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Dynamic Analysis of A Building With And Without Floating Columns

Konda Bala Chandra & J.V.Subba Rao
[1]PG Student, Civil Department (Structural Engineering) Chintalapudi engineering college Ponnur,Guntur,India
[2]Assistant Professor, Civil Department Chintalapudi engineering college Ponnur,Guntur,India
E-mail:mahendrabalachandra@gmail.com & E-mail:maddi.anirudh@gmail.com

Abstract

The beam which support the column acts as a foundation, is nothing but the floating column resting on the beam. That beam is called as transfer beam. This is widely used in high storied buildings which is used for both commercial and residential purpose. This helps to alter the plan of the top floors to our convenience. The transfer beam that support floating column will be designed with more reinforcement. Earthquakes in different parts of the world demonstrated the hazardous consequences and vulnerability of inadequate structures. In present scenario buildings with floating column is a typical feature in the modern multistory construction in urban India. The floating column which is at its lower level resting on a beam is a vertical element. The present objective this work is to compare the behavior of High-rise Building with and without floating columns. The parametric Studies comparison of Maximum Storey Displacement, Maximum Storey Drift generated in High-rise Building with and without floating columns Using ResponseSpectrumAnalysisin ETABS Software.

Keywords: Response Spectrum Analysis, High-rise Building with and without floating columns, StoreyDrift, StoreyDisplacement, ETABSsoftware.

I. INTRODUCTION

A series of connected, interrelated elements is a structure that form together a system which provides adequate rigidity that can resist a series of external load effects applied to it, which includes its own self weight. A structure in civil engineering is usually made up of beams, columns, cables, slabs . Failure of a structure can occur from many types of problems such as if the structure is not strong and tough enough to support the load ,due to instability, failure is caused by manufacturing errors, from the use of defective materials, failure is from lack of consideration of unexpected problems. Earthquakes are caused by differential movements of the earth's crust. An earthquake is the result of a rapid release of strain energy stored in the earth's crust that generates seismic waves. Structures are vulnerable to earthquake ground motion and damage the structures. The result of these movements is the well-known 'ground shaking' that can lead to significant damage and/or collapse of buildings,infrastructure systems(e.g. dams, roads, bridges, via ducts etc.), landslides, when soil slopes lose their cohesion, liquefaction in sand and destructive waves or' tsunamis' in the maritime environments. Here are the biggest reasons buildings fail in an earthquake.

1.1 INTRODUCTION TO FLOTING COLUMNS

Floating column means the beam which support the column and act as a foundation and rests on the beam. That beam is called as transfer beam. This is widely used in high storied buildings which is used for both commercial and residential purpose. This helps to alter the plan of the top floors to our convenience. The transfer beam that support floating column will be designed with more reinforcement. Earthquakes in different parts of the world demonstrated the hazardous consequences and vulnerability of inadequate structures. In present scenario buildings with floating column is a typical feature in the modern multistory construction in urban India. The floating which at the lower level resting on a beam is a vertical element. The seismic inertia forces generated at its floor levels in a building need to be brought down along the height to the ground and any deviation or discontinuity in this load transfer path results in poor performance. For the buildings built in seismically active area the highly undesirable feature is the floating column. Present study examines the adverse effect of the floating columns in building. Models of the frame are developed for multi-storey RC buildings with and without floating columns to carry out comparative study of structural parameters such as natural period, base shear, and horizontal displacement under seismic excitation. The alternative measure of providing lateral bracing to decrease the lateral deformation is depicted by the results obtained are taken. The RC building with

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floating column after providing lateral bracing is analyzed. A comparative study of the results obtained is carried out for all above three models. After providing bracings the buildings with floating column showed the improved seismic performance.

Now a day's, multi-storey buildings in urban cities are required to have column free space due to shortage of space, population and also for aesthetic and functional requirements. For the buildings built in seismically active areas with floating columns are highly disadvantageous at one or more storey. The earthquake forces that are developed at different floor levels in a building need to be carried down along the height to the ground by the shortest path. Deviation or discontinuity in this load leads to the transfer of path which results in poor performance of the building. The behavior of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. Many buildings are collapsed or severely damaged in Gujarat during the 2001 Bhuj earthquake and the buildings are of mostly with an open ground storey intended for parking.

