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SESEMIC ANALYSIS OF HIGH RISE BUILDING WITH AND WITHOUT 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. FEM codes are developed for 2D multi storey frames with and without floating column to study the responses of the structure under different earthquake excitation having different frequency content keeping the PGA and time duration factor constant. The time history of floor displacement, inter storey drift, base shear, overturning moment are computed for both the frames with and without 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.

I.INTRODUCTION

A.Floating Column

A column is declared to be a vertical affiliate starting from foundation akin and appointment the amount to the ground. The appellation amphibian column is aswell a vertical aspect which (due to architectural design/ website situation) at its lower level(termination Level) rests on a axle which is a accumbent member. The beams in about-face alteration the amount to added columns beneath it

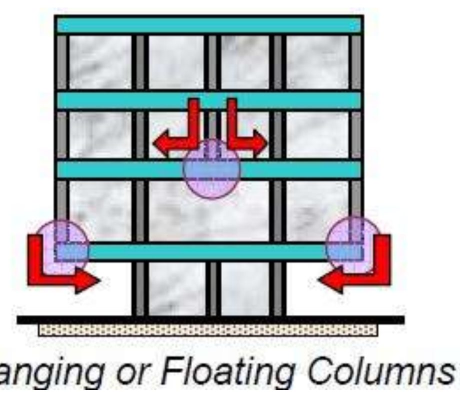

Fig.: Hanging or Floating Columns

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.

B. Transfer Beam:

In Frame as amount accustomed arrangement if cavalcade is not accustomed to abide bottomward due to some restriction, botheration is bound by application alteration beam. A alteration axle carries the amount of an abnormally abundant load, about a column. It is acclimated to alteration the amount of a cavalcade aloft to two abstracted columns below. This is generally bare in cases area you charge altered or beyond cavalcade spacing. One archetype area we generally see alteration beams is in top acceleration buildings. These barrio generally accept retail spaces and parking garages at the lower levels and residential or appointment units on the high levels.

C. High-rise buildings:

High-rise buildings in general are defined as buildings 35 meters or greater in height which are divided at regular intervals into occupable levels. Undeniably the high-rise buildings are also seen as a wealth-generating mechanism working in an urban economy. High-rise buildings are constructed largely because they can create a lot of real estate out of a fairly small piece of land. Because of the availability of global technology and the growing demand for real estate, high rise buildings are seen as the most fitting solution to any city that is spatially challenged and can't comfortably house its inhabitants.

D.Objective:

In this thesis a G+15 High-rise building with and without floating column in which some storey's are considered for commercial purpose and remaining storey's are for residential purpose. It should withstand against all potential loading conditions and fulfills the task for which it is built. It should also ensure that the structure will be designed economically. Safety necessities must be met so that the structure will able to serve its purpose· with the minimum cost. The analysis and design of the super structure was done by using ETABS which has been recognized as the industry standard for Building Analysis and Design Software and the comparison and seismic analysis is done by applying all the loads and combinations and to find whether the structure is safe or unsafe with floating column and the analysis and results are shown in this study.

II. 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 in fig. 20 and 21.

1.Size of Structural Members

a)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

b)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

III. LOAD CASES

1. Live Load

Live load is assumed as per IS 875(part 2-imposed loads) table 1. Since the building is assumed to be a Commercial building the live load was taken as $3KN/m^2$ for all floors except the top floor where the live load is taken as $2KN/m^2$. Also a slab dead load is applied assuming a 120mm thick concrete slab on all floors (to avoid complicated load calculations involving composite floor systems). These slab panels are assumed to behave as a rigid diaphragm.

2.Quake Load

Quake load in this study is established in accordance with IS 1893(part 1)-2002. The buildings cases are prepared in all seismic zones i.e. in Z3, and Z5. Therefore the value of Z is taken as, 0.16, and

0.36 respectively. The importance factor (I) of the building is taken as 1.0. On the other hand the cases are made in all types of soils i.e., Hard/ Rocky (Type I), Medium soil (Type II) and in Loose

Soil (Type III). The response reduction factor R is taken as 3.0 for zone 3& 5 for zone 5.

