SEISMIC ASSESMENT OF MULTISTOTIED BUILDING WITH FLOATING COLUMN

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Abstract - *Modern multi-story building are constructed with irregularities such as soft story, vertical or plan irregularity, floating column and heavy loads. These types of structure have become a very common construction practice in urban India. It is observed that most of RC structure with such irregularities constructed are highly undesirable in seismically active areas from the result of past earthquake studies. These effects occur due to various reasons, such as non-uniform distribution of mass, stiffness and strength. This study explains the seismic analysis of a multi-story building with floating column constructed in seismically active areas observing its reaction to the external lateral forces exerted on building in various seismic zones using the software STAAD PRO V8i. The highlighting the alternative measures involving in improvising the non-uniform distribution in the irregular building such as multi-storied building with floating column, and recommended the safer design of such building in seismically active areas considering the result observed from story drift, story displacement, base shear, when compared to response spectrum method shows best results.*

Key Words: **Floating column, Seismic analysis, STAAD PRO V8i, Story drift, Story displacement, Base Shear.**

1. INTRODUCTION

India is a developing country, where urbanization is at the faster rate in the country such as adopting the methods and type of constructing buildings which is under vast development in the past few decades. As a part of urbanization multi-storey buildings with architectural complexities are forced to be constructed. These complexities are nothing but soft storey, floating column, heavy load, the reduction in stiffness, etc. Now a day's most of the urban multi-storey buildings have open first storey as an unavoidable feature. Accommodation of parking or reception lobbies is the primary use of this open first story in the multi-storey buildings constructed. But Conventional Civil Engineering structures are designed on the basis of strength and stiffness criteria. Usually the ground storey is kept free without any constructions, except the columns which transfer the building weight to the ground. This thesis adopts the multi-storey building with a architectural complexities. The complexity of a multi-storey building with "Floating column" and the behavior of the building in higher seismic zones is observed and considered some recommendations.

Research Significance

In urban areas, multi storey buildings are constructed by providing floating columns at the various floor for the various purposes like parking spaces, conference halls etc. These floating column buildings are designed for gravity loads and safe under gravity loads but these buildings are not designed for earthquake loads. So these buildings are unsafe in seismic prone areas. The paper aims to create awareness about these issues in earthquake resistant design of multistoried buildings.

FLOATING COLUMNS

A column is supposed to be a vertical member starting from foundation level and transferring the load ultimately to the ground. "Floating Column" is also a vertical element which at its lower level rests on abeam which is a horizontal member. At present, a building with floating column is a typical feature in the modern multistory construction. There are many projects in which floating columns are adopted, especially above the ground floor, where transfer girders are employed, so that more open space is available in the ground floor. As the load path in the floating columns is not continuous, they are more prone to the seismic activity.

OBJECTIVES OF PRESENT STUDY

In this present project, the following aspects are attempted to study.

1. Modeling of the multi-storey building with and without floating column using STAAD PRO V8i,

2. Comparative study is done between the multi-storey building with and without floating column in different zones, when the floating column are present at the same floor and different location in the building,

3. Comparative study on variations in the structural response in the structure due to seismic excitation is also performed,

4. The building with floating column is tending to fail at seismic excitations; hence the recommendations for the earthquake resistant design of the considered buildings are modeled and analyzed.

5. The main objective of the study is to provide an economical and safe design of a building with floating column at seismic zones with recommending some design recommendations as there is no specified provision or magnification factor provided in I.S codes for this type of irregularities.

MODELLING OF THE BUILDING

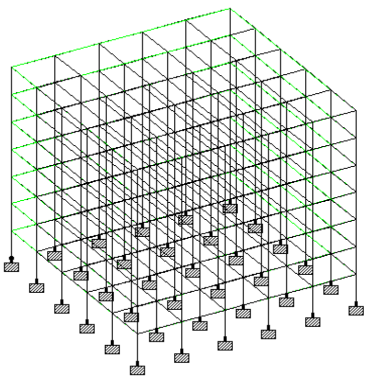
Model 1: G+6 building without floating column

Model 2: G+6 building with floating column at Edge column position,

Model 3: G+6 building with floating column at Centre portion

Model 4: G+6 building with floating column at parallel positions

Model 5: G+6 building with floating column with recommendations, such as Shear wall, Infill wall and Steel bracing system, G+6 building with floating column at Edge column position with recommendations considering Shear wall.



