cases are considered. These buildings were analysed for two different zones i.e. zone III & zone V. For this two cases the various parameters such as storey displacement, storey driftand storey forces are calculated.

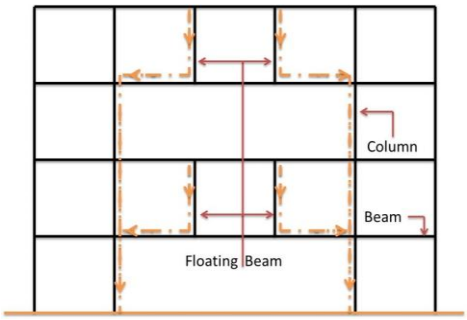

Fig. 1 Model of building with floating column.

1.2 Objective and scope

a) To study the effect of floating column on a building by considering two different cases for two different zones i.e. Zone III and Zone V.

b) To compare the various structural parameters of a normal building with building containing floating column.

c) To study the dynamic effect on a normal building and building with floating column.

d) To compare which case is more superior with another in high seismic zone.

II. MODELLING DETAILS

In present study, seven storey normal building is considered and in normal building columns of storey one are removed with different arrangements to make it into building with floating column. For this evaluation two different cases are considered along with normal building. These cases are evaluated for two different zones i.e. zone III and zone V. Building has storey height of 3m.

The building has plan area of 20m x 20m. The spacing of columns in X direction is 5m and spacing of columns in Y direction is 5m. For building with floating column, two different cases are considered.

The building properties are shown in following table:

TABLE I. MEMBER PROPERTIES

Member Dimensions		
Beams		350mm x 500mm 550mm x 700mm
Columns		350mm x 350mm 550mm x 550mm
Slab Thickness		125mm
Loads		
Floors	Live Load	4 kN/m^2
	Floor Finish	1.5 kN/m^2
Walls	External Walls	12 kN/m
	Internal Walls	6 kN/m

	Parapet	4.6 kN/m
Grade		
Concrete		M – 35
Rebar		HYSD 500

Building plan and elevation of normal building and building with floating column are shown in fig. 3 to fig. 6. 3D view of normal building is shown in following building.

