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STUDY OF BEHAVIOUR OF FLOATING COLUMN FOR SEISMIC ANALYSIS OF MULTISTOREY BUILDING

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Abstract:

Now a day's lots of multistory buildings are constructed with floating column for aesthetic point of view and for getting more space at parking areas for movement. But such building are highly get damaged during earthquake in highly seismic zone as compared to normal building.

In this paper present study about analysis of G+5 Building with and without floating column in highly seismic zone v. four models are created such as floating column at 1st ,2nd,and 3rd floor buildings and without floating column building. Linear static and time history analysis are carried out of all the four models .from linear static analysis compare all the of models result obtained in the form of seismic parameter such as time period, base shear ,storey displacement ,storey drift .and from time history analysis plot the response of all the models .modeling and analysis done by using sap 2000v17 software.

Keyword: with and without floating column building, linear static analysis, time history analysis, sap2000v17.

I .Introduction

In recent times, 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 this buildings are provided with floating columns at one or more storey. These floating columns are highly disadvantageous in a building built in seismically active areas. 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 transfer path 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 with an open ground storey intended for parking collapsed or were severely damaged in Gujarat during the 2001 Bhuj earthquake.

Floating Column:

The floating column is a vertical member which rest on a beam and doesn't have a foundation. The floating column act as a point load on the beam and this beam transfers the load to the columns below it. But such column cannot be implemented easily to construct practically since the true columns below the termination level are not constructed with care and hence finally cause to failure.

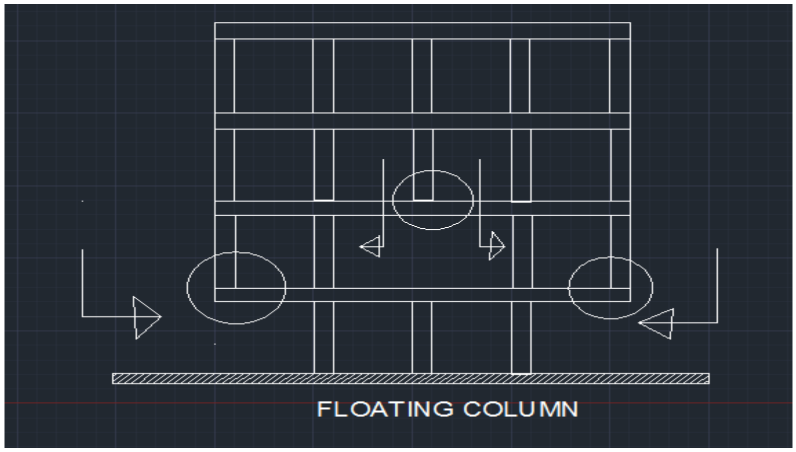

Fig no.1 floating column in building

II. Objectives of the present work

The main objectives of the proposed work are:

1. To compare the modal response of all the models (Mode shapes, Time period, Frequency). 2. To compare the Base shear, Storey drift, Storey displacement and maximum displacement of each storey.
3. To plot the response of the structure for Time history analysis.

III. Model Description

A G+5 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 .then there types of models namely 2,3and 4 are modeled. In model 2 floating column is located at 1st floor ,in model3 floating column located at 2nd floor and in model 4 floating column is located at 3rd floor. Modeling and analysis was carried out in sap 2000v17.

TABLE 1. BUILDING DATA

parameters	Without floating column building Model1	Floating column at 1st floor building Model2	Floating column at 2nd floor building Model3
Soil type	Hard soil	Hard soil	Hard soil
Seismic zone	V	v	v
Response reduction factor	5	5	5
Importance factor	1	1	1
Height of building	16.70m	16.70m	16.70m

Floor to floor height	3.1m	3.1m	3.1m
Thickness of slab	125mm	125mm	125mm
Beam sizes	230×450mm	230×450mm	230×450mm
Column sizes			
Ground to 2nd floor	230×450mm	230×450mm	230×450mm
3rd floor to 5th floor	230×380mm	230×380mm	230×380mm
Material properties	M20 Grade of concrete	M20 Grade of concrete	M20 Grade of concrete

For analysis purpose four models considered namely as:

MODEL1- Building without floating column

MODEL2-Building in which floating column located at 1st floor.