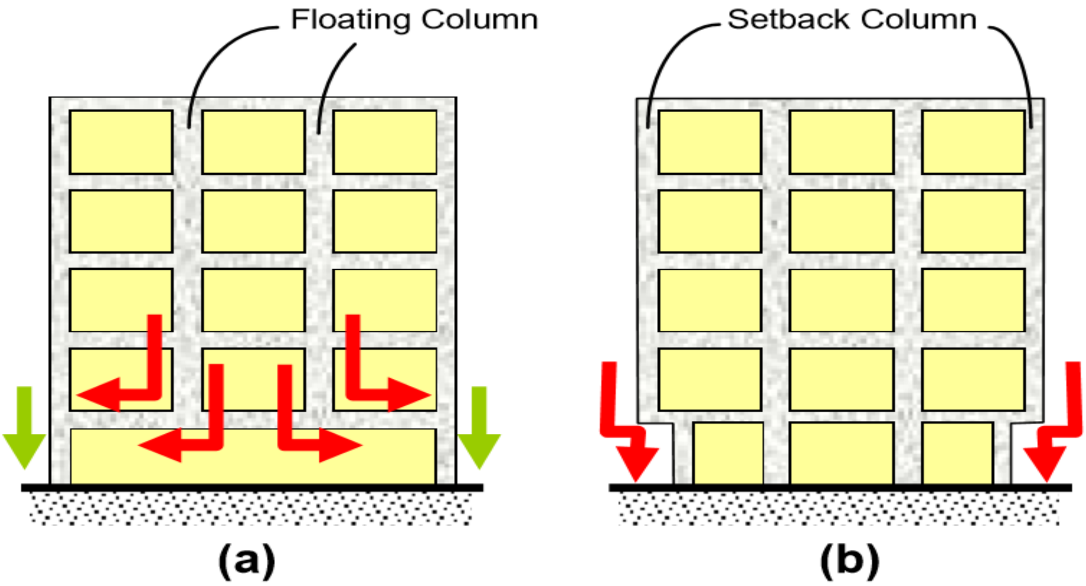

Fig. 1.1Building with floating column

1.2 FLOATING COLUMN:

A column is nothing but a vertical member transferring the load to the ground and starts from the ground level. The term floating column is also a vertical element which (due to architectural design/ site situation) at its lower level (termination Level) rests on a beam which is a horizontal member. The beams in turn transfer the load to other columns below it.

In this century due to huge population the no. of areas in units are decreasing day by day. Few years back the populations were not so vast so they used to stay in Horizontal system (due to large area available per person). But now a day's people preferring Vertical System (high rise building due to shortage of area). Hence, the structures already made with these kinds of discontinuous members are endangered in seismic regions. But those structures cannot be demolished, rather study can be done to strengthen the structure or some remedial features can be suggested

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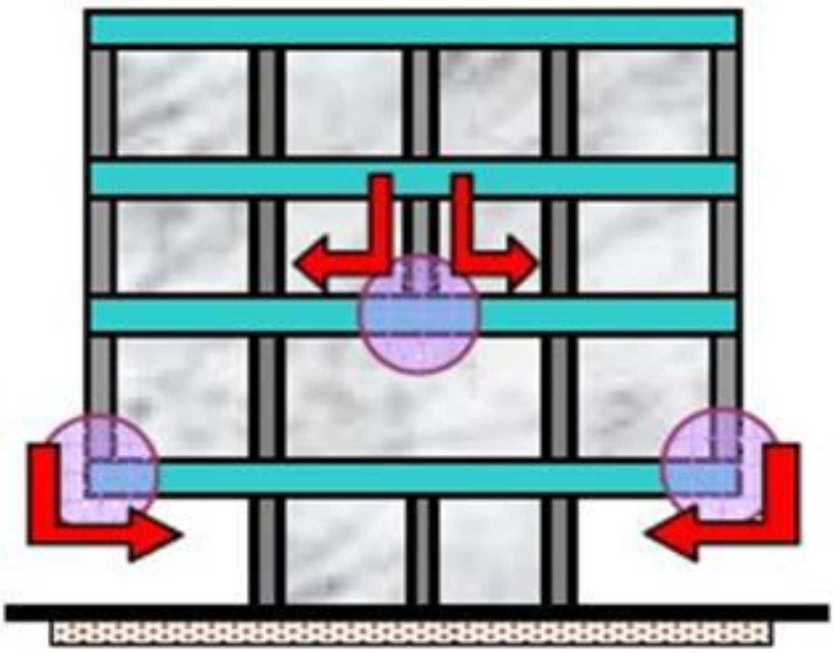

Fig. 1.2: Hanging or Floating Columns.

1.3 TRANSFER BEAM:

In Frame as load carrying system when column is not allowed to continue downward due to some restriction, problem is resolved by using transfer beam. A transfer beam is typically a column which carries the load of an especially heavy load. 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. Where we often see transfer beams is in high rise buildings is one example. These buildings often have retail spaces and parking garages at the lower levels and residential or office units on the upper levels.

