Design And Analysis of High-Rise Building With And Without Floating Columns

Khuram Bakal[1], Mohd. Wahajoddin[2], Kaustubh Pawar[3], Dipak Landge[4], Maruti Kumbhar[5], Prof. P.A.Manatkar[6]
[1, 2, 3, 4, 5, 6] Dept of Civil Engineering
[1, 2, 3, 4, 5, 6] Trinity Academy of Engineering, Pune

Abstract- *Floating columns are a typical feature in the modern multistory construction in urban India and are highly undesirable in buildings built in seismically active and inactive zone areas. The present study investigates the effects of the structural irregularity which is produced by the discontinuity of a column in a building subjected to seismic loads in diff. zones. In this paper static analysis and conventional analysis using equivalent static method is done for a multistory building with and without floating columns in seismic zone-III & zone-V. Different cases of the building are studied by varying the location of floating columns floor wise, setback column and within the floor. The structural response of the building models with respect to Fundamental time period, Base shear, Storey drift and Storey displacements is investigated. The analysis is carried out using ETABS16 software.*

Keywords: *Base Shear,Story Drift, Static Analysis,Multi-story.*

I. INTRODUCTION

1.1 Overview

Multistory buildings constructed for the purpose of residential, commercial, industrial etc., with an open ground storey is becoming a common feature. For the purpose of parking all, usually the ground storey is kept free without any constructions, except the columns which transfer the building weight to the ground. For a hotel or commercial building, where the lower floors contain banquet halls, conference rooms, lobbies, show rooms or parking areas, large interrupted space 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.

II. PROBLEM STATEMENT

Analysis of G+15 storied building with floating column and building without floating column.A G+15 storied building with floating column and building without floating column located in zone v of India as per code IS 1893(Part1):2002 were taken for the investigation. In this study first a normal building without floating column is modeled as model1. In model 2 floating column is located at 6th floor, Modeling and analysis will be carried out in Etabs 16 software.

Table No:1 Parameters

Parameters	**Without floating column building Model1**	**Floating column at 5st floor building Model2**
Soil type	Hard soil	Hard soil
Seismic zone	III	III
Response reduction factor	5	5
Importance factor	1	1
Height of building	16.70m	16.70m
Floor to floor height	3.1m	3.1m
Thickness of slab	150mm	150mm
Beam sizes	300*450mm	300*500mm
Column sizes		
Ground to 2nd floor	230*600m	300*900m
3rd floor to 5th floor	230*450mm	300*750mm
Material properties	M-25 Grade of concrete	M-25 Grade of concrete

III. ANALYSIS IN ETABS

In the beginning, first we have to set grid dimensions in ETABS. This includes setting number of lines in X direction, Y direction and the spacing between grid lines. Then the storey data is defined which includes setting the number of stories, height of typical and bottom storey. The type of slab is also mentioned in the grid data.

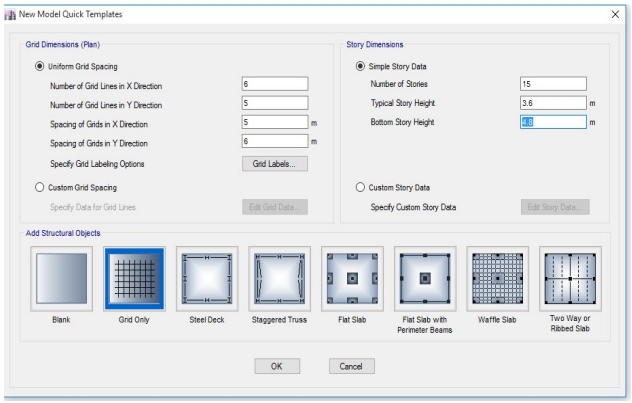

Fig No.1 Properties

Modelling: This paper deals with the comparison of a G+15 High-rise building with normal columns and with floating column. Here a normal G+15 storey building is considered in the first case and in the second case another building in which first 10 storeys are for commercial purpose and from11th storey to roof it is for residential purpose in which we considered floating column. Here the plan configurations of both the building are shown. Upto 10th storey they are same and from 11th storey they differ. By applying the static loads both the structures are safe. 1) Model – 1: Here a G+15 building with all normal columns which is nothing but a normal building is considered as model 1 with dimensions of beams as 300mm X 450 mm and column as 250mm X 600mm upto fourth storey and 450mm X 450mm from there. For the overall building the dimensions of beams are same in both X and Y directions.

