SEISMIC ANALYSIS OF MULTI-STOREY REINFORCED CEMENT CONCRETE FRAMES WITH FLOATING COLUMNS

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ABSTRACT:
In Today's era buildings with floating column is a complex construction practice in the multi storey building construction in urban India. Buildings with irregularities show completely different behavior than regular buildings when subjected to earthquake loads. The buildings with floating columns are considered as irregular buildings thus its important to study and understand its behavior and compare it with the regular ones.

In the present study eight storey buildings (G+8) have been taken into consideration to study the effect of earthquake forces on the structural elements with or without floating columns. Alternate design measures are also proposed in this thesis such as different structural element cross section and member properties to reduce the effect caused by floating columns. The analysis of the structures is done by response spectrum analysis using STAAD Pro software. The height wise distribution of the peak storey shear, displacement and storey drift has been studied and compared with buildings with and without floating columns. Members are also designed using IS: 13920 and IS: 456. It has been found that storey displacements and drift increases from the level of floating column along the height of the structure. Special attention is required for the design of the structural elements along the floating column periphery.

KEYWORDS - floating columns, response spectrum analysis, storey drift, storey displacements, base shear.

INTRODUCTION:
Many Urban multi-storey building 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 floating column is a vertical member which rest on a beam doesn't have a foundation. The Floating column act as a point load on the beam and this beam transfer the load to the columns below it. But such column cannot be implemented easily to construct practically since the true column below the termination level are not constructed with care and hence finally causes to failure.

Floating column structures are the structures which are of more interest of architects all over the world. Because of the advantage that more open space is available due to the limit use of columns without much obstacles. These are more commonly used in urban areas where space is an issue. All the recent multi-storey buildings are made by the concept of floating columns.

The objective of study are as following:To carry out seismic analysis of RC multi-storey frame with and without floating columns; To study the structural response of the building models with respect to following aspects: Peak Storey Shear, Storey Displacement, Storey Drift, Fundamental Time Period. To compare the

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forces and moments at critical section in beam and column. To design the building subjecting to seismic forces as per IS 13920 code.
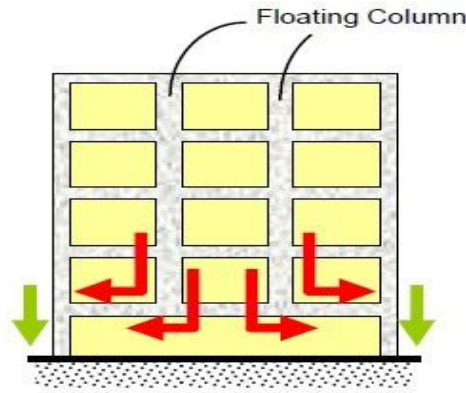

Figure 1: Floating Column

MODELLING & MATERIAL SPECIFICATIONS

STAAD Pro software is used for the analysis and seismic design of building frames. STAAD stands for Structural analysis and design program. This software is capable to analyze 2-D and 3-D building frames subjected to seismic loads and it can perform response spectrum method to obtain the required results. Software can also be design the building frames as per IS 13920 code.
There are various type of models are analyzed with different cases. The model is eight storey building with plan size 25x25m^2.

Table 1: Material Specifications

Name	E kN/mm2	Poisson's Ratio	Density kg/m3	Alpha /°C
STEEL	205.000	300E-3	7833.413	12E-6
ALUMINUM	68.948	330E-3	2712.631	23E-6
BRICK	14.000	220E-3	1937.461	3.1E-6
CONCRETE	21.718	170E-3	2402.615	10E-6

$E_c = 5000 \sqrt{f_{ck}}$ N/mm^2 = $5000 \sqrt{f_{ck}}$ MN/m^2
Steel
HYSD reinforcement of grade fe415 confirming to IS: 1786 is used throughout
Table 2 as sectional dimensions.

Table 2: Sectional Dimensions

Live load	:	3.5kN/m^2 at typical floor
	:	1.75kN/m^2 on terrace
Zone	:	II
Earthquake load	:	As per IS-1893(Part1) -2002
Type of soil	:	Type II, Medium soil condition as per IS:1893

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Building height	:	28 m
Storey height	:	3.5 m
Column size	:	$0.5 \times 0.35 \text{ m}^2$
Main Beam size	:	$0.4 \times 0.8 \text{ m}^2$
Thickness of wall	:	0.23 m
Damping in structure	:	5%
Importance Factor	:	1.0