1.4 HIGH-RISE BUILDINGS:

Buildings 35 meters or greater in height which are divided at regular intervals into accusable levels are generally high rise buildings. Undeniably the high-rise buildings are also seen as a wealth-generating mechanism working in an urban economy. High-rise buildings create a lot of real estate out of a fairly small piece of land so they are largely constructed. Because of the availability of global technology and the growing demand for real estate, high rise buildings are seen as the most fitting solution to any city that is spatially challenged and can't comfortably house its inhabitants.

An earthquake (volcanic activity) is a chain of throbs induced within the layer by the abrupt rupture and rebound of rocks during which elastic strain has been slowly accruing. An earthquake is that the results of a sharp unharness of energy within the Earth's prime 700 kilometer that makes unstable waves. These waves are sensed with seismo-meters and strengthened electronically so that they will be displayed and operated by a measuring instrument named seismogram. At the external, earthquakes manifest themselves by throbbing and generally translation of the core. Once the epicenter of an oversized earthquake is found offshore, the core generally is elated enough to cause a moving ridge. The throbbing in earthquake may trigger landslides and sometimes devastating activity.

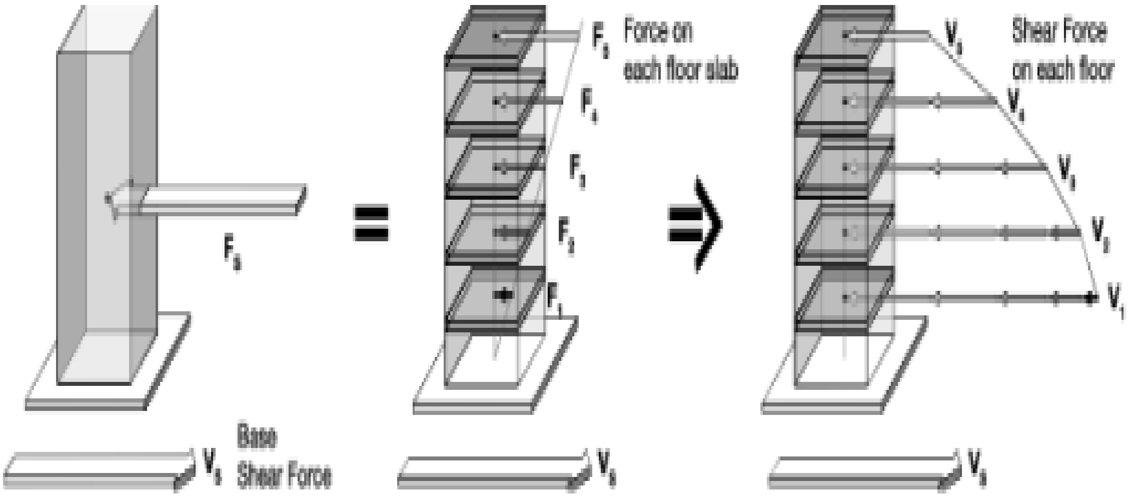

Fig No.1.3: Lateral forces and Shear forces generated in buildings due to ground motion

II. OBJECTIVE AND SCOPE

If structure is not constructed in earthquake prone areas the structure needs not to be analyzed for the seismic analysis, the dead load and live load analysis is enough without considering the seismic forces. As occurrence of earthquakes in India is increasing day by day the demand of seismic analysis is increasing. In this present work Dynamic analysis of a High-rise building with and without Floating Columns has been analyzed under Response spectrum Analysis.

The purpose of this project is

1. To study the seismic behavior of High-rise building with and without Floating Columns using Response Spectrum analysis by using ETABS software.

2. To study and evaluate various Seismic assessment parameters such as Storey Displacement, StoreyDrift.

3. To compare the maximum Storey Drift, Storey Displacement of a Normal High-rise Building With and without Floating Columns obtained by the Response Spectrum method.

III. METHODOLOGY

On the basis of external action, the behavior of structure or structural materials, and the type of structural model selected the analysis is performed. Based on the type of external action and behavior of structure, the analysis can be further classified as given below

A. Equivalent static analysis
B. Nonlinear Static Analysis
C. Response Spectrum Method

From the above methods I have chosen the Response Spectrum Analysis for the analysis of a Flat Slab, Grid Slab and Flat Plate.

A **response spectrum** is simply a steady state response (displacement, velocity or acceleration) of a series of oscillators of varying natural frequency, that are forced into motion by the same base vibration or shock or a peak. To pick off the response of any linear system, given its natural frequency of oscillation the resulting plot is used. One such use is in assessing the peak response of buildings to earthquakes. For correlation with seismic damage, the values from the ground response spectrum is used by the science of ground motion. (calculated from recordings of surface ground motion from seismographs).

IV.MODELLING

Nine High –rise building with and without Floating Columns are taken for the analysis. The height of each Floor will be taken as 3 m. The Buildings are subjected to vertical loads as well as Horizontal Loads.