MODEL 3-Building in which floating column located at 2nd floor

MODEL 4- Building in which floating column located at 3rd floor.

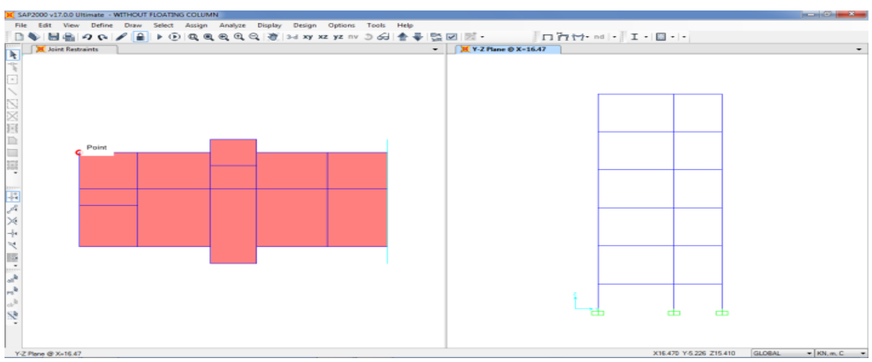

Fig no.2 MODEL 1

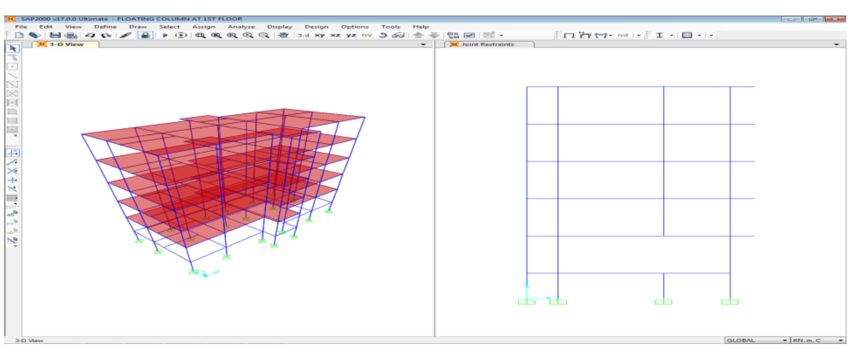

Fig no.3 MODEL 2

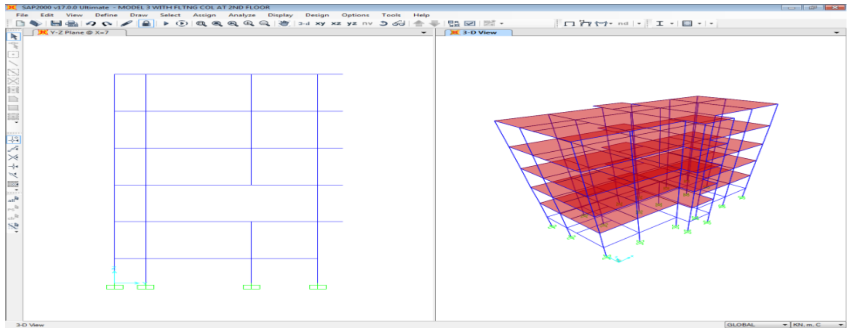

Fig no.4 MODEL 3

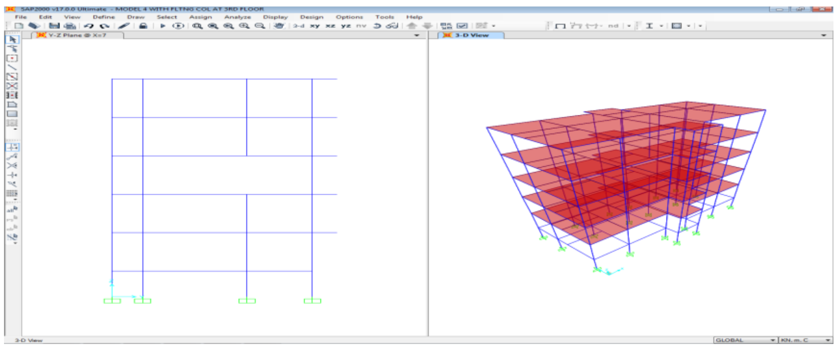

Fig no.5 MODEL4

IV .Method Of Seismic Analysis

Seismic analysis is a subset of structural analysis and the calculation of the response of a building structure to earthquake .It is a part of the process of structural design ,earthquake engineering or structural assessment in region where earthquake is are prevalent.

A building has the potential to 'wave back and forth during an earthquake (or even a severe wind storm).This is 'fundamental mode' and is the lowest frequency of building response .most building ,however higher modes of response ,which are uniquely activated during earthquake.

1.Linear Static Analysis.

This method defines a series of forces acting on a building to represent the effect of earthquake ground motion, typically defined by a seismic design response spectrum .It assumes that the building responds in its fundamental mode. For this to be true , the building must be low-rise and must not twist significantly when ground moves. The response is read from a design response ,given the natural frequency of building. The applicability of this method is extended in many building codes by applying factors to account for higher buildings with some higher modes ,and for low levels of twisting. To account for effects due to "yielding" of structure, many codes apply modification factors that reduce the design forces (example force reduction factors).

2. Time History Analysis

A linear time history analysis overcomes all the disadvantages of modal response spectrum analysis, provided non-linear behavior is not involved. This method requires greater computational efforts for calculating the response at discrete time. One interesting advantage of such procedure is that the relative signs of response qualities are preserved in the response histories. This is important when interaction effects are considered in design among stress resultants.