2) Model – 2: Here a G+15 building with floating columns is considered as model 2 with dimensions of beams as 300 mm X 500 mm and column as 300mm X 900mm up to fourth storey and 300mm X 750mm from there. Here upto 10 floors both buildings are same, but from there floating columns are introduced. The structure is not safe with same beam dimensions. To make the structure safe beams and columns are to be increased Due to this transfer beams are considered. A transfer beam carries the load of an especially heavy load, typically a column. It is used to transfer the load of a column above to two separate columns below. This is often needed in cases where you need different or larger column spacing.

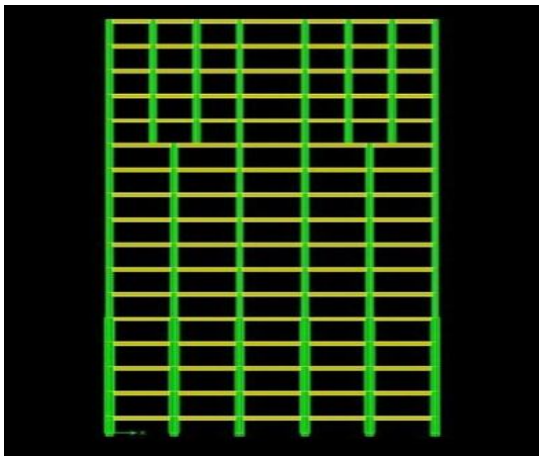

Fig No.3 Elevation of Model 2

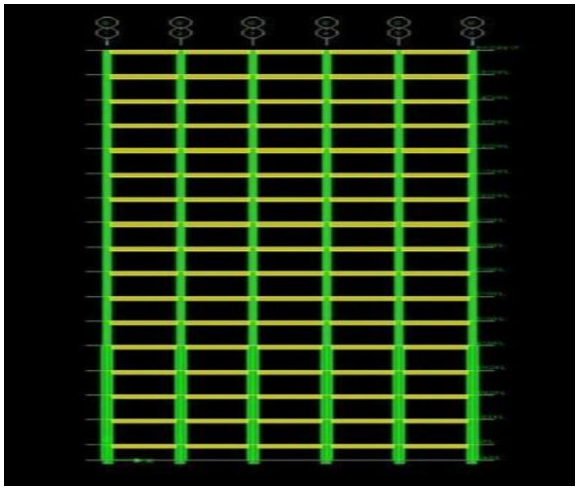

Fig No.2 Elevation of Model 1

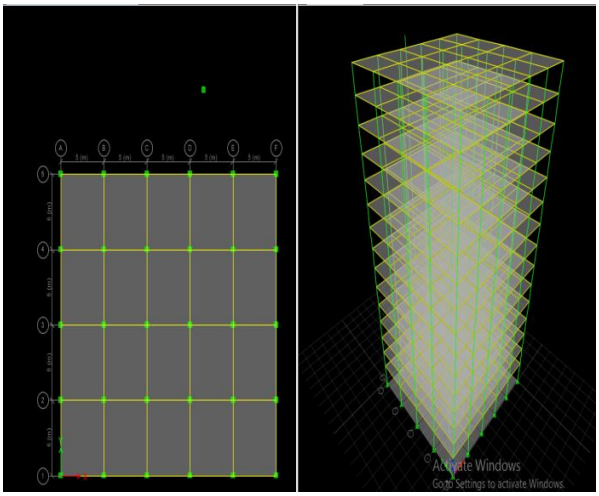

Fig No.4 Plan And Elevation

III. RESULTS AND DISCUSSIONS

Table No:2

STORY	WITHOUT FC	WITH FC			
			8	0.00178	0.00285
15	0.00073	0.00103	7	0.00189	0.00295
14	0.00092	0.00142	6	0.00197	0.00302
13	0.00104	0.00176	5	0.002	0.00304
12	0.00109	0.00236	4	0.0017	0.00257
11	0.00112	0.00246	3	0.00166	0.0025
10	0.0012	0.00253	2	0.00153	0.0023
9	0.0016	0.00271	1	0.00117	0.00175
-	-	-	GF	0.00045	0.00068