4.1 DETAILS OF HIGH-RISE BUILDING WITHOUT FLOATING COLUMN

Table No 4.1 shows the details of High-rise Building without Floating Column

1. Plan Dimensions	30 m X 30 m
2.Length in X- Direction	30 m
3.Length in Y- Direction	30 m
4. Floor to floorheight	3m
5. No. ofStories	9
6.Total height ofBuilding	26.75 m
7.Slab Thickness	150 mm
10. Beam Size	450 mmX 600 mm
11. Size of column	600 mmX 600 mm
13. Gradeof Concrete	M25
14. Gradeof steel	Fe415
15. Panel Dimensions	5m X 5 m
16.Loading	Terrace Remaining FLR
A)LiveLoad	1.5 kN/sq.m 4 kN/sq.m
B) DeadLoad	3 kN/sq.m 2.7 kN/sq.m

4.2 DETAILS OF HIGH-RISE BUILDING WITH FLOATING COLUMN

Table No 4.2 shows the details of High-rise Building with Floating Column

1. Plan Dimensions	30 m X 30 m
2.Length in X- Direction	30 m
3.Length in Y- Direction	30 m
4. Floor to floorheight	3m
5. No. ofStories	9
6.Total height ofBuilding	26.75 m
7.Slab Thickness	150 mm
10. Beam Size	300 mmX 450 mm
11.Size of Pneumatic Beam	950 mm X 950 mm
12. Sizeofthe column	450mmX 450 mm
13. Size of floating column	850 mm X 900 mm
13. Gradeof Concrete	M25
14. Gradeof steel	Fe415
15. Panel Dimensions	5m X 5 m
16.Loading	Terrace Remaining FLR
A)LiveLoad	1.5 kN/sq.m 4 kN/sq.m
B) DeadLoad	3 kN/sq.m 2.7 kN/sq.m

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17. masonry infill wall thickness	230 mm

V .ANALYSIS OF MODEL

4.1 HIGH-RISE BUILDING WITHOUT FLOATING COLUMN BY USINGETABS

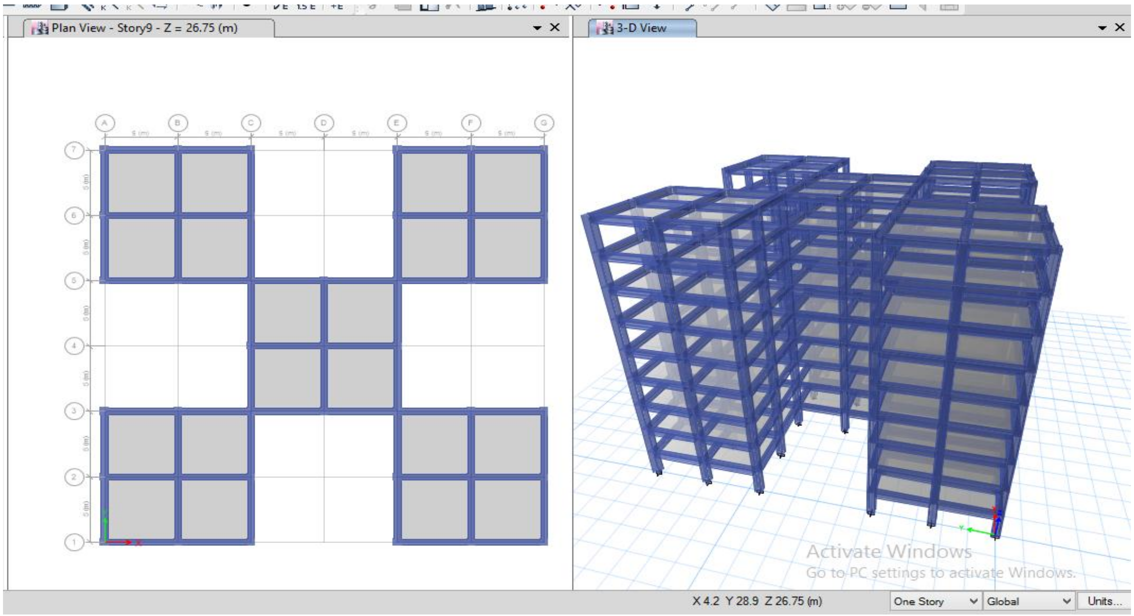

Fig3.1 Three-DimensionalViewofHigh-Rise Building without Floating Column inEtabs.