IV. Result and discussion

In present study, comparison of seismic response parameter such as time period ,base shear, storey displacement, storey drift and dynamic response are done by varying the location of floating column floor wise by using linear static and time history analysis. Result are compared in tabular and graphically for the analysis of building with and without floating column.

1.Time Periods in sec.

The time period of the structure for particular mode shape is the time required to complete the oscillation for corresponding mode shape. After giving a unit displacement to the structure and when releasing the displacement suddenly the structure moves in back and forth motion having some time period which is called as fundamental time period of the structure.

Time period determined for building with and without floating column for different cases are given in table 2.also variation in time period as shown in fig. 6 graphically. It has been found that 5-10% increase in time period of floating column building as compared to building without floating column.

Table no.2 Comparison of Time period in sec.

Mode	RCC building without floating column (Model1)	RCC building with floating column at 1st floor (Model2)	RCC building with floating column at 2nd floor (Model3)
1	0.8423	0.8614	0.8572
2	0.6475	0.6493	0.6487
3	0.5604	0.5706	0.5685
4	0.2776	0.2816	0.2774
5	0.2124	0.2128	0.2124
6	0.1799	0.1822	0.1798
7	0.1648	0.1657	0.1666

8	0.1246	0.1247	0.1248
9	0.1211	0.1212	0.1236
10	0.1016	0.1036	0.1038
11	0.1010	0.1022	0.1026
12	0.0889	0.1010	0.1016

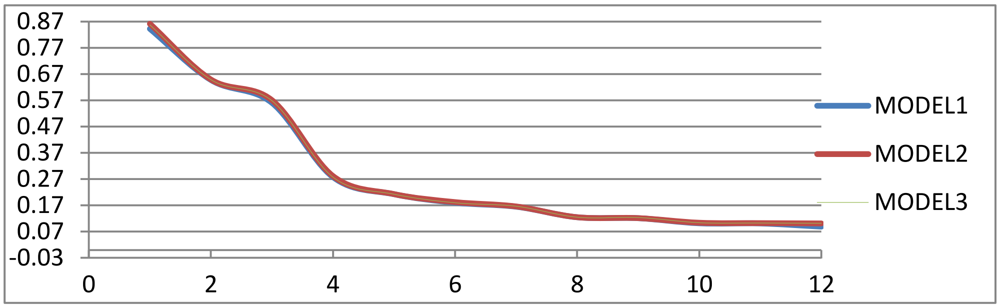

Fig no .6 Comparative graph of Time Period in sec

2. Base Shear in KN

Base shear is the horizontal reaction at the base against horizontal earthquake load. This base shear is acting at the base or supports of the structure or wherever structure is fixed.

