Effect Of Floating Column On Irregular Buildings Subjected To Lateral Loads

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Abstract: Floating column is a feature of the modern construction industry which is used to increase the maximum use of area, or due to the architectural requirement of large column free space. Whatever the reason is use of floating columns in seismic areas is very dangerous. Due to continuous pressure from the industry to deliver some fresh and new designs, the designers have started making irregular plans of buildings with extensive use of floating columns in it at one or more than one floors. This study tells us about the behaviour of irregular structures with and without floating columns in seismic areas. Various models are made by varying the location of floating column and the analysis is done in STAAD Pro.

Indexterms – Floating column, irregular plan, seismic areas, staad pro.

I. INTRODUCTION

Floating column is a vertical structure which rests on a beam instead of a foundation. It acts as a point load on the beam on which it rests and this beam transfer its load to the ground. The performance of a building in a seismic zone is dependent on the ability of the building to transfer the earthquake forces to the ground by the least hindering path, but the floating columns brings a discontinuity in this load transfer path which results in unsatisfactory performance of the building. The use of floating column has been increased day by day due to need of large open spaces for parking or halls for other gatherings. The need of this large column free space has bring the concept of use of floating columns. In the present study we have studied the building model with floating column as well as without floating columns and their properties such as storey drift, storey displacement,& max displacement is compared with respect to various load combinations provided in IS Code 1893. We also found out that whether floating columns are suitable for use in seismic prone areas or not.

II. LITERATURE REVIEW

[1] S. Shah (2015), carried out a study on multi-storey building with and without floating columns in seismic zones. A model has been made in ETABS to study the behaviour of multi-story frame. The dynamic analysis done is studied by changing the size of columns. The study explained that with increase in number of columns at the bottom storey, the maximum displacement is reduced and base shear changes with the change in the dimensions of the columns.

[2] S. A. Bhoyar (2017), carried out a study to study the various parameters of a building which uses floating column in its design. The position of the floating column is varied within the floor and found out that the lateral displacement is more in the structure when floating columns is used and its value increases with increase in number of floating columns.

[3] S. G. Nanabala, P. K. Ramancharla *et al* (2014), conducted a study to find whether the structure which uses floating column is safe or unsafe when built in seismically active areas and also find out whether it is economical to build floating column building in seismically active areas. They concluded that floating column building will suffer extreme soft storey effect where normal building is free from soft storey effect by observing the lateral stiffness at each floor. Due to which the floating column building is considered dangerous. Total quantity of steel and concrete used in both the structures is then compared with each other and found out that the building which uses floating column has around 45% more reinforcement and around 50% more concrete quantity than a normal building. So the floating column building is uneconomical when compared with a normal building.

[4] C. P. Pise *et al* (2017) has done a study in which static analysis is done for a multi-storey building with and without floating columns. Different cases of the building are studied by varying the location of floating columns to different storeys. The analysis is carried out using software sap2000. The study revealed that in buildings as we introduce floating column at 1st floor we observe a rapid fall in the base shear of such buildings as compared to the buildings that uses no floating columns. It also reveal that base shear first decreases at 1st floor and then it increases from 1st floor to upwards & the displacement of floating column building is more as compared to without floating column building.

III. OBJECTIVES

i. To find out the effect of use of floating columns at various levels in an unsymmetrical frame when it is subjected to lateral loads i.e. seismic events.

ii. To find out storey drift, & storey displacement.
iii. To find if floating column is good for use in a seismic zone.

IV. METHODOLOGY

Seismic analysis of a structure can be performed by either static analysis or by dynamic analysis. In this study we are going to use static analysis by following the design spectrum given in IS code 1893 (Part 1): 2002 with the help of a analysis and designing software known as STAAD Pro. Total no. of four models were analysed in this study by varying the location of floating columns as described below.

i. Model A : No floating column is used
ii. Model B : Nine floating columns are used in ground storey
iii. Model C : Nine floating columns are used in first storey
iv. Model D : Nine floating columns are used in second storey