4.2 HIGH-RISE BUILDING WITHOUT FLOATING COLUMN BY USINGETABS

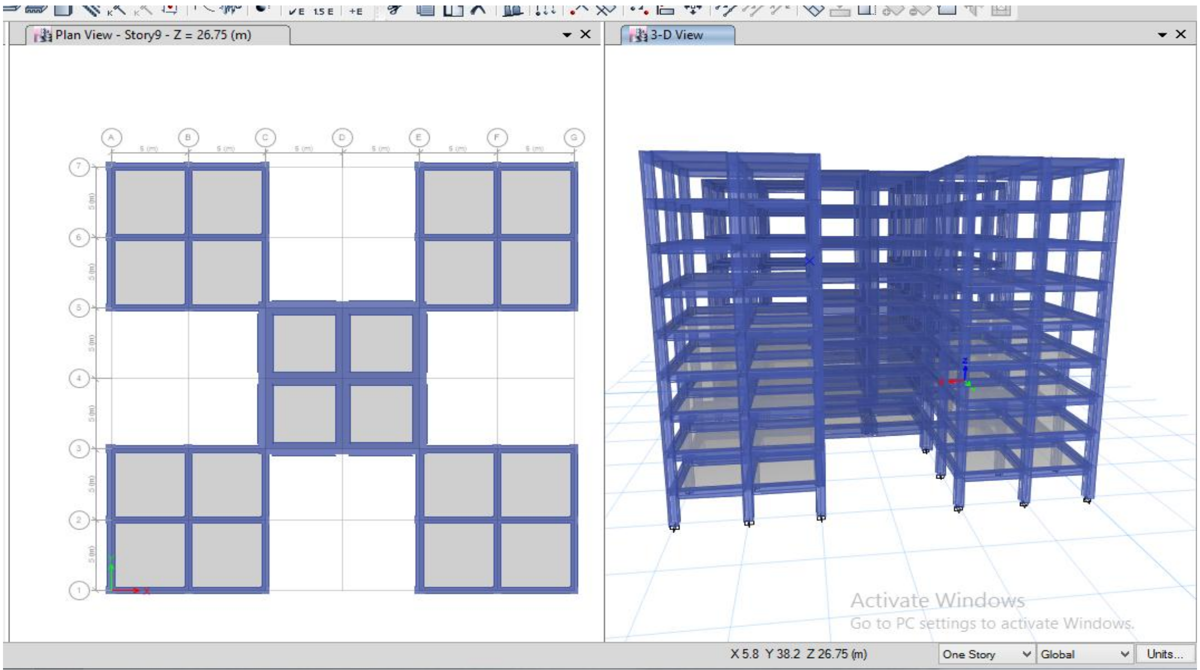

Fig4.2 Three-Dimensional View of High-Rise Building without Floating Column in Etabs.

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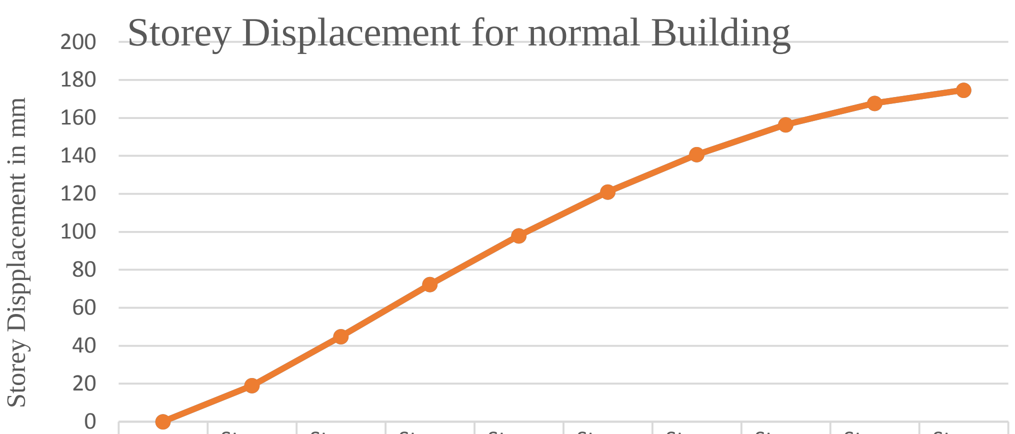
V. RESULTS AND DISCUSSION

The maximum storey Displacement and drifts of High-Rise Building with and Without Floating Columns in different stories for Response spectrum analysis has been collected. The Storey Drift and Displacement of High-Rise Building with and Without Floating Columns in buildingresultsare takenfor Response spectrum analysisdrawn based on theresults.

5.2.1 Story Displacement in ZoneIII:

The Below Figures from5.1 Show the Storey Displacement of High-Rise Building without Floating Columns With respect to Zone III Medium Soil(soil Type II). The below figure Represents the Displacement of a Normal Building in X-direction and Y-Direction. The Diplacement is Same In Both Action in Normal Building.