The variation in base shear due to different location of floating column floor wise are tabulated in table 3.also variation in base shear are shown through graph in fig no.7

The base shear is decreases by 5-10% for floating column building as compared to without floating column building.

Table no. 3. Comparison of Base Shear in KN

Model No.	Base shear in KN
Model 1	631.704
Model 2	617.074
Model 3	619.687
Model 4	623.201

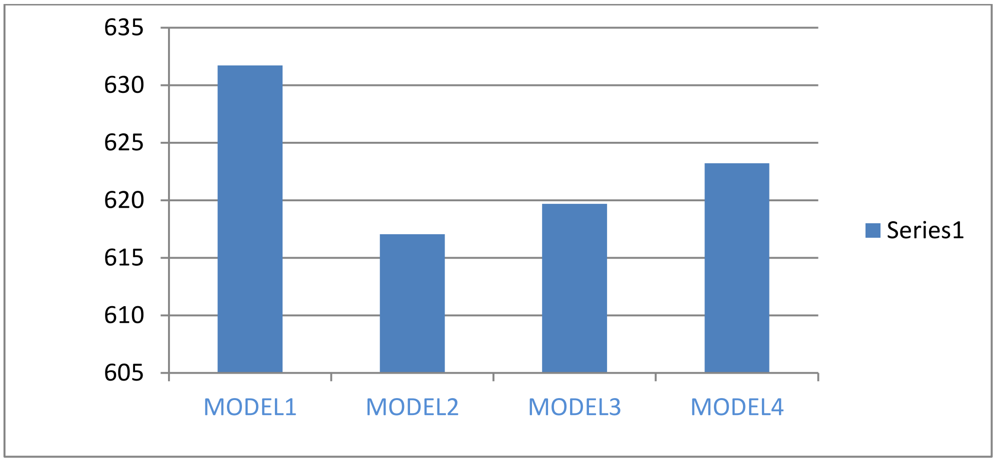

Fig no.7. Comparison of Base Shear in KN

3. Storey Displacement

Storey displacement is the lateral movement of the structure caused by lateral force. The deflected shape of a structure is most important and most clearly visible point of comparison for any structure. No other parameter of comparison can give a better idea of behavior of the structure than comparison of storey displacement.

The results variation of storey displacement due to different location of floating column floor wise are tabulated in table no 4.also variation of storey displacement are shown through graph in fig no.8 .

The storey displacement increases 5-10% for floating column building as compared to building without floating column.

Table no 4.Comparision of Storey Displacement

	Model 1	Model 2	Model 3	Model 4
Floor6	18.088	18.232	18.291	18.356
Floor5	16.162	16.342	16.389	16.441
Floor4	13.103	13.345	13.374	13.398
Floor3	9.353	9.671	9.671	9.235
Floor2	5.287	5.674	5.187	5.214
Floor1	1.224	1.041	1.206	1.207
Base	0	0	0	0