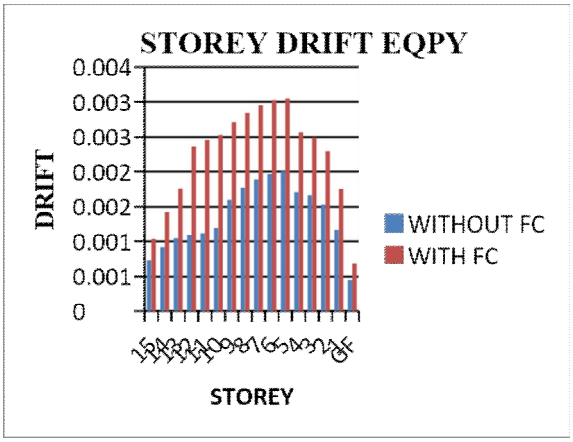

Fig No.5

Table No:3

STORY	WITHOUT FC	WITH FC			
			8	0.0011	0.00137
15	0.00029	0.00033	7	0.00124	0.0015
14	0.0004	0.00048	6	0.00137	0.00163
13	0.0005	0.00064	5	0.00149	0.00175
12	0.00058	0.00098	4	0.00135	0.00156
11	0.00057	0.00104	3	0.00138	0.00158
10	0.00068	0.00109	2	0.00133	0.00152
9	0.00094	0.00123	1	0.00106	0.0012
-	-	-	GF	0.00042	0.00047

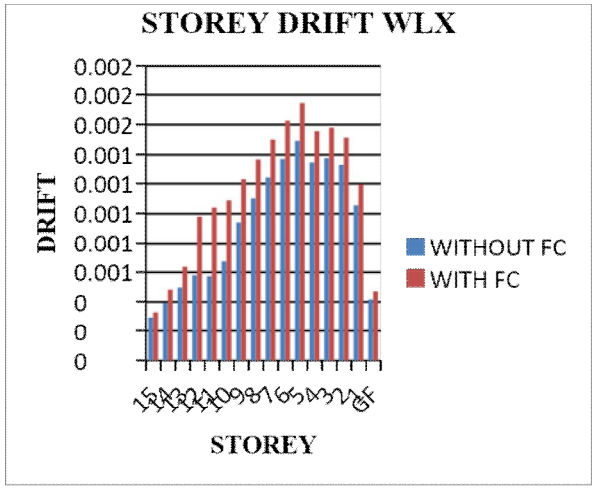

Fig No.6

Table No.4

STORY	WITH FC	WITHOUT FC			
			8	2741.86	1796.18
15	871.68	527.89	7	2859.85	1909.9
14	1273.12	752.69	6	2949.07	1995.88
13	1621.68	947.88	5	3013.53	2058.01
12	1921.1	1115.56	4	3058.41	2101.26
11	2175.11	1257.8	3	3086.91	2128.73
10	2403.51	1470.08	2	3101.99	2143.27
9	2591.09	1650.86	1	3107.88	2148.94
-	-	-	GF	3108.29	2149.33