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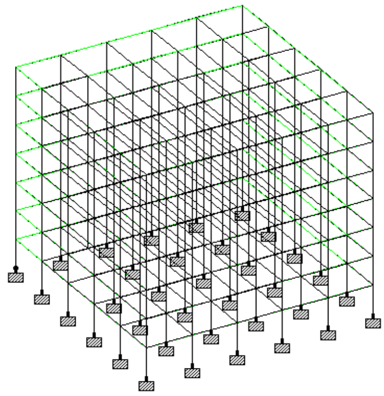
Model 1: building without Floating column



Model 2: Building with floating column

Height: 32m, Plan dimension: 30m x 20m,

Soli type: Medium

Seismic zone: III

Table 1: Details of Building Models

Member Dimension		
Slab	Thickness	120mm
Beam	Normal Building	300 x 500mm
	Floating column building	300 mm x 500mm to300 mm 600mm
Column	Normal Building	400 mm x 400mm
	Floating column building	400mm x 400mm to 600mm x 600 mm
Brick infill wall Thickness	Exterior wall	250mm
	Interior wall	150mm
Shear wall	Thickness	250mm
Loads		
Unit Weight of Concrete		25 KN/m2
Unit weight of brick infill		20 KN/m2
Floor Loads	Live Load	3.5
	Dead Load	1
Roof Loads	Live Load	1.5
	Dead Load	1
Beam		Fe415
Column		Fe415
Grade of Concrete		M30

ANALYSIS OF BUILDING

In India, Indian standard criterion for earthquake resistant design of structures IS 1893:2002 (Part 1) is the main code that provides outline for calculating seismic design forces. This force depends on the mass and seismic coefficient of the building and the latter in turn depends on properties such as seismic zone in which the structures lies, importance of the structure the soil strata, its stiffness and its ductility.

Response spectrum Method

Response spectrum method is a linear dynamic analysis. This method is applicable for structures where modes other than the fundamental one affect significantly the response of the structure .In this method, the response of Multi Degree of Freedom (MDOF) system is expressed as the superposition of modal response, each of the modal response being determined from the spectral analysis of Single Degree of Freedom (SDOF) system, which are then combined to compute the total response. Modal analysis leads to the response history of the structure to a specified ground motion; however, the method is usually used in conjunction with a response spectrum method.

Shear walls

Shear walls are specially designed structural walls included in the buildings to resist horizontal forces that are induced in the plane of the wall due to wind, earthquake and other forces. They are mainly flexural members and usually provided in high rise buildings to avoid the total collapse of the high rise buildings under seismic forces. Shear walls have very high in plane stiffness and strength, which can be used to simultaneously resist large horizontal loads and support gravity loads, making them quite advantageous in many structural engineering applications.

RESULT AND DISCUSSIONS

By the application of lateral loads to the structure can be analyzed for various load combinations given IS 1893:2002. For the given load combinations the displacement, drift, total base shear at each floor is noted and are shown below in the form of a graph

DISPLACEMENT VARIATION FOR VARIOUS MODELS

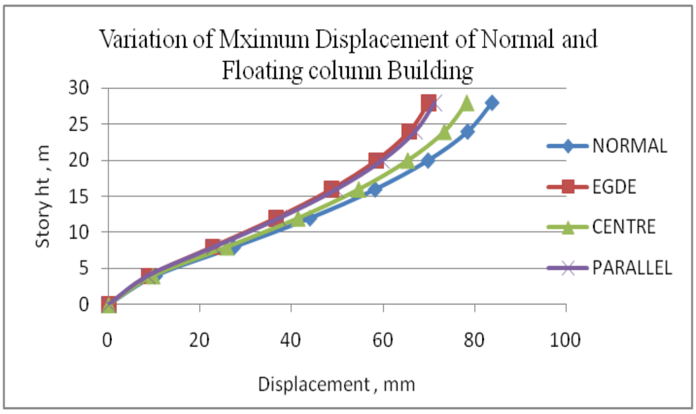


Fig: 1

The above figure shows that, in this study it is observed that the displacement in building having floating column at Edge and Parallel position is almost same and it decreases by 16.57% as compared to Normal building. Also , The displacement in building having floating column at centre position decrease by 6.58%.

