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Engineering

SEISMIC ANALYSIS OF DIFFERENT HEIGHTS OF MULTISTOREY BUILDING WITH FLOATING COLUMN

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ABSTRACT In present scenario buildings with floating column is a typical feature in the modern multistory construction in urban India. Such features are highly undesirable in building built in seismically active areas. This study highlights the importance of explicitly recognizing the presence of the floating column in the analysis of building. Alternate measures, involving stiffness balance of the first storey and the storey above, are proposed to reduce the irregularity introduced by the floating columns.

In the Present thesis a multi-storey building of 6 storey & 12 storey building is analyzed with floating column and the results of Displacement, tabulated in static analysis, analysis is carried out in ETABS2013.

KEYWORDS : Floating column, Multi-storey Building.

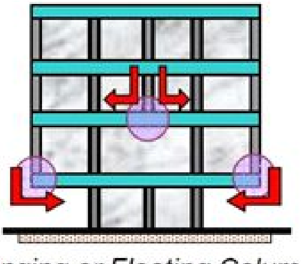
INTRODUCTION

Many urban multistorey 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.

1.2 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.



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 earth quake 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. Floating columns are competent enough to carry gravity loading but transfer girder must be of adequate dimensions (Stiffness) with very minimal deflection.

METHODOLOGY

BUILDING DIMENSIONS:

The building is 36m x 36m in plan with columns spaced at 6m from centre to centre. A floor to floor height of 3.0m is assumed. The location of the building is assumed to be at different zones and different types of soils. An elevation and plan view of a typical structure is shown below.

Size of Structural Members

Column Sizes for 6 storey building :

From ground floor to sixth floor: 230 mm X 600 mm

For 6 storey building without floating column & with floating column

Column dimension is changed after placing the floating column

From ground floor to sixth floor : 450mm x 700mm for inner columns

Beam Size: 230 mm X 450 mm

Column Sizes for 12 storey building :

From ground floor to twelfth floor 400mm x700mm

After placing the floating column inner columns sizes are 600mm x 600mm

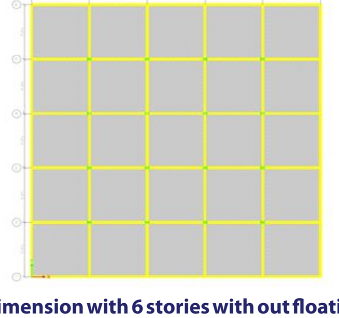
Beam size of 450 mm x 600 mm

Slab Thickness: 120 mm

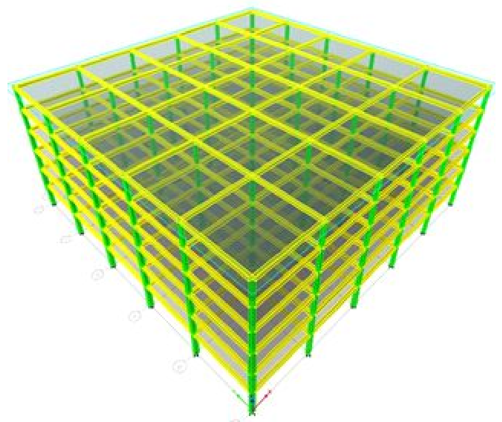
Grade of Concrete and Steel: M30; Fe 500 Steel

PLAN AND ELEVATION OF MODEL:

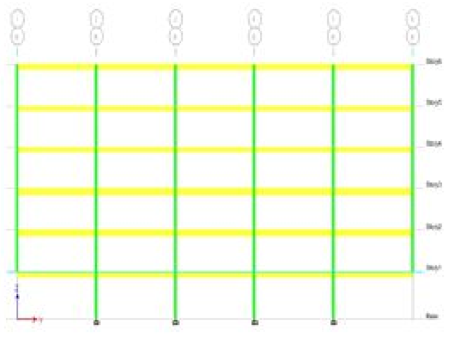
A simple plan of 40m X 40m is taken, with 5 bays of 8 m each as shown in Fig.