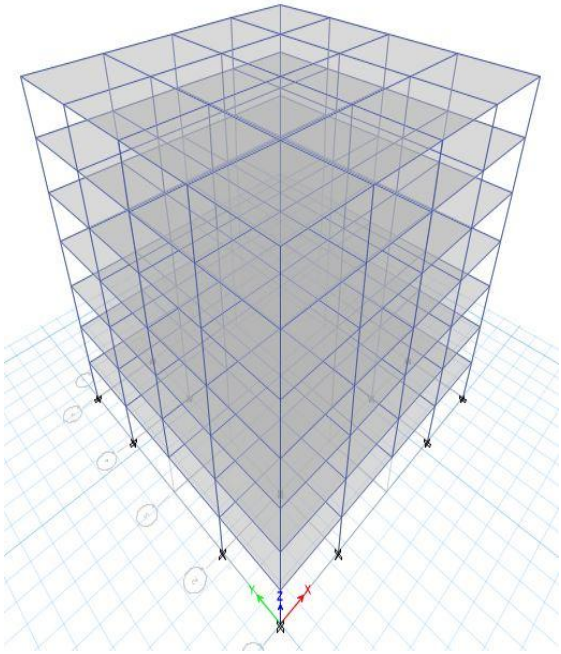

Fig. 2 3D view of building

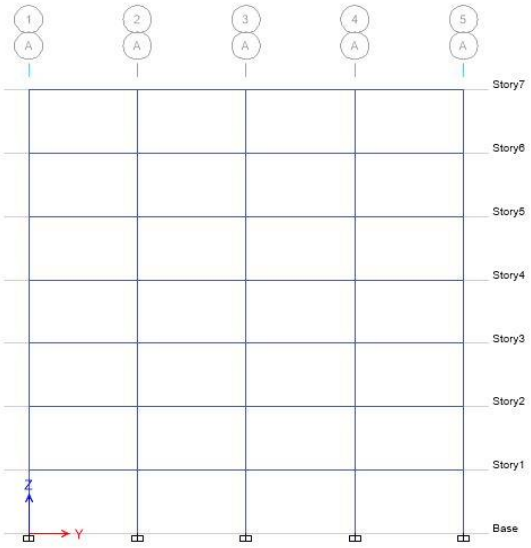

Fig. 3 Elevation of normal building

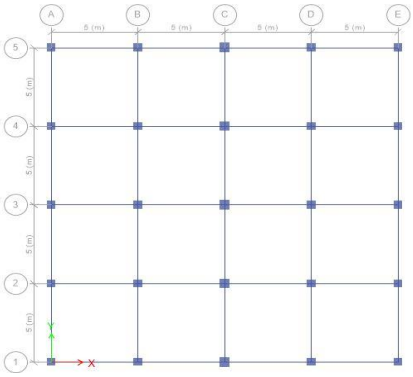

Fig. 4 Plan of normal building

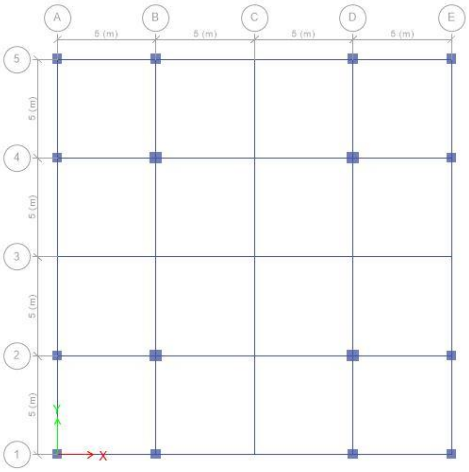

Fig. 5Plan of building with floating column(case1)

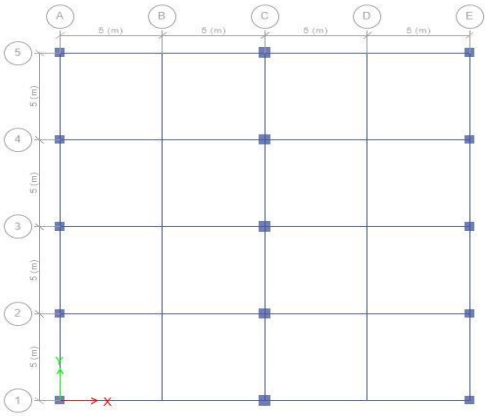

Fig. 6 Plan of building with floating column (case2)

III. RESULTS AND DISCUSSION

In this study a normal building and two cases of building with floating columns were analyzed for two different zones and the results obtained were shown in tabular form and compared. The various structural parameters such as Storey Displacement, Storey Drift, Storey Forces and Time Period were calculated.

Storey Displacement: Storey Displacement is defined as the lateral movement of the building which is caused by the lateral force along the direction.

Following table shows Storey Displacement for building of Zone III

TABLE II. STOREY DISPLACEMENT FOR ZONE III

Storey	Normal	Case1	Case2
Base	0	0	0
Storey1	2	2.8	2.8
Storey2	5.3	5.9	6.1
Storey3	8.4	9	9.2
Storey4	11.1	11.6	11.8
Storey5	13.2	13.7	13.8
Storey6	14.7	15.2	15.3
Storey7	15.4	16	16