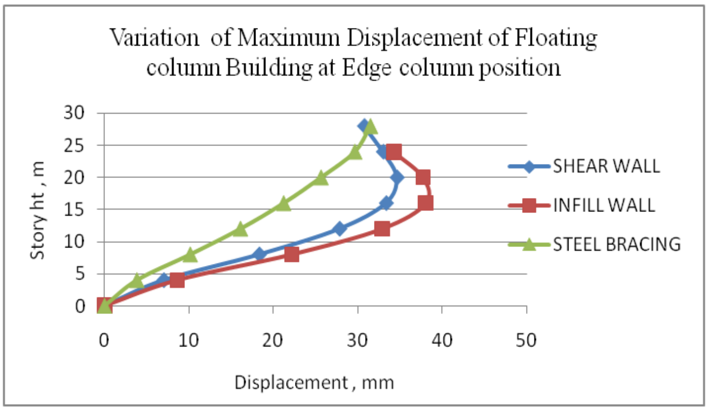


Fig: 2

From above figure, the displacement of floating column building at Edge column position with recommendation of provision of Shear wall, Infill wall and Steel bracing. It is observed that the displacement is increases by 22.22% in structure with infill wall and decreases by 45% in structure with steel bracing as compared to structure with Shear wall.

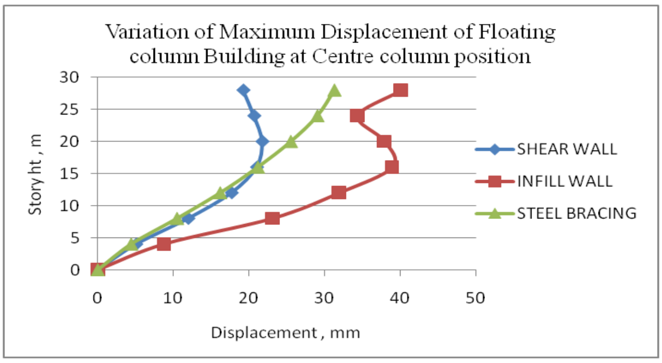


Fig: 3

From above figure, the displacement of floating column building at Centre column position is increases by 22.22% in structure with infill wall and decreases by 37.26% in structure with steel bracing as compared to structure with Shear wall.

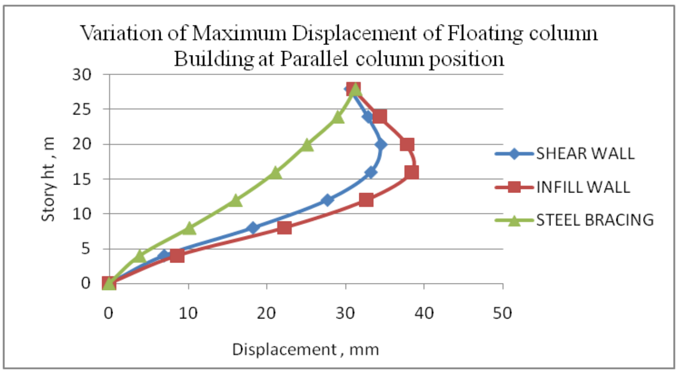


Fig: 4

From above figure, the displacement of floating column building at Centre column position is increases by 23.60% in structure with infill wall and decreases by 44.20% in structure with steel bracing as compared to structure with Shear wall.

DRIFT VARIATION FOR VARIOUS MODELS

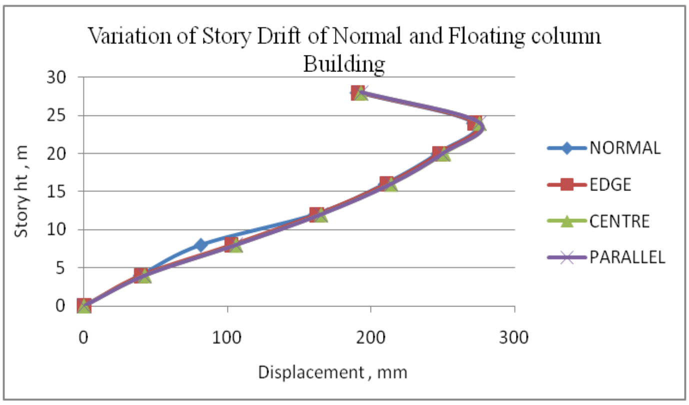


Fig: 5

The above figure shows that, in this study it is observed that the story drift in Normal building and building having floating column at Edge position is almost same and story drift of building having floating column at centre and parallel position it increases by 16.57% as compared to Normal building.

