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"COMPARATIVE STUDY OF G+5 RCC BUILDING WITH & WITHOUT FLOATING COLUMNS USING ETABS"

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ABSTRACT

The static method of analysis implemented here is Equivalent Lateral Load Method. All the parameters and formulae considered in our analysis are in compliance with the Indian Standard Codes of practice (IS 1893:2002). Modal & Static Analysis of regular building is carried out and the values of various parameters are compared and tabulated against the values obtained by Static and Modal analysis of building with Floating columns respectively.

Thus, the present study makes an attempt to compare the analysis results of regular building to the building with floating columns with the help of Static analysis and to see the effect of floating columns at various positions in the structure.

Keywords: floating column, mutli-storey G+5 RCC building with floating column, building without floating column

1. INTRODUCTION OF FLOATING COLUMN AND ABOUT ETABS

1.1 GENERAL

India is primarily an agriculturally based country with more than 70% of its population depending directly upon agriculture for their livelihood. During the past decade the country has undergone a stunning transformation towards urbanisation and is a hub for power, coal, steel, aluminium industries to name a few. With the increasing pace towards urbanisation and modernisation there has been a great need for infrastructure incorporating large serviceable areas.

For a hotel or commercial building, where the lower floors contain banquet halls, conference rooms, lobbies, show rooms or parking areas, large uninterrupted space is required for the movement of people or vehicles. Closely spaced columns based on the layout of upper floors are not desirable in the lower floors. So, to avoid that problem floating column concept has come into existence.

This project involves providing floating columns to tackle the existing challenges and to analyse and compare various parameters in the absence of floating columns.

1.2 WHAT IS FLOATING COLUMN

We know that column being a vertical member starts from the foundation level transferring the load to the ground. The term floating column refers to a vertical element which at its lower-level rests on a beam which is a horizontal member. Buildings with columns that rest directly on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in their load transfer path. The beams in turn transfer the load to the columns below it. Floating columns are competent enough to carry gravity loading but transfer beam must be of adequate dimensions (Stiffness) with very minimal deflection

1.3 NEED FOR FLOATING COLUMNS

With the ever-increasing rate of modernisation and industrialisation there has been a huge demand for industrial and commercial infrastructure. In commercial and industrial buildings, a large serviceable area is desired from serviceability point of view where core or internal columns are to be removed to provide a large service area resulting in floating columns at a particular storey. These floating columns must be designed carefully to avoid failure of the structure.

1.4 Extended Three-Dimensional Analysis of Building System (ETABS)-2015

New ETABS is more inventive and ultimate integrated software package for the structural analysis and design of buildings. Absorbing 40 years of incessant research and development, this current ETABS provides 3D object-based modelling and visualization tools, blazingly fast linear and nonlinear analytical power, sophisticated and comprehensive design capabilities for extensive materials, displays, reports, and schematic drawings which provide support by making engineers to decrypt analysis and design results.

ETABS helps at every-step of structural design, designing has become less complex with inventive drawing commands which allow for instant generation of floor, elevation and framing plan. ETABS enabled design engineers to plot CAD drawings directly into ETABS models or used as templates onto which ETABS objects may be overlaid.

ETABS provides an unequalled suite of tools for structural engineers designing buildings, whether they are working on one-story industrial structures or the tallest commercial high-rises. ETABS, since its launch and till today conventionally help Engineers to design minor and mega structure more securely.

2. OBJECTIVE OF STUDY

The objective of this study to do comparative analysis of RCC buildings with and without floating columns at different positions for a G+5 structure keeping all the sectional properties and design parameters are same using ETABS-2015(Extended 3D Analysis of Building Systems). The comparison of various indices has been opted for structure with and without floating columns.

3. LITERATURE REVIEW

In this comparative study of a RCC building with and without floating columns by static as well as dynamic analysis using ETABS-2015 software. We have done brainstorming to evaluate the overturning moment, base shear, storey shear & deflection at the frame members as well as joints. Our purpose is to evaluate these parameters at different locations in the building and to see their effect by positioning the floating columns at the locations chosen by us. However, as we progress in the project, we have checked the behaviour of the structure under earthquake loads. Along with this we worked out for dynamic analysis by using the method of Response Spectrum.