CASES CONSIDERED IN MODELLING

Following four cases are considered for MODEL for the analysis purpose
- Model 1: Regular 8 storey building with usual columns
- Model 2: 8 storey building with floating from 5[th]storey to 8[th]storey in center position.
- Model 3: 8 storey building with floating from 6[th]storey to 8[th]storey in center position.
- Model 4:8 storey building with floating from 7[th]storey to 8[th]storey in center position.
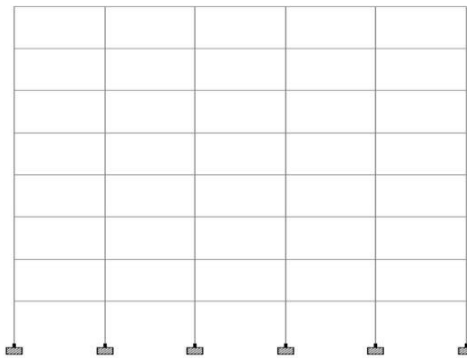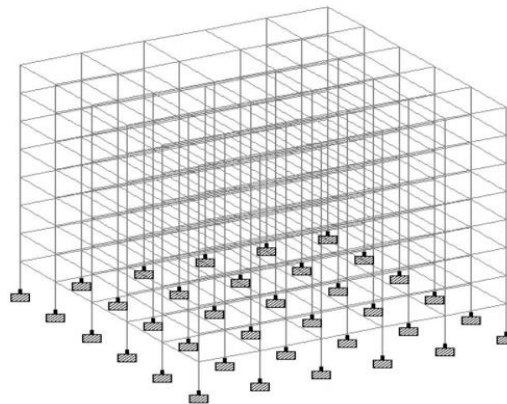

Figure 2: Elevation View
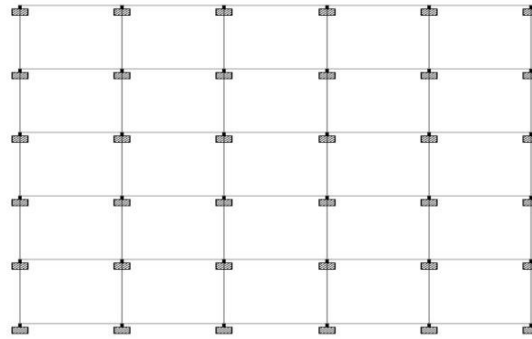

Figure 3: Isometric View

Figure 4: Plan View

RESULTS & DISCUSSION

This chapter deals with the result and analysis of the models. The analysis is done on STAAD Pro V8i software. All the models are analyzed and results obtained after the analysis is presented here. The focus of the study is to analyze the various frames with and without floating columns for response spectrum analysis and study the behavior change and compare them with regular frame works. All the significant details regarding the analysis is discussed in chapter. This chapter gives the analysis results and comparison of both the models. These comparison is done in various parameters such as, Time Period, Storey Displacement, Storey Drift, Peak Storey Shear, Shear Force and Bending Moments in critical elements.
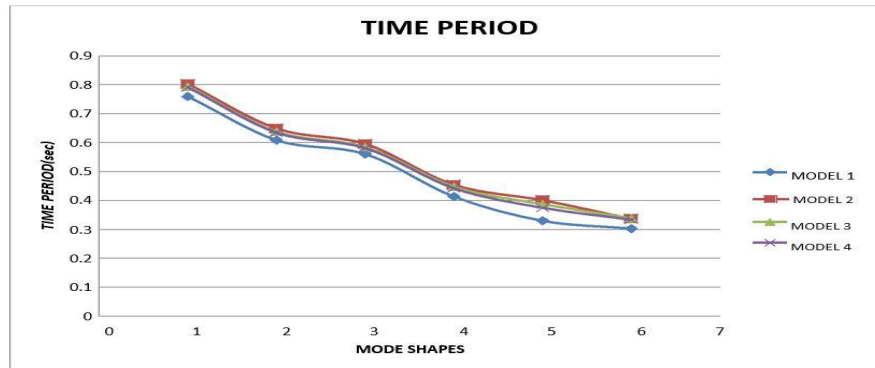
TIME PERIOD –