3 Load combinations

As per clause 6.3.1.2 of IS 1893 different load combinations are considered in the analysis and design of a concrete structures. The different load combinations are:

A. Static & Dynamic Loading

- 1.5(Dead load + Live load)
- 1.2(Dead load + Live load + Lateral load in X direction)
- 1.2(Dead load + Live load - Lateral load in X direction)
- 1.2(Dead load + Live load + Lateral load in Y direction)
- 1.2(Dead load + Live load - Lateral load in Y direction)
- 1.5(Dead load + Lateral load in X direction)
- 1.5(Dead load - Lateral load in X direction
- 1.5(Dead load + Lateral load in Y direction)
- 1.5(Dead load - Lateral load in Y direction)
- 0.9(Dead load) + 1.5(Lateral load in X direction)
- 0.9(Dead load) - 1.5(Lateral load in X direction)
- 0.9(Dead load) + 1.5(Lateral load in Y direction)
- 0.9(Dead load) - 1.5(Lateral load in Y direction)

B. Linear Time History Analysis

The linear time history analysis were carried with eight different ground motions depends on acceleration as BHUJ, The displacements with respect to time is calculated in Ux, Uy and Uz directions.

IV.PLAN AND ELEVATION OF CASE

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

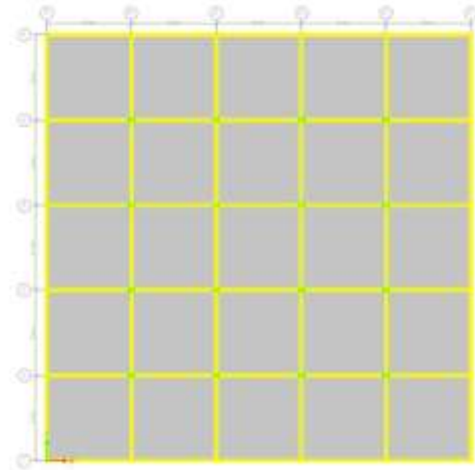

Figure 1 : Building plan dimension with 6 stories without floating column

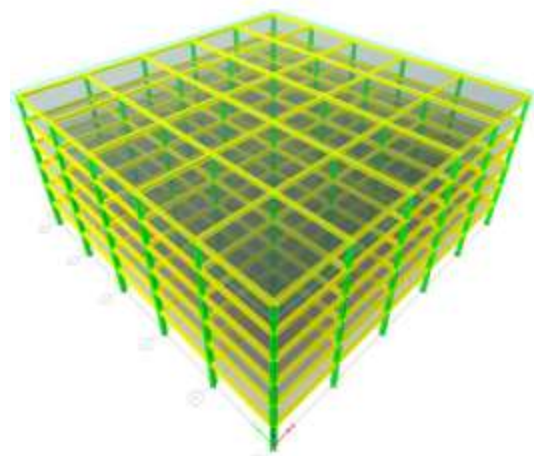

Figure 2 : 3d view of 6 stories building without floating colummn

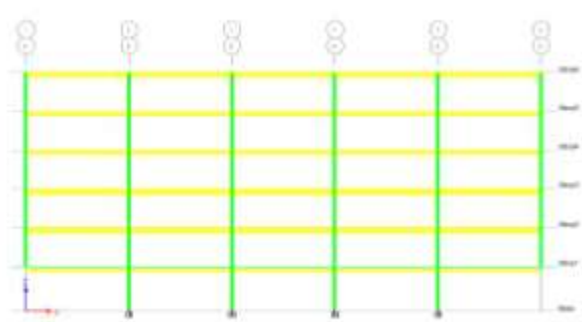

Figure 3:Showing elevation view of 6 stories building with floating column

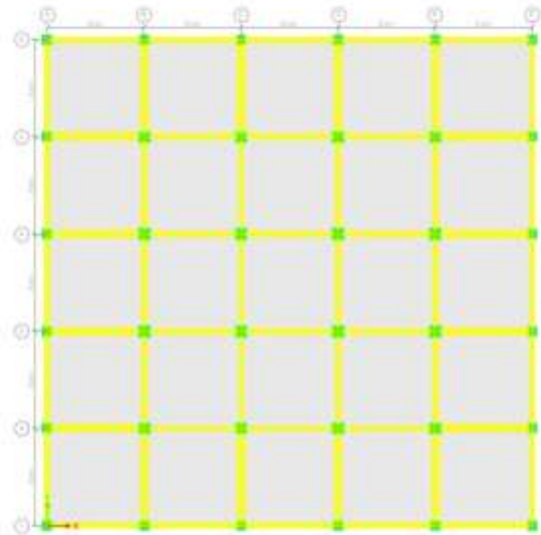

Figure 4:Showing plan view of 12 storey building without floating column

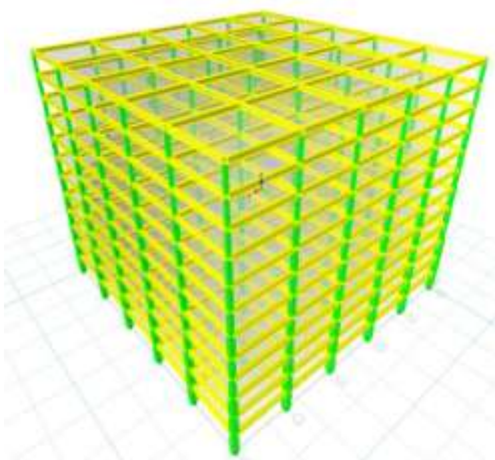

Figure 5:3d view of 12 storey building without floating column

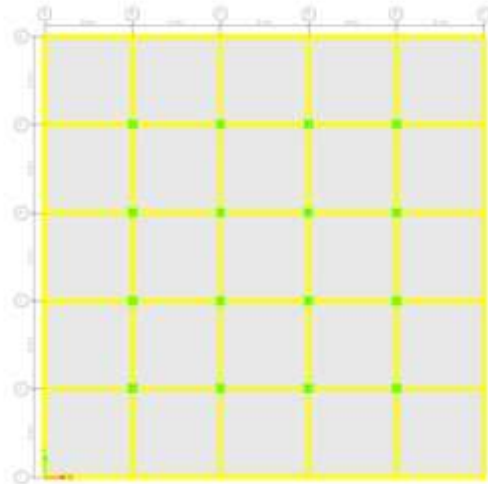

Figure 6:Plan view of 12 storey building with floating column

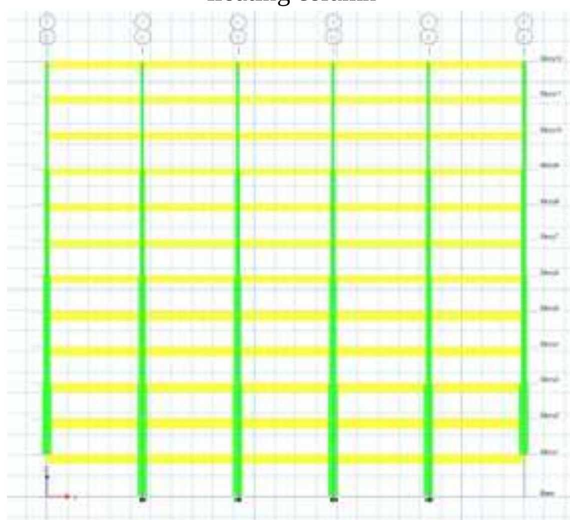

Figure 7:Showing elevation view of 12 storey building with floating column

IV. RESULTS

Case-1: Displacement comparison for 6 storey building & 12 storey building

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Table1: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