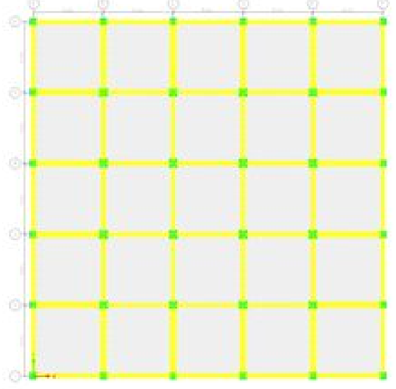
Building plan dimension with 6 stories with out floating column



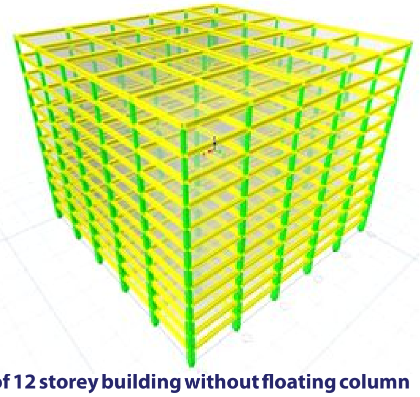
3d view of 6 stories building without floating column



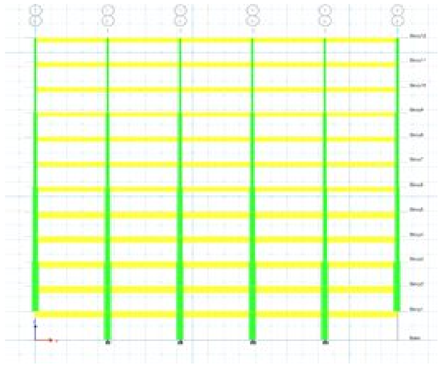
Showing elevation view of 6 stories building with floating column



Showing plan view of 12 storey building without floating column



3d view of 12 storey building without floating column



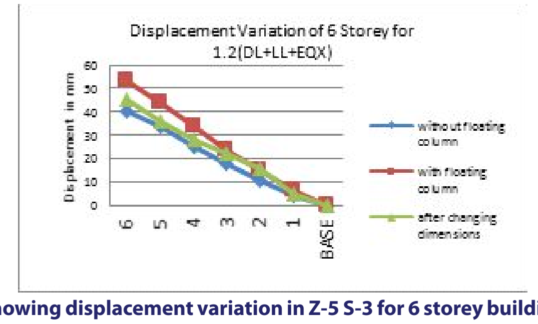
Showing elevation view of 12 storey building with floating column

I. RESULTS & DISCUSSIONS

Displacement comparison for 6 storey building & 12 storey building

Table 1 Showing displacement values for zone-5 soil-3 for 6 storey building in X direction

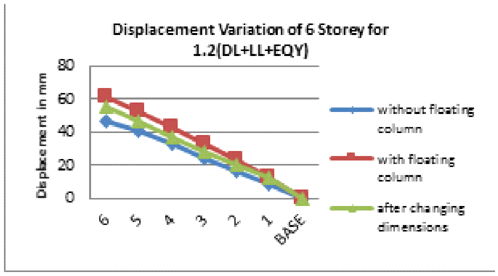
storey	without floating column	with floating column	after changing dimensions
6	40.3	52.9	45
5	33.6	43.6	36
4	25.5	33.6	28
3	17.7	23.9	22
2	11	15	16
1	4.6	6.7	5.2
BASE	0	0	0



Showing displacement variation in Z-5 S-3 for 6 storey building in X direction

Table 2 Showing displacement values for zone-5 soil-3 for 6 storey building in Y Direction

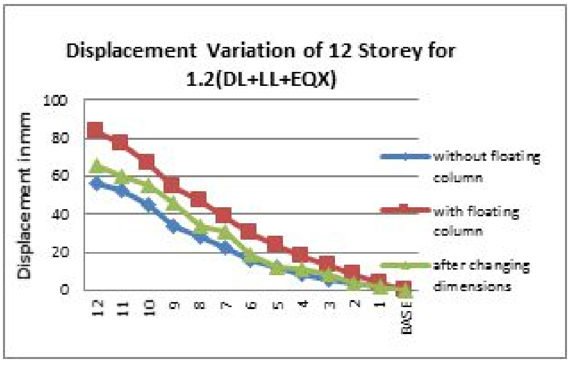
storey	without floating column	with floating column	after changing dimensions
6	46.4	61.1	55
5	41	52.8	47
4	33.2	43.1	37
3	24.7	32.8	28
2	16.7	22.9	20.3
1	8.4	13	12.3
BASE	0	0	0