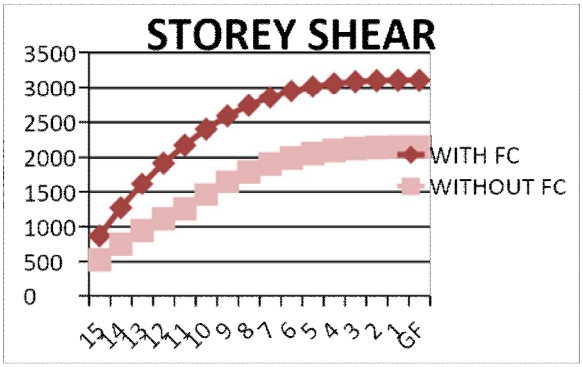

Fig No.7

Table No.6

STORY	WITHOUT FC	WITH FC
15	0.00148	0.00188
12	0.00146	0.00183
9	0.00095	0.00144
6	0.00062	0.00122
3	0.00036	0.00066

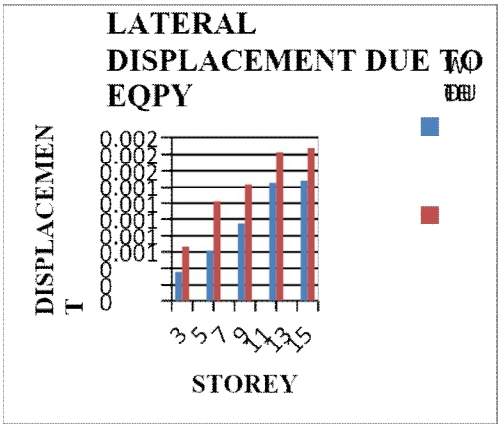

Fig No.8

Table No.7

STORY	WITH FC	WITHOUT FC
15	0.00187	0.00149
12	0.00182	0.00146
9	0.00143	0.00095
6	0.00122	0.00062
3	0.00066	0.00036

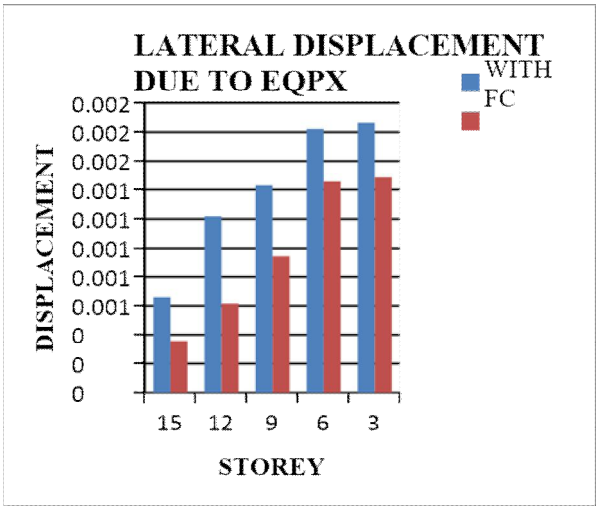

Fig No.9

IV. CONCLUSION

The study presented in the paper compares the difference between normal building and a building on floating column. The following conclusions were drawn based on the investigation

1) By Applying lateral loads in X and Y direction at each floor, the lateral displacements of floating column building in X and Y directions are more compared to that of a normal building. So the floating column building is unsafe for construction when compared to a normal building
2) The storey drift at each floor for the buildings it is observed that floating column building will suffer extreme storey drift than normal building. The storey Drift is maximum at 5th and 6th storey levels in both the cases.
3) The building with floating columns experienced more storey shear than that of the normal building. This is due to the use of more quantity of materials than a normal building. So the floating column building is uneconomical to that of a normal building
4) The final conclusion is that do not prefer to construct floating column in buildings unless there is a proper purpose and functional requirement for those. If they are to be provided then proper care should be taken while designing the structure

REFERENCES

[1] A.P.Mundada, and S.G.Sawdatkar,(2009) "Comparative seismic analysis of multistory Building with and without floating column".

[2] Agarwal Pankaj, Shrikhande Manish (2009), "Earthquake resistant design of structures", PHI learning private limited, New Delhi.
[3] Brodericka B.M., Elghazouli A.Y. and Goggins, "Earthquake testing and response analysis of concentrically-braced sub-frames", Journal of Constructional Steel Research ,Volume 64, Issue 9, Page no: 997-1007,2008.
[4] Sukumar Behera (2012) "Seismic analysis of multistory building with floating column, Department of Civil Engineering, National Institute of Technology Rourkela-769008.
[5] Shrikanth .M.K (2014) "Seismic response of complex building with floating column and without floating column, International journal of Engineering Research-Online.International Journal .Vol. 2. Issue.4, 2014.ISSN: 2321-7758.
[6] Maison and Ventura, Members of ASCE computed dynamic properties and response behaviours OF THIRTEEN-STORY BUILDING,(1991).
[7] Santosh kumar, S.S Dyavanal and Satish A. Annigeri (2006) "Performance based Seismic Evaluation of Symmetric Multi storied Buildings