4. DETAILS OF BUILDING MODEL

4.1 PARAMETER AND SPECIFICATION OF TYPE G+5 Regular BUILDING

Table 1 Details Of G+5 RCC Building Model: -

Sr. No	Parameter	Specification
1.	Grade of Concrete	M25
2.	Dead load	Self-Weight of the Building
3.	Live Load on Floors	$3kN/m^2$
4.	Masonry Load on Roof	8.05kN/m
5.	Masonry Load on Floors	16.1kN/m
6.	Thickness of Slab	150mm
7.	Thickness of External Wall	230mm
8.	Height of Each Floor	3.5m
9.	Support Conditions	Fixed
10.	Density of Brick	$20kN/m^3$
11.	Number of Stories	6
12.	Parapet Wall Height	1750mm
13.	Dimension of Beam	300x500mm
14.	Dimension of Column	450x450mm
15.	Size of the building	20mx20m

4.2 Base Shear Parameters

Table 2 Base Shear Parameters: -

Sr.No	Parameter	Value
1	**Zone factor**	**0.16**
2	**Response Reduction Factor**	**3**
3	**Importance Factor**	**1.0**

4.3 MODEL OF REGULAR BUILDING

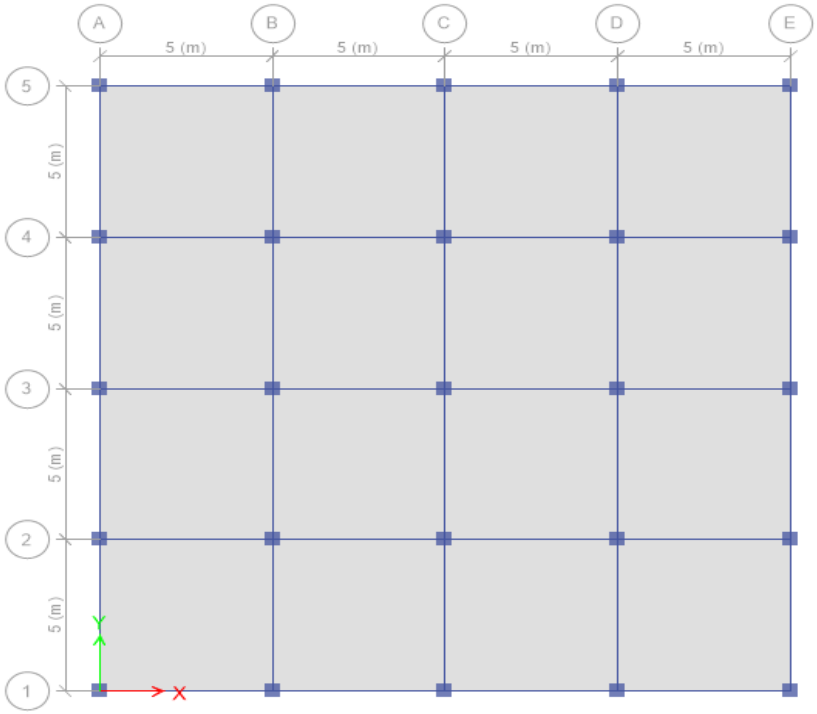


Fig.1 Plan of the Regular Building

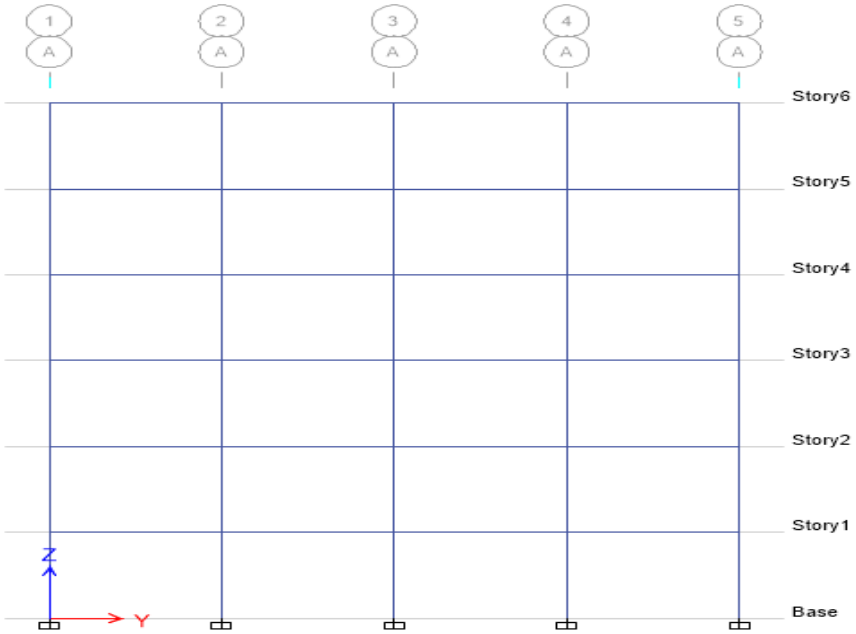
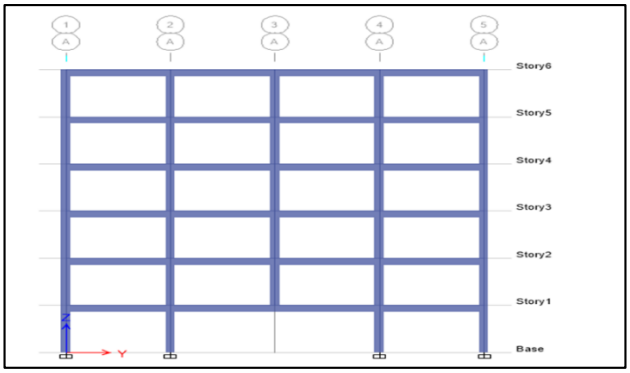