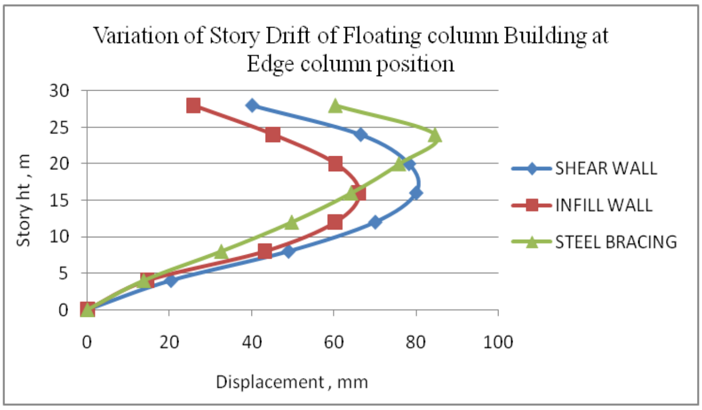


Fig: 6

From above figure, the story drift of floating column building at Edge column position is decreases by 17.24% in structure with infill wall and increases by 27.44% in structure with steel bracing as compared to structure with Shear wall.

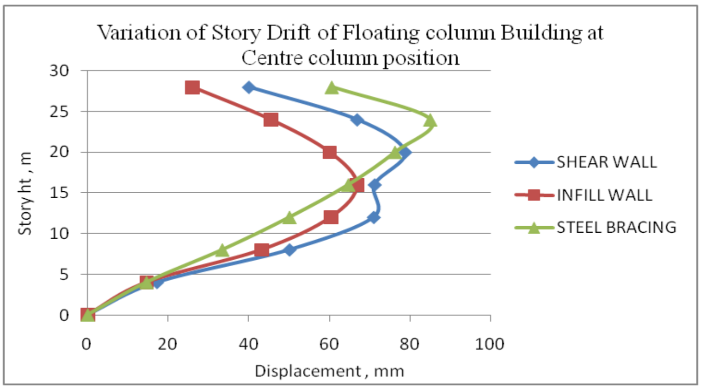


Fig: 7

From above figure, the story drift of floating column building at Centre column position is decreases by 23.37% in structure with infill wall and increases by 27.25% in structure with steel bracing as compared to structure with Shear wall.

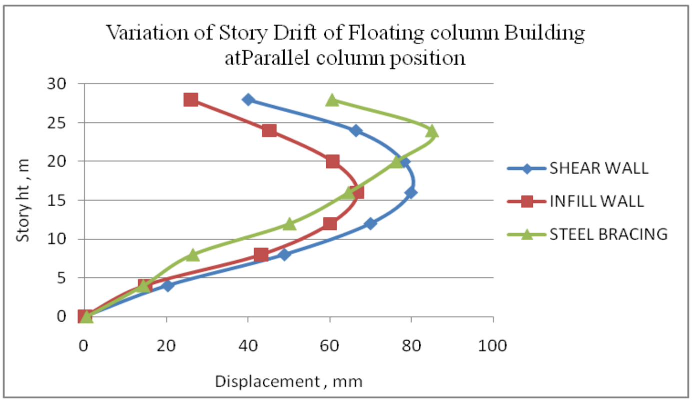


Fig: 8

From above figure, the story drift of floating column building at Parallel column position is decreases by 17.24% in structure with infill wall and increases by 28.27% in structure with steel bracing as compared to structure with Shear wall.

VARIATION OF STORY SHEAR FOR VARIOUS MODELS

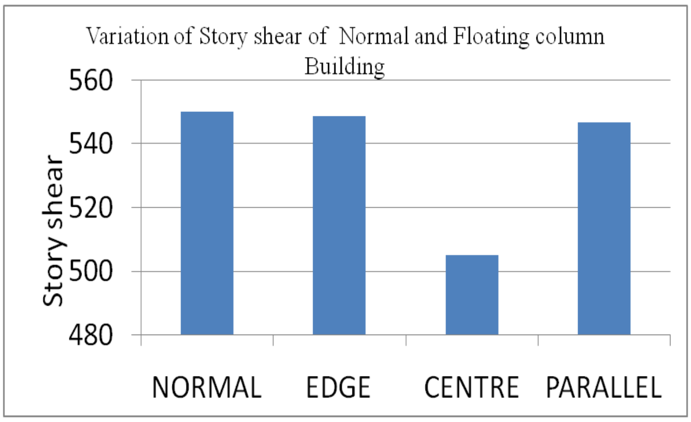


Fig: 9

The above figure shows that, in this study it is observed that the story shear in Normal building and building having floating column at Edge and Parallel position is almost same and story shear of building having floating column at centre position it decreases by 33% as compared to Normal building.