	Base	Storey 1	Storey 2	Storey 3	Storey 4	Storey 5	Storey 6	Storey 7	Storey 8	Storey 9
X-Direction	0	18.95	44.872	72.257	97.968	121.001	140.672	156.393	167.713	174.617
Y-Direction	0	18.951	44.874	72.259	97.969	121.002	140.672	156.393	167.714	174.618

Storey Level

Fig.5.1Storydisplacementin Zone III Soil II Graph for Without Floating Columns

The below Figure5.2 Show the Story Displacement of High-Rise Building with Floating Columns With respect to Zone III Medium Soil(soil Type II). The below figure Represents the Displacement of a Floating Column Building in X-direction and Y-Direction. The Diplacement is Same In Both Action in Normal Building.

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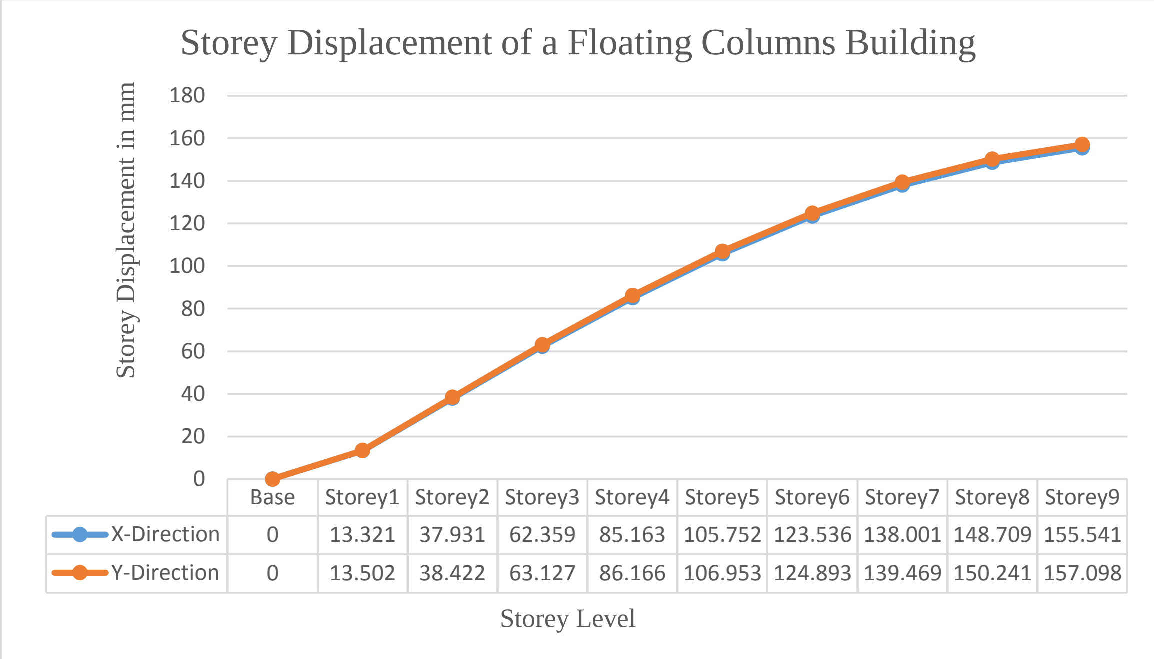
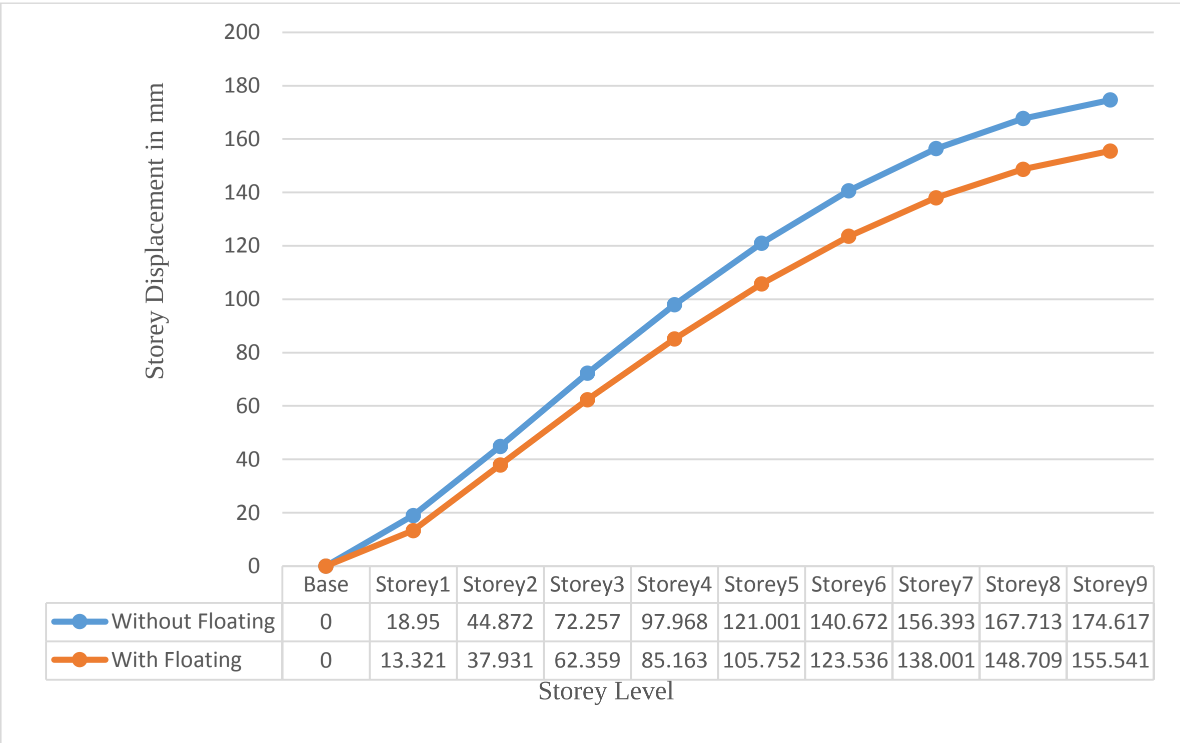