Table2: 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

2.Case2:comparison of maximum displacement in both X & Y direction

Table3: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

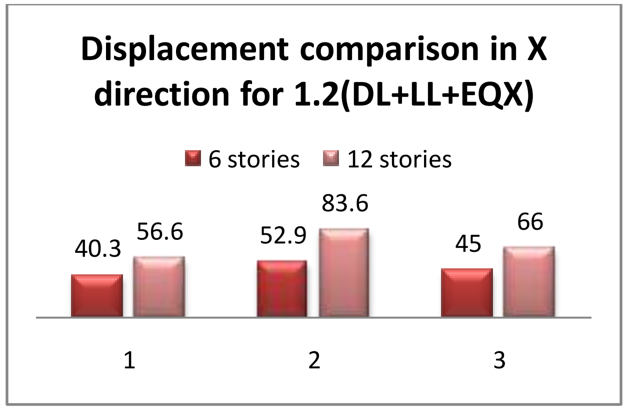

Fig 4.1:Showing displacement variation in X direction

Table 4: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

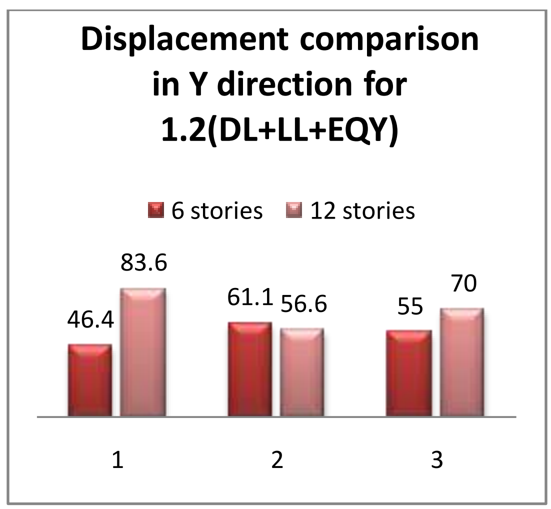

Figure 4.2:Showing displacement variation in Y direction

3.case3:comparison of shear in both X & Y directions

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Table 5:shear comparison values in X direction

stories	with out floating column	with floating column	with change in dimension
6 stories	49.22	-82.07	40.25
12 stories	25.06	-18.3	20.265

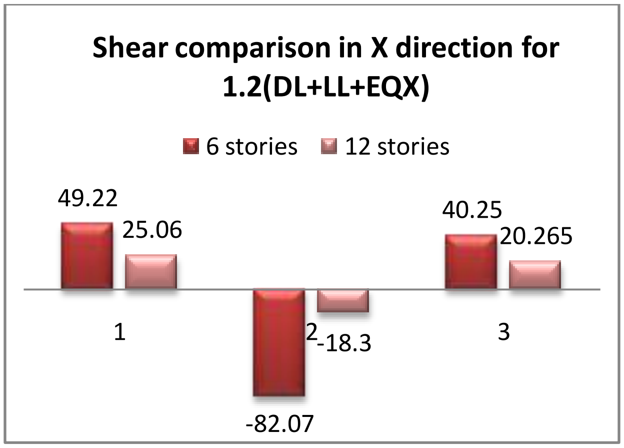

Fig4.3Showing shear variation in X direction

Table5:shear comparison values in Y direction

stories	with out floating column	with floating column	with change in dimension
6 stories	64.8	-91.3	50
12 stories	42.9	-6.1	39.62

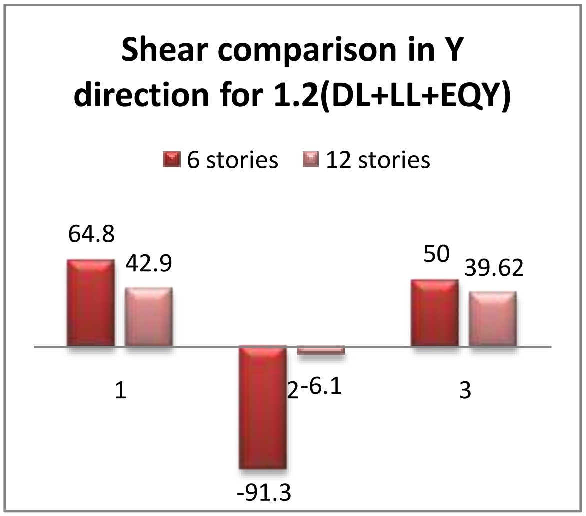

Fig 4.4Showing shear variation in Y direction

V.CONCLUSION

The behavior of multistory building with and without floating column is studied under different earthquake excitation. The compatible time history and Elcentro earthquake data has been considered. The PGA of both the earthquake has been scaled to 0.2g and duration of excitation are kept same. A finite element model has been developed to study the dynamic behavior of multi story frame. The static and free vibration results obtained using present finite element code are validated. The dynamic analysis of frame is studied by varying the column dimension. 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 column dimension.

1.By the application of lateral loads in X and Y direction at each floor, the displacements of Case 2 and Case 3 building in X and Y directions are less than the case 1 building but displacement of Case 2 and Case 3 building in Z-direction is more compared to that of a Case 1 building. So the Floating column buildings are unsafe for construction when compared to a Normal building.

2.After the analysis of buildings, comparison of quantity of steel and concrete are calculated, From which it is to be identified that Case 3 (Floating column) building has 40 % more quantity of rebar steel and 42 % more concrete quantity than Case 1(Normal) building. So the Floating column building is uneconomical to that of a Normal building.

Research can be further continued by

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

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