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"Behaviour of Regular and Non Regular RC Buildings with & without Floating columns using ETABS"

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Abstract- Lately, multi-storey and high rise buildings in urban locales require column free territory because of shortage of space and for architectural prerequisites. For this reason multistorey structures are inhibited with floating columns for aesthetic perspective and also in getting more space at parking territories for free vehicular movement. Floating-column is a vertical member that ends at its lower level and rest on a beam that is a horizontal member. Provision of floating columns is extremely biased in building built-in seismically active regions. The primary aim of this study is to present a general review of the performance of reinforced concrete frame structures with and without the floating columns at different floors in "Regular and Non Regular" RC buildings. The analytical study of the RC buildings with and without floating columns is done using ETABS 2013 software.

Key Words *–Floating Columns, Regular and Non Regular RC buildings*

I. Introduction

In numerous high rise structures, today open first storey is an inescapable component. The adaptation is mainly to have more space for parking or reception lobbies in the first storey. For this purpose, buildings are incorporated with hanging columns at least in one or more storeys. There are several activities in which floating columns are embraced, particularly over the ground floor, where transfer girders are utilized, so that more open space is realistic in the preliminary floor. These open areas might be essential for social affair hall or parking reason.

In structural engineering column is a structural element that transmits the heaviness of the construction to its lower underlying part. In general, compression components are often termed as "columns" because of the stress conditions. Columns generally bear beams or arches on which the upper parts of masonry or ceiling rest. A column is an upstanding pillar, typically cylindrical, supporting an arch, entablature, or other structure or remaining solitary as a monument beginning from establishment level and transferring the load to the ground.

The floating column is a upward structural element which lays on a beam however doesn't pass the load in a straight line to the establishment. The floating column will act as a point load on the beam and in turn the load is transferred to the columns underneath it through beam. The column may get going on the first or second or any other intermediate floor while resting on a beam. These floating columns are extremely inconvenient in a structure built in seismically dynamic territories. The seismic forces which are generated at various floor levels in a structure needs to be transferred down along the height to the ground by the shortest path.

[1] Kapil Dev Mishra & Dr A K Jain (2018) analyzed a G+5 building and studied on "Comparative Study of Floating and Non Floating Column of Plaza Building subjected to Seismic Loading by Using Staad-Pro Software". It has been concluded that maximum bending moments as well as highest support reaction are seen in the structures having floating columns and are higher than that of structures without floating columns, maximum bending moments at seismic Zone IV are greater than that of Zone III and structures with floating column constructed in Zone IV are more affected by earthquake than Zone III.

[2] Prof. Y. R. Deshmukh etal (2018) studied on "Study on Seismic Analysis of Multistorey Building with Floating Column using Staad.ProV8i". It has been concluded that, building with floating columns produces more base shear and lateral displacement in seismic prone area's when compared with non-floating column buildings i.e storey drift of floating column building is ultimately more but does not sway the steadiness of structure.

The objective of the present work is to find out the performance of G+4 Regular and Non Regular RC buildings modelled with floating columns present at ground floor, 1st, 2nd & 3rd floor. Various parameters such as storey shear, storey drift, storey displacement and base shear are compared for buildings with and without floating columns.

II. Methodology

Regular and Non Regular R C buildings of G+4 stories is considered for modeling with bare frame and floating columns at different floors. Designed as per Indian standard codes, the RC buildings are subjected to non seismic loads. The performance of RC structure with and without floating columns for storey displacements, storey drifts, base shear are compared.

III. Modelling

Various parameters such as load intensities, material properties, dimensions of the structural member considered in the modelling of the various types of regular & non regular buildings considered for analysis are mentioned below.

Table 3.1: General features of RC Buildings

Regular building	
No of storey's	G+4
Plan Area	20m×20m×17.5m
Column Spacing	4m
Too long building	
No of storey's	G+4
Plan Area	40m×16m×17.5m
Column Spacing	4m
Too large building	
No of storey's	G+4
Plan Area	40m×40m×17.5
Column Spacing	4m
C type building	
No of storey's	G+4
Plan Area	24m×28m×17.5m
Column Spacing	4m

Table 3.1: Geometrical details of RC building

Type of structure	RCC
Bare frame Support condition	Fixed
Thickness of slab	175 mm

Table 3.2: Structural member of building

Beam size in mm	0.3m×0.45m
Column size in mm	0.3m×0.45m

Table 3.3: Material properties of RC building

Grade of concrete	M25 & M30
Grade of steel	Fe500
Density of concrete	25 kN/m^3
Young's Modulus of Elasticity	27386 x 10^3 kN/m^2
Poison's ratio of concrete	0.2

Table 3.4: Load Intensities

Wall load	22.875 KN/m^2
Parapet wall load	7.5 KN/m^2
Floor finish	1.5 KN/m^2
Floor load	3 KN/m^2