	Base	Storey1	Storey2	Storey3	Storey4	Storey5	Storey6	Storey7	Storey8	Storey9
X-Direction	0	13.321	37.931	62.359	85.163	105.752	123.536	138.001	148.709	155.541
Y-Direction	0	13.502	38.422	63.127	86.166	106.953	124.893	139.469	150.241	157.098

Fig.5.2 Storey displacement in Zone III Soil II Graph for With Floating Columns

Displacement in X- Direction for with and Without Floating Columns



	Base	Storey1	Storey2	Storey3	Storey4	Storey5	Storey6	Storey7	Storey8	Storey9
Without Floating	0	18.95	44.872	72.257	97.968	121.001	140.672	156.393	167.713	174.617
With Floating	0	13.321	37.931	62.359	85.163	105.752	123.536	138.001	148.709	155.541

Fig.5.3 Storey displacement in Zone III Soil II Graph for with and without Floating Columns

The above graph (fig no 5.3) shows the storey displacement of a high-rise building with and without floating columns. here the maximum displacement occurs in without floating column building compare to high- rise building with floating columns due to the distribution of load to the sub structure. the above graph show the displacement in x- direction and y- direction of a high- rise building without and with floating columns. and the maximum displacement was occur in without floating column due to distribution of load from super structure to the sub structure

5.2.2 Story Drift Zone III:

The Below Figures from 5.4-5.5 Show the Story Drift of High –Rise Building Without and with Floating Columns With respect to Zone III Medium Soil(Soil Type II).