Showing displacement variation in Z-5 S-3 for 6 storey building in X direction

Table 3 Showing displacement values for zone-5 soil-3 for 12 storey building in X Direction

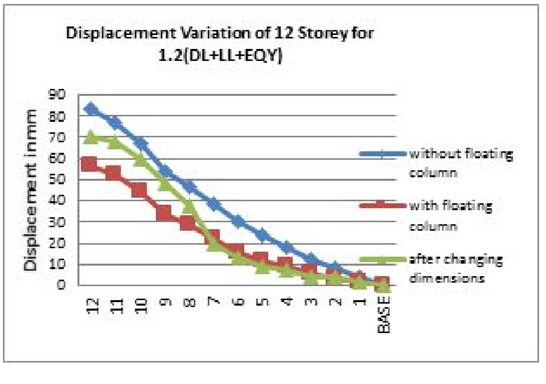
storey	without floating column	with floating column	after changing dimensions
12	56.6	83.6	66
11	52.3	76.9	60
10	44.5	66.9	55
9	33.9	54.3	45.9
8	28.4	46.5	33.6
7	22.3	38.2	30.54
6	15.9	29.9	18.54
5	11.8	23.4	12.4
4	8.6	17.8	10.77
3	5.6	12.6	8
2	3.5	7.9	3.7
1	1.7	4	1.8
BASE	0	0	0



Showing displacement variation in Z-5 S-3 for 12 storey building in X direction

Table 4 Showing displacement values for zone-5 soil-3 for 12 storey building in Y Direction

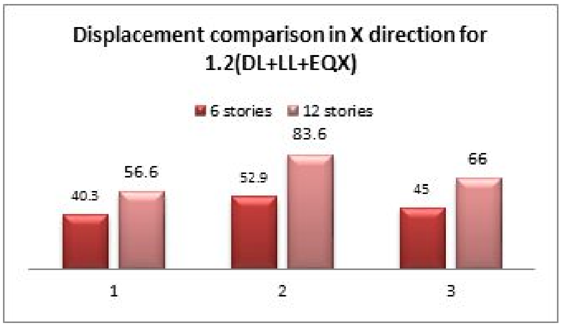
storey	without floating column	with floating column	after changing dimensions
12	83.6	56.6	70
11	76.9	52.3	68
10	66.9	44.5	60
9	54.3	33.9	48
8	46.5	28.4	38
7	38.2	22.3	20
6	29.9	15.9	13
5	23.4	11.8	9
4	17.8	8.6	7.1
3	12.6	5.6	4.21
2	7.9	3.5	3.7
1	4	1.7	1.8
BASE	0	0	0



Showing displacement variation in Z-5 S-3 for 12 storey building in Y direction

Table 5 Comparison of maximum displacement in both X & Y direction Showing displacement comparison values in X direction

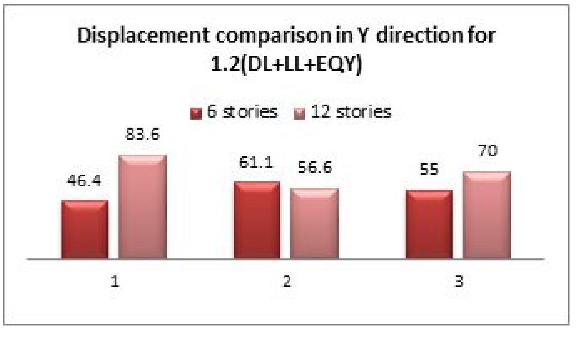
stories	with out floating column	with floating column	with change in dimension
6 stories	40.3	52.9	45
12 stories	56.6	83.6	66



Showing displacement variation in X direction

Table 6 Showing displacement comparison values in X direction

stories	with out floating column	with floating column	with change in dimension
6 stories	46.4	61.1	55
12 stories	83.6	56.6	70



Showing displacement variation in Y direction

CONCLUSION

1. Displacement is analyzed and compared with normal building, building with floating column, building after change in dimensions for load combinations 1.2(DL+LL+EQX) & 1.2(DL+LL+EQY). It is observed that the displacement is more when the floating column is provided to reduce the displacement the section properties of the building are changed for better performance.
2. Displacement is analyzed for 6 stories & 12 storey building in both X & Y directions with the load combinations of 1.2 (DL+LL+EQX) & 1.2(DL+LL+EQY),
3. Displacement of 30% is reduced when the dimensions of column and beam are increased.

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