Following graph shows the comparison of Storey Displacement for Zone III

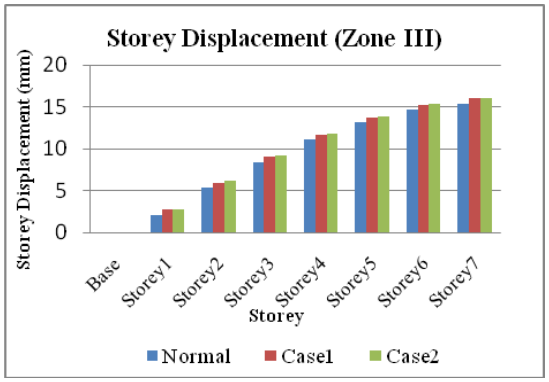

Fig.7Comparison of Storey Displacement for zone III

Following table shows Storey Displacement for building of Zone V

TABLE III. STOREY DISPLACEMENT FOR ZONE V

Storey	Normal	Case1	Case2
Base	0	0	0
Storey1	2.8	3.7	4
Storey2	8.8	10.3	11.9
Storey3	16.1	17.8	19.6
Storey4	22.5	24.4	26.4
Storey5	27.6	29.6	31.6
Storey6	31.1	33.3	35.4
Storey7	33	35.1	37.4

Following graph shows the comparison of Storey Displacement for Zone V

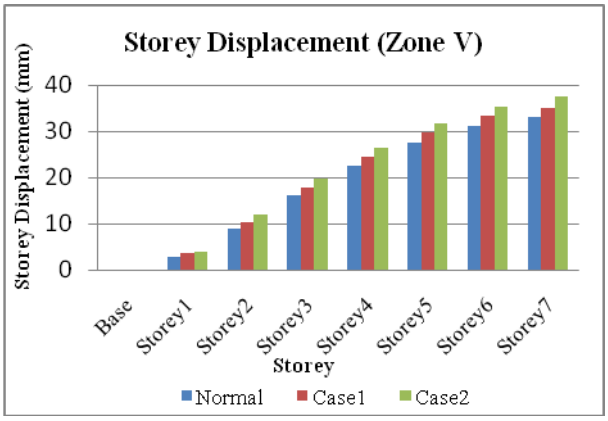

Fig. 8Comparison of Storey Displacement for zone V

Storey Drift: Storey Drift is defined as the relative difference between the displacements of adjacent storey. As storey displacement increases, storey drift also increases.

Storey Drift for normal building and both cases of building with floating column and their comparison are shown below.

TABLE IV. STOREY DRIFT FOR ZONE III

Storey	Normal	Case1	Case2
Story1	2.386	2.799	2.826
Story2	2.785	3.111	3.294
Story3	3.18	3.211	3.12
Story4	2.802	2.875	2.745
Story5	2.319	2.327	2.271
Story6	1.689	1.695	1.65
Story7	0.933	0.957	0.903

Following graph shows the comparison of Storey Drift for Zone III

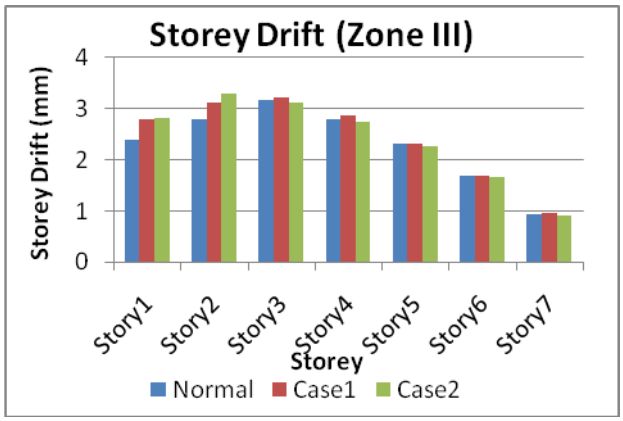

Fig. 9 Comparison of Storey Drift for zone III

TABLE V. STOREY DRIFT FOR ZONE V

Storey	Normal	Case1	Case2
Story1	2.76	3.99	3.69
Story2	6.08	7.96	6.63
Story3	7.33	7.75	7.67
Story4	6.67	7.15	6.92
Story5	5.55	5.79	5.8
Story6	4.08	4.47	4.3
Story7	2.29	2.46	2.36