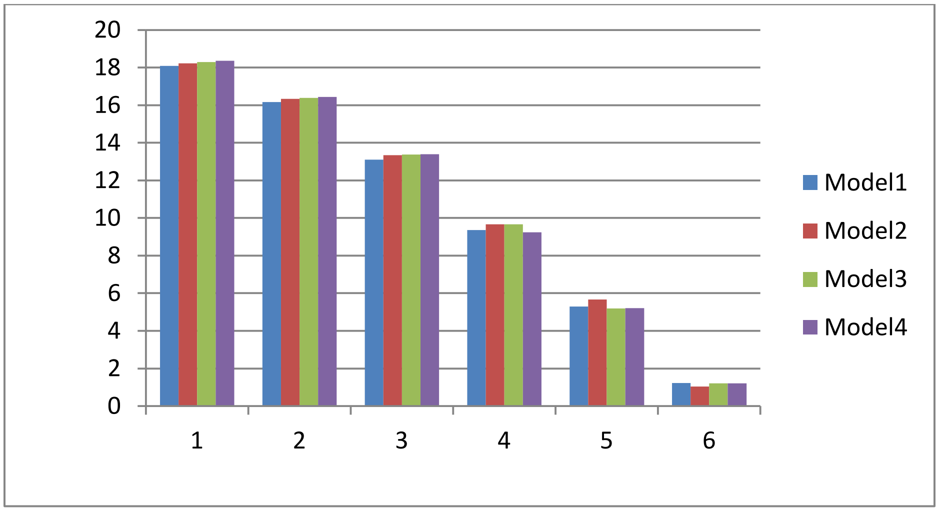

Fig no.8 Comparison of Storey Displacement.

4. Storey Drift

Storey drift is the relative displacement of the floor. The results variation of storey drift due to different location of floating column floor wise are tabulated in table no 4.also variation of storey displacement are shown through graph in fig no.8 .

The storey drift increases 5-10% for floating column building as compared to building without floating column.

Table no.5 8 Comparison of Storey Drift

Height	Model 1	Model 2	Model 3
17	-0.00085	-0.0009	-0.00082
14	-0.00273	-0.00294	-0.00271
11	-0.00279	-0.00276	-0.00306
8	-0.00255	-0.00251	-0.00254
5	-0.00205	-0.00202	-0.00202
2	-0.00128	-0.00126	-0.00127
0	0.012254	0.012388	0.012409

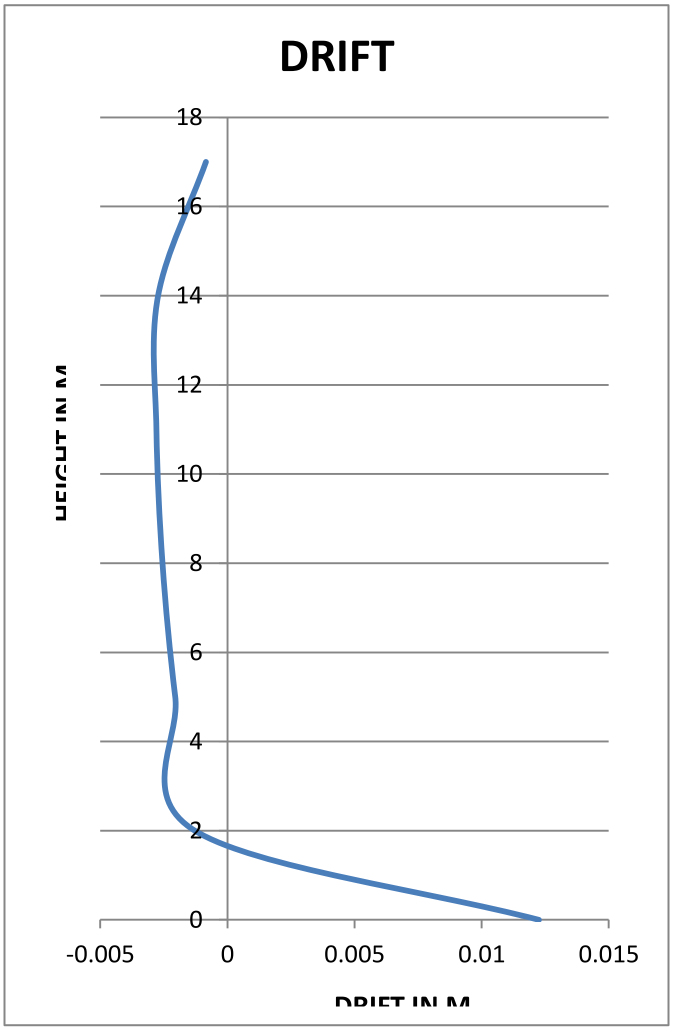

Fig no.9 With floating column Storey Drift

5. Plot of response of buildings for Time History analysis.

Without floating column for Bhuj earthquake