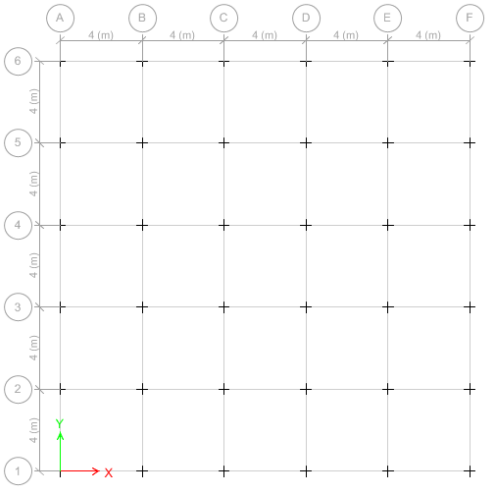

Figure 3.1: Plan of Regular RC building

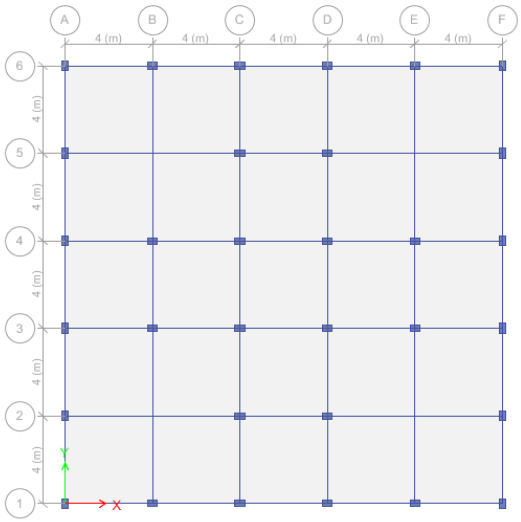

Figure 3.2: Regular RC building with floating columns

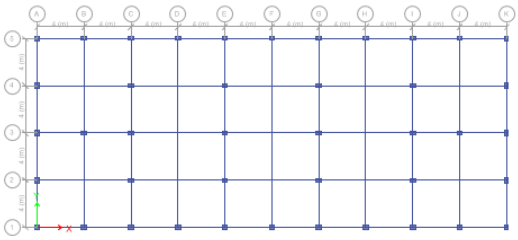

Figure 3.3: Non Regular RC building (Too long) with floating columns

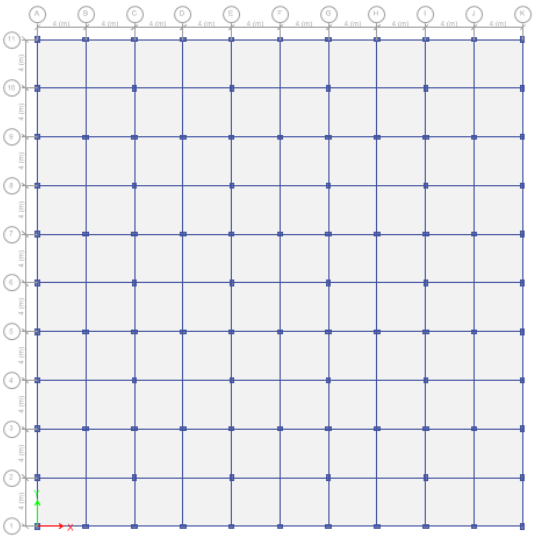

Figure 3.4: Non Regular RC building (Too large) with floating columns

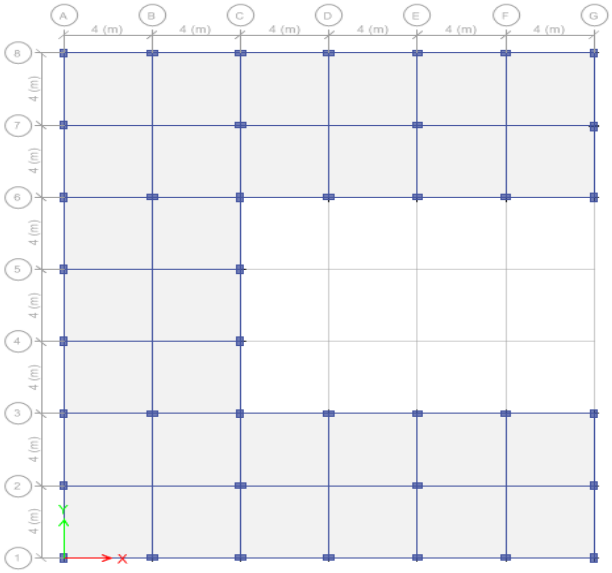

Figure 3.5: Non Regular RC building (C type) with floating columns

IV. Results and discussions

The evaluation of various parameters such as storey displacement, storey shear, storey drift ratio and base shear of RC buildings subjected to non-seismic loads with and without floating columns for regular and non regular RC buildings has been characterized in the below tables.