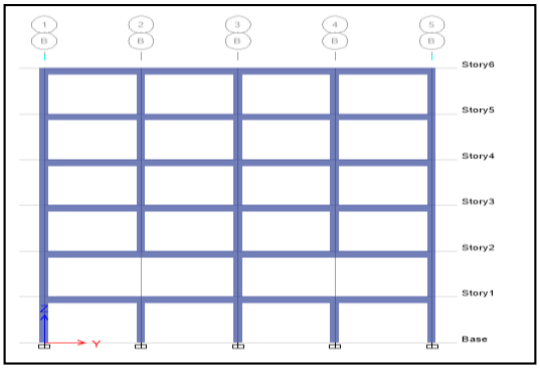
Fig. 2 Regular building model

4.4 BUILDING WITH FLOATING COLUMN

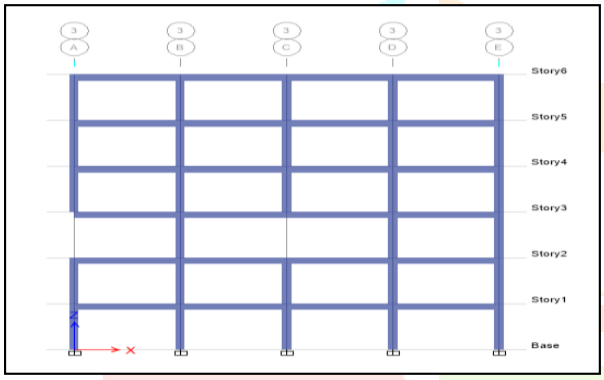
MODEL 1



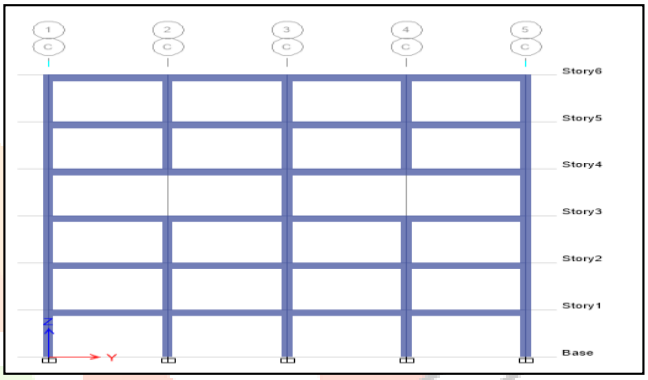
MODEL 2



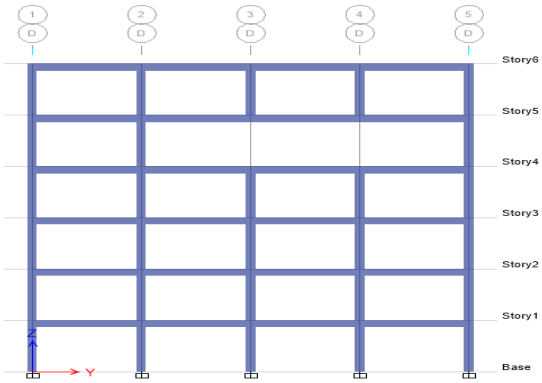
MODEL 3



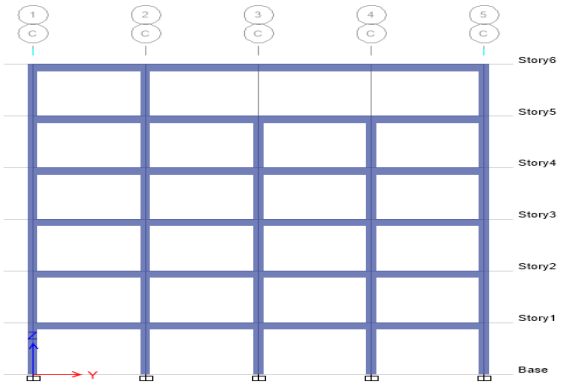
MODEL 4



MODEL 5



MODEL 6



5. RESULT & DISCUSSION

After the analysis of the Regular Building, Model-1, Model-2, Model-3 , Model-4, Model-5, Model-6 respectively we have obtained the following results as shear, overturning moment and displacement due to static (ELF) analysis.

5.1 Comparison of Storey Shear in case of Static Analysis

Table 4– Storey Shear in case of Static Analysis

Storey Shear (in KN)							
Storey	**RB**	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**
	kN	kN	kN	kN	kN	kN	kN
Base	0	0	0	0	0	0	0
Storey1	1653.12	1654.58	1651.5169	1651.62	1649.85	1649.41	1649.17
Storey2	1626.77	1627.45	1625.3627	1625.29	1623.52	1623.05	1622.78
Storey3	1539.27	1539.41	1537.7027	1538.22	1536.07	1535.5	1535.1
Storey4	1352.09	1351.9	1350.3367	1351.53	1350.53	1348.18	1347.49