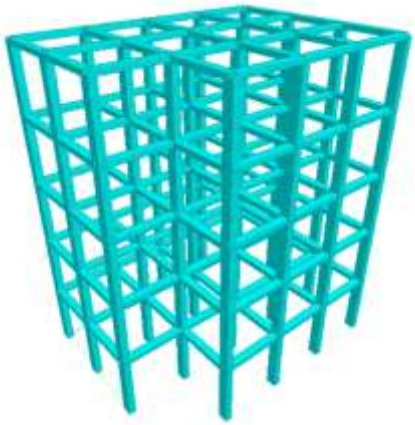

Fig.4.1 View of Staad 3d model

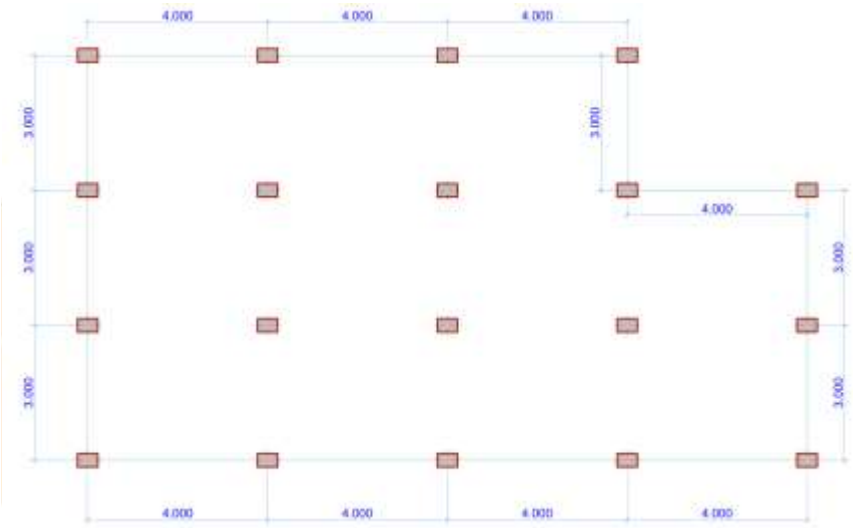

Fig.4.2 Plan of model

Load combinations were taken from the table 6.3.1.2 of IS 1893 (Part 1): 2002

i. 1.5 (DL + IL)
ii. 1.2 (DL + IL ± EL)
iii. 1.5 (DL ± EL)
iv. .9 DL ± 1.5 EL

Where "DL" stands for dead load, "IL" stands for imposed load or live load & "EL" stands for earthquake load.

The earthquake load is taken in x direction as well as in z direction, so there is total 13 load combinations which is applied on the structure during analysis.

V. RESULT

Analysis of all the four models were carried out by commercial software STAAD Pro. & the storey drift and the storey displacement is obtained from each model at different levels. This data is then tabulated in tables form and then graphs are made from them for easy understanding and comparison of data of all the four models.

5.1 Storey drift of all four models

Table 5.1: Storey drift of models in X direction

Storey	Storey drift (cm)			
	Model A	Model B	Model C	Model D
0	0	0	0	0
1	0.2002	0.3936	0.2002	0.1929
2	0.3320	0.5238	0.5238	0.3313
3	0.3252	0.5116	0.5116	0.5253
4	0.2603	0.4487	0.4510	0.4416