Table 4.1: Storey shear (kN) for 5 different models of Non Regular RC Buildings subjected (Too long)

	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5
STOREY 5	-1.07E-14	-1.46E-14	-6.71E-15	4.63E-14	4.55E-14
STOREY 4	-1.61E-14	-3.39E-14	1.48E-14	-5.91E-15	5.46E-15
STOREY 3	-1.64E-14	3.07E-14	3.83E-14	9.09E-16	1.21E-14
STOREY 2	-1.76E-14	7.32E-14	3.37E-14	3.71E-14	9.86E-15
STOREY 1	-1.49E-14	5.47E-14	3.62E-14	2.47E-14	5.14E-15

{Model 1 – RC building without Floating columns, Model 2 – RC Building with floating columns in ground floor, Model 3,4 & 5 - RC Building with floating columns in 1st, 2nd & 3rd Floors}

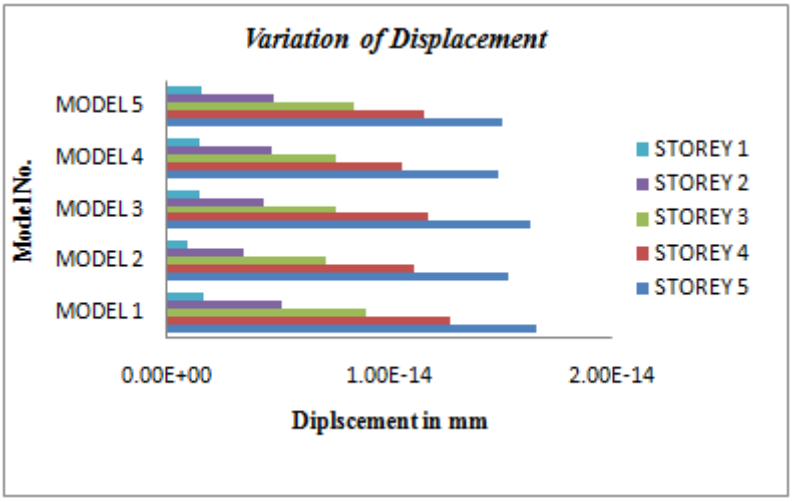

Fig 4.1: Variation of displacement along 'X' direction w.r.t Regular RC building

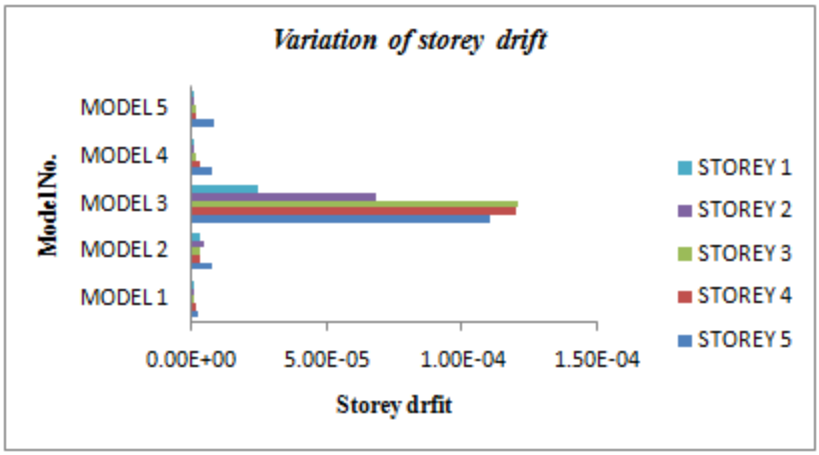

Fig 4.2: - Variation of Storey drift in 'X' direction w.r.t Non Regular RC building (C type)

V. Conclusions

In the current study 20 models of G+4 'Regular and non regular RC buildings' with and without floating columns is modelled and subjected to non seismic loads.

Major conclusions are as follows:

1. When a floating column is provided in Regular RC building at the ground floor the base shear increases equally in corner & intermediate columns, whereas in Non regular RC buildings the base shear increases by more than 2 – 2.5 times in the intermediate columns.

2. In regular RC building without floating column the displacement decreases by 0.2 – 0.5 times, whereas in Non regular RC buildings the displacement increases upto 150 – 200 times in various floors.

3. In regular RC buildings with floating columns the storey shear increases by 2 – 2.5 times whereas in non regular RC buildings the storey shear increases upto 400 times.

4. From the analysis we can conclude that, RC buildings with floating columns in the ground floor will have more impact on the performance of RC Structure when compared with buildings having floating columns in the intermediate floor.

5. Among the non regular RC buildings with floating columns the "Too large" building behaviour is worse when compared with others.

VI. REFERENCES

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