Storey5	1026.09	1025.77	1024.5658	1025.6	1026.14	1024.64	1020.7
Storey6	521.979	521.745	521.1316	521.708	521.942	522.547	519.592

From the table above we find out that the % variation of maximum storey shear in Model-1, Model-2, Model-3, Model-4, Model-5 & Model-6 with respect to Regular Building is obtained as, 0.08%, 0.1%, 0.11%, 0.2%, 0.23%, 0.24% respectively.

5.2 Comparison of Overturning Moments In case of Static Analysis

Table 5- Overturning Moments In case of Static Analysis

Overturning Moment (in KNm)							
Storey	**RB**	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**
Base	27017.62	27023.01	26987.16	26999.6527	26978.22	26961.66	26931.9
Storey1	21231.7	21231.98	21206.85	21218.6958	21203.73	21188.74	21159.82
Storey2	15538.02	15535.9	15518.08	15529.9136	15521.41	15508.06	15480.1
Storey3	10150.57	10147.97	10136.12	10145.9064	10145.15	10133.8	10107.24
Storey4	5418.24	5416.306	5409.941	5415.5112	5418.286	5415.167	5391.026
Storey5	1826.927	1826.108	1823.961	1825.9377	1826.798	1828.913	1818.572
Storey6	0	0	0	0	0	0	0