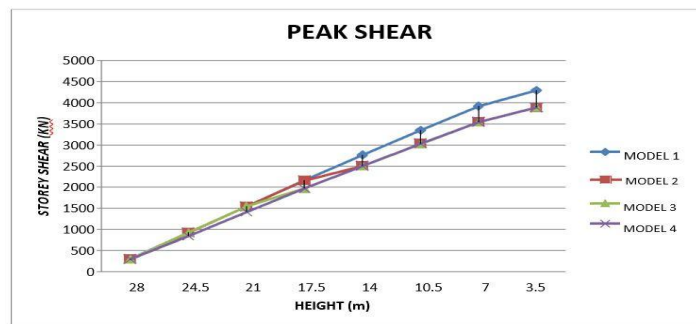Figure 2: Time period for 8 storey frame

PEAK SHEAR –

Figure 3: Peak storey shear

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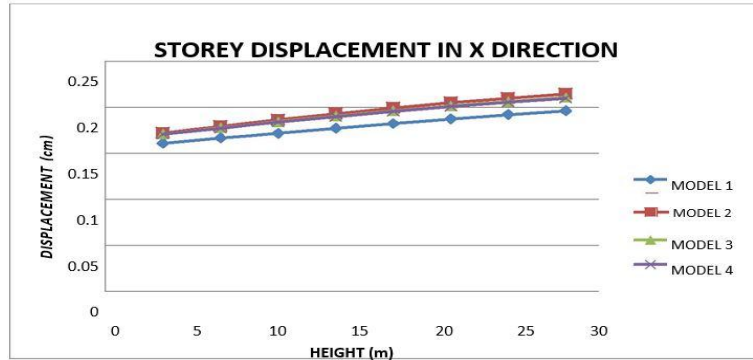## STOREYDISPLACEMENT –

Figure 4: Displacement in 8 storey structure in x direction
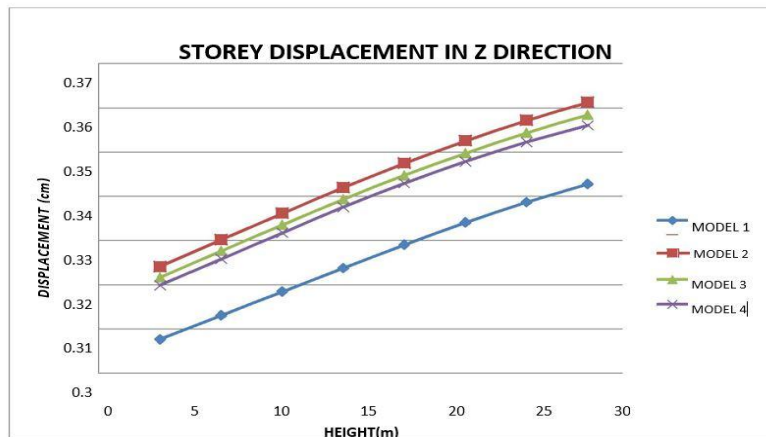

Figure 8: Displacement in 8 storey structure in z direction

STOREY DRIFT–

Figure 9: Storey drift in 8 storey structure in x direction

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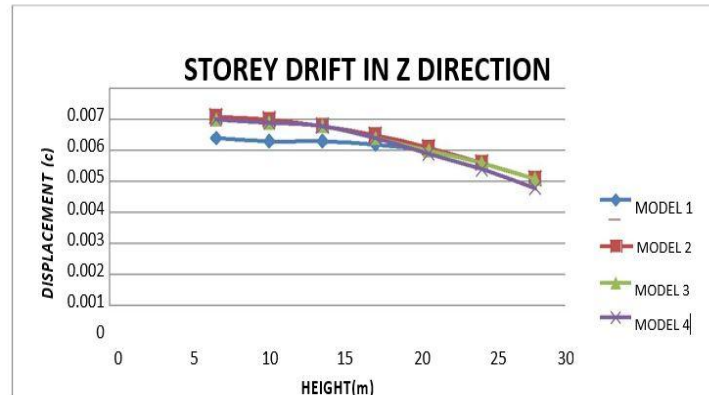editor@ijarets.org

Figure 10: Storey drift in 8 storey structure in z direction

Since the maximum reinforcement in the columns and beams is under 4%. Hence there is no failure in the frames while it can be seen that the area of reinforcement for frame having floating column is more than the regular frame due to the discontinuity in the structure.

There is 35-40% increase in the reinforcement in the frame as compared to the regular frame

CONCLUSIONS

Based on the thesis work done, the following conclusion can be derived regarding the seismic behavior of building frames with and without building floating column

- The storey displacement in the models having floating column is more compared to the ones without floating column whereas the models with increased cross-sectional properties show less displacement.
- The models with the floating column has less base shear and storey shear than regular building while frame with increased cross-sectional properties show more.
- The effects caused by floating column which are created on removing the columns of lower storey are more critical than the upper storey.
- The time period of the frames with floating columns is more than the regular frames. The time period with the increase in mode number is also less.
- The storey drift in asymmetrical model is quite more than the symmetrical frames.
- The bending moments, axial forces, and shear force of frames with floating column is also more.
- The total reinforcement required as per the design provision based on IS-13920 of structural elements are more in case of frames with floating column as compared to that of regular frame by 35-40 percent.

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