Following graph shows the comparison of Storey Drift for Zone V

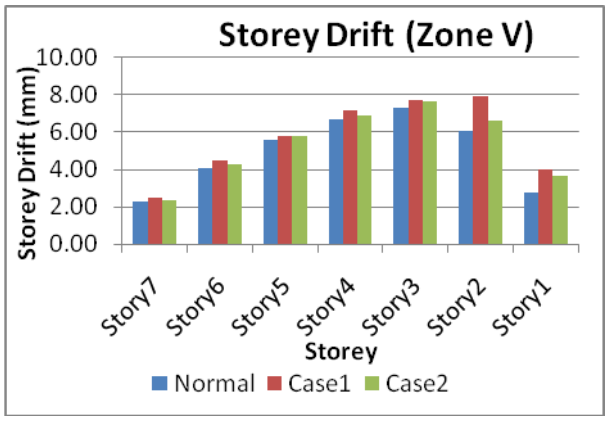

Fig.10 Comparison of Storey Drift for zone V

Storey Forces: The Forces which are induced at every storey during an earthquake is known as Storey Forces. Storey Forces induces in a building with floating column will be less as compared to normal building since the mass is less for building with floating column

TABLE VI. STOREY FORCES FOR ZONE III

Storey	Normal	Case2	Case2
Story1	1638	1576	1556
Story2	1564	1447	1437
Story3	1403	1357	1347
Story4	1220	1141	1135
Story5	1113	1102	1092
Story6	749	740	732
Story7	346	335	325

Following graph shows the comparison of Storey Forces for Zone III

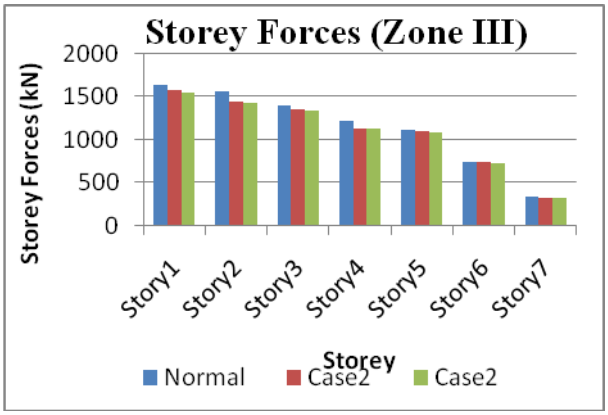

FIG. 11 COMPARISON OF STOREY FORCES FOR ZONE III

TABLE VII. STOREY FORCES FOR ZONE V

Storey	Normal	Case1	case2
Story1	4072	4000	3639
Story2	3893	3772	3459
Story3	3503	3383	3113
Story4	3051	2950	2716
Story5	2540	2474	2283
Story6	1868	1829	1703
Story7	893	869	824

Following graph shows the comparison of Storey Forces for Zone V

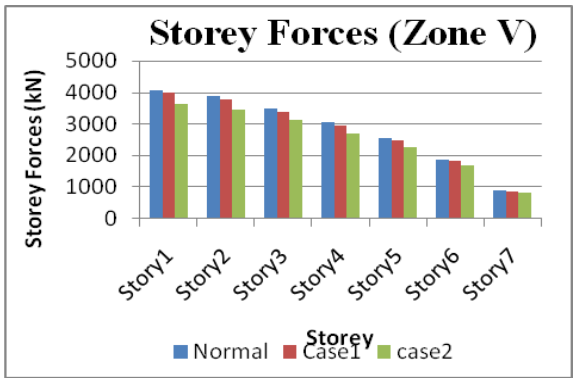

Fig. 12 Comparison of Storey Forces for zone V

IV. CONCLUSION

From the analysis done and the results obtained, the following conclusions were drawn:

a) Storey Displacement: With the introduction of floating column in the building, storey displacement increases.

b) Storey Drift: As storey displacement increases, storey drift also increases for a building with floating column.

c) Storey forces: Storey Forces in a building with floating column is less as compared to the normal building since there is less number of columns.

d) Floating columns should be avoided the areas of high seismic zones because of its poor performance.

e) The performance of building can be improved by increasing the dimensions of beams and columns where floating columns are provided.

f) The results obtained for Case 2 were more as compared than Case 1.

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