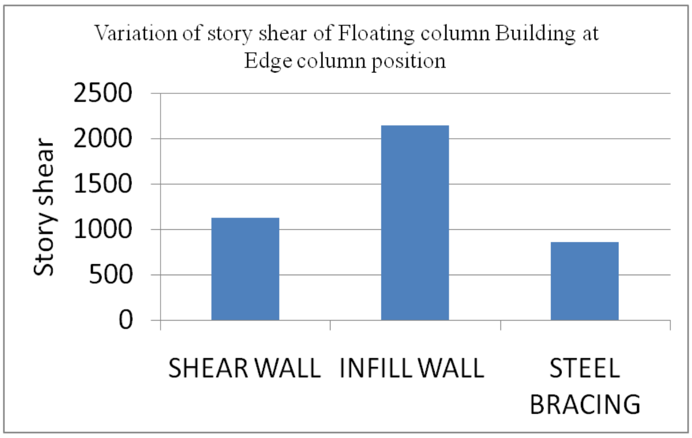


Fig: 10

From above figure, the story shear of floating column building at Edge column position is two times in structure with infill wall and it is decreases by 23.22% in structure with steel bracing as compared to structure with Shear wall.

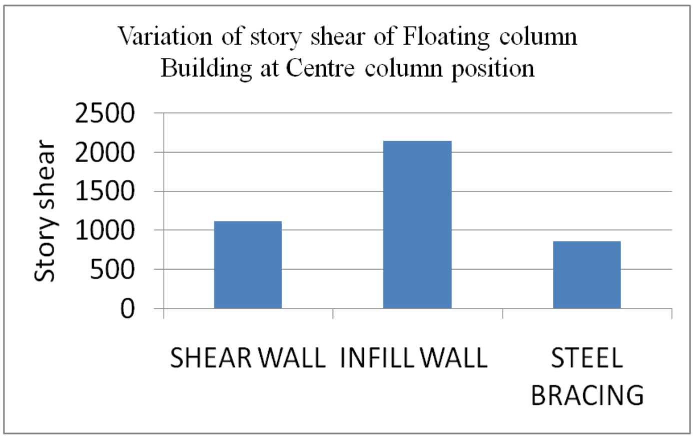


Fig: 11

From above figure, the story shear of floating column building at Edge column position is two times in structure with infill wall and it is decreases by 23.02% in structure with steel bracing as compared to structure with Shear wall.

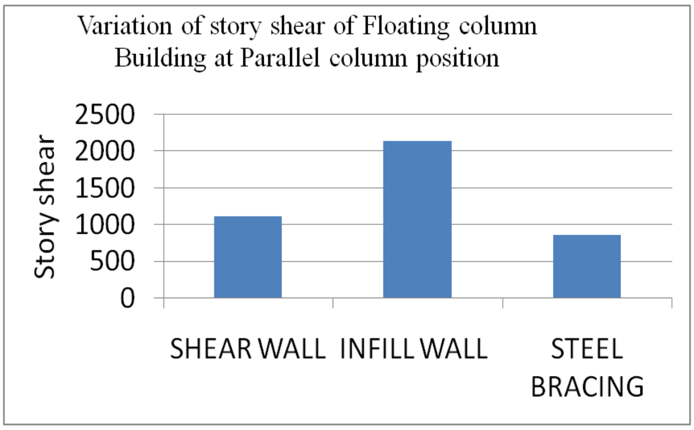


Fig: 12

From above figure, the story shear of floating column building at Edge column position is two times in structure with infill wall and it is decreases by 23.19% in structure with steel bracing as compared to structure with Shear wall.

CONCLUSIONS

The following conclusions are drawn from the analysis.

1. It is observed that the displacement of normal building is decreasing in building with Floating column at edge and parallel position by 14.94% and at centre position by 6.5%.
2. It is observed that the storey drift of normal building and building with floating column at edge position is almost same but it increases at centre and parallel position by 1.49%.
3. It is observed that the storey drift of normal building and building with floating column at edge and parallel position is almost same but it decrease at centre position by 33%.
4. Provision of floating column with recommendations, such as Shear wall, Infill wall and Steel bracing system, the displacement of normal building is decreasing by 56.06%, by 55.74 and by 54.97% respectively as compared to Normal building.
5. Provision of floating column with recommendations, such as Shear wall, Infill wall Steel bracing system, the Story drift of normal building is decreasing by 78.94%, by 86.4 and by 68.25% respectively as compared to Normal building.
6. Provision of floating column with recommendations, such as Shear wall, Infill wall and Steel bracing system, the story shear of normal building is decreasing by 26.67%, increasing by 15.50% and increasing by 13.30% respectively as compared to Normal building.

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