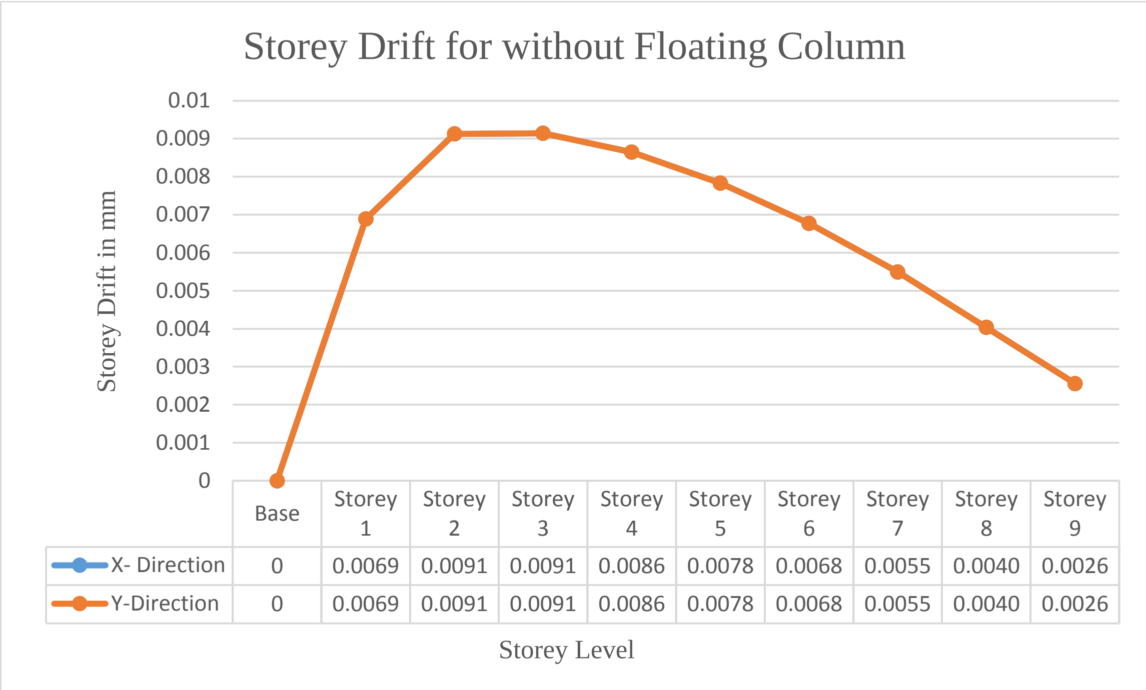


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Fig.5.4Storey drift in Zone III Soil II Graph for Without Floating Columns

The above figure5.4 show the storey displacement of high-rise building without floating columns with respect to zone iii medium soil(soil type ii). the below figure represents the displacement of a floating column building in x-direction and y-direction. the diplacement is same in both action in normal building.

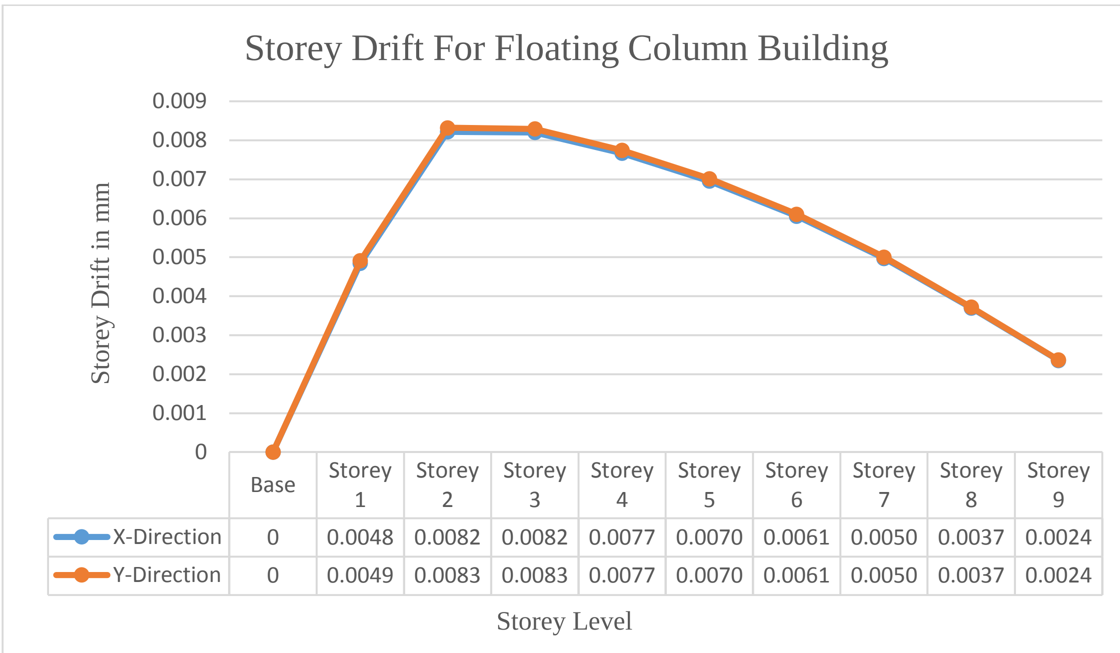

Fig.5.5 Storey drift in Zone III Soil II Graph for With Floating Columns

From the above Graphs I concluded that The Provision of Floating Column gives the less Storey Drift compare to Normal Building.

By the Provision of Floating Column the Building is to resist the Seismic Loads from the above Stories by Providing the Boundary beam size as more than the Normal Beams.

VII.CONCLUSIONS

Following conclusions can be drawn for Normal Building, Floating Column buildings from the results obtained in chapter5:

1. As the mode number is getting increased the time period of the structure is getting decreased and frequency of the building is increasing.
2. As the time period is decreasing the acceleration in X and Y direction is increasing and at some points the acceleration became constant (frommode-2 to mode-7).
3. In present Study the normal building, Floating column buildings are analyzed In Zone III medium soil (Soil Type II).
4. The provision of a floating column in a high rise building Pneumatic Beam Compare to Normal Building in Zone III, medium Soil (Soil Type II).

It can be summarized that the response of a floating column building is less compare to Normal Building. In Floating column the Pneumatic Beams are acting as a Girders to transfer the load from the Superstructure to the sub structure. Storey Displacement and Storey Drift Performance is observed to be within the permissible limits in

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floating column building is the preferable in Zone III, Medium Soil (Soil Type II).

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