5	0.1601	0.3565	0.3594	0.3504

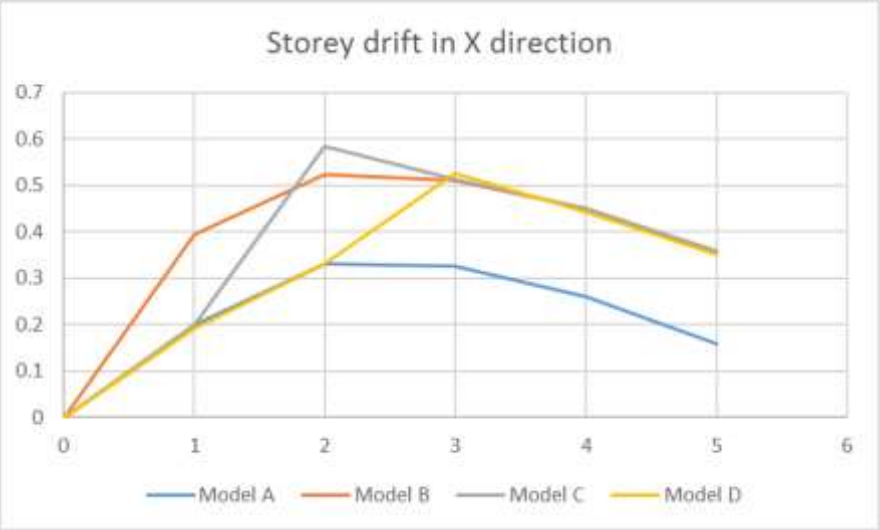

Fig. 5.1: storey drift in x direction

Table 5.2: Storey drift of models in Z direction

Storey	Storey drift (cm)			
	Model A	Model B	Model C	Model D
0	0	0	0	0
1	0.1396	0.3090	0.1501	0.1348
2	0.2656	0.5671	0.4904	0.2608
3	0.2784	0.5877	0.5750	0.3466
4	0.2339	0.5480	0.5467	0.2583
5	0.1625	0.4819	0.4845	0.1913

Fig. 5.2: storey drift in z direction

5.2 Displacement of all four models

Table 5.3: Displacement of model in X direction

Storey	Displacement (cm)			
	Model A	Model B	Model C	Model D
0	0	0	0	0
1	0.2002	0.3936	0.1974	0.1929
2	0.5322	0.9174	0.7837	0.5242
3	0.8574	0.6638	1.2972	1.0495
4	1.1177	1.8777	1.7841	1.4911
5	1.2778	2.2342	1.8480	1.8416

Fig. 5.3: displacement in x direction

Table 5.4: Displacement of model in Z direction

Storey	Displacement (cm)			
	Model A	Model B	Model C	Model D
0	0	0	0	0
1	0.1389	0.1547	0.1226	0.1348
2	0.4026	0.3618	0.3984	0.3956
3	0.6778	0.5825	0.5784	0.7421
4	0.9078	0.7724	0.7345	1.0005
5	1.0660	0.9162	0.8782	1.1918

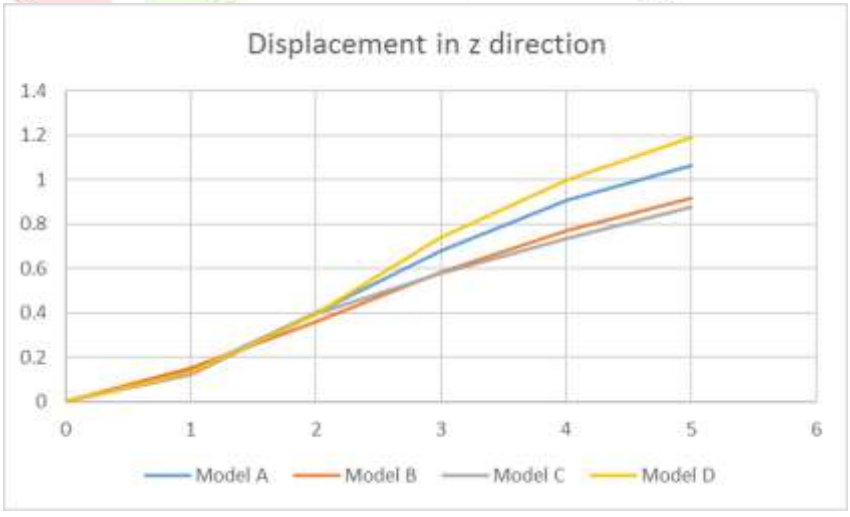

Fig. 5.4: displacement in z direction

VI. CONCLUSION

From this study we can conclude that the use of floating column has huge impact on the stability of the structure. The structure which uses floating column has high displacement as well as high storey drift when compared with the structure which has no floating column. The change in these values depends on the position of the floating column in horizontal as well as vertical direction. The model which uses floating column at the base has more storey drift and displacement as compared with the structure which has floating column on first and second storey. The values of storey drift increases rapidly till third floor and then they starts decreasing while the displacement keep on increasing when we go upwards. So we can conclude that it is not safe to use floating column in high seismic zone due to the high storey drift and displacement which floating column produces.

REFRENCES

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