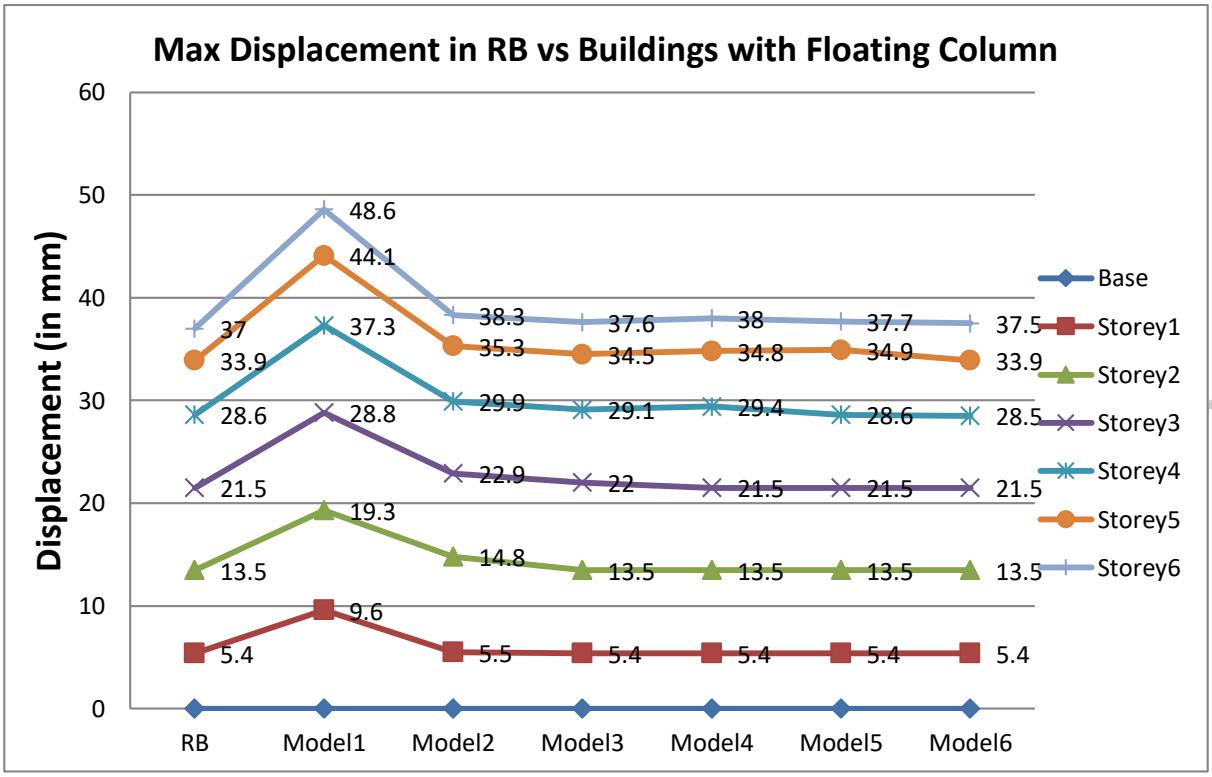
From the table above we find out that the % variation of maximum overturning moments in Model-1, Model-2, Model-3, Model-4, Model-5 & Model-6 with respect to Regular Building is -0.02%, 0.11%, 0.07%, 0.15%, 0.21%, 0.32% respectively

5.3 Max Displacement due to Static (ELF Method) Analysis

The Table below gives the values of maximum displacement due to Static Analysis-

Table 6- Max Displacement due to Static (ELF Method) Analysis

Displacement(mm)							
Storey	**RB**	**Model1**	**Model2**	**Model3**	**Model4**	**Model5**	**Model6**
Base	0	0	0	0	0	0	0
Storey1	5.4	9.6	5.5	5.4	5.4	5.4	5.4
Storey2	13.5	19.3	14.8	13.5	13.5	13.5	13.5
Storey3	21.5	28.8	22.9	22	21.5	21.5	21.5
Storey4	28.6	37.3	29.9	29.1	29.4	28.6	28.5
Storey5	33.9	44.1	35.3	34.5	34.8	34.9	33.9
Storey6	37	48.6	38.3	37.6	38	37.7	37.5



Relation of Max Displacement in RB & Building with Floating Columns

From the table and the graph plotted above we find that the maximum % variation of maximum displacement, at the position where floating columns are provided, with respect to Regular Building is obtained in Model-1 where the floating column is provided at the storey1. Its value is 77.8%. Similarly in Model-2, Model-3, Model-4, Model-5 & Model 6, the variation in maximum displacement is 9.7%, 2.35%, 2.80%, 2.96% & 1.36% respectively.

5. CONCLUSION

From the Static Analysis carried out for the Regular Building and Building with Floating Columns we found out that-

1. The % variation of maximum storey shear in Model-1, Model-2, Model-3, Model-4, Model-5 & Model-6 with respect to Regular Building was obtained as, -0.08%, 0.1%, 0.11%, 0.2%, 0.23%, 0.24% respectively. Thus, we can say that the provision of floating column has a little effect in storey shear of the building. This is because of the fact that there is not much variation in the overall weight of the building.

2. The % variation of maximum overturning moments in Model-1, Model-2, Model-3, Model-4, Model-5 & Model-6 with respect to Regular Building is -0.02%, 0.11%, 0.07%, 0.15%, 0.21%, 0.32% respectively. Thus, again we can say that there is not much variation in the overturning moment in regular buildings and building with floating columns.

3. The maximum % variation of maximum displacement, at the position where floating columns are provided, with respect to Regular Building is obtained in Model-1 where the floating column is provided at the storey1. Its value is 77.8%. Similarly in Model-2, Model-3, Model-4, Model-5 & Model 6, the variation in maximum displacement is 9.7%, 2.35%, 2.80%, 2.96% & 1.36% respectively. Thus, we find that the displacement is maximum when the floating column is provided at the storey1, however in stories other than the storey1, the variation in displacement with respect to Regular Building is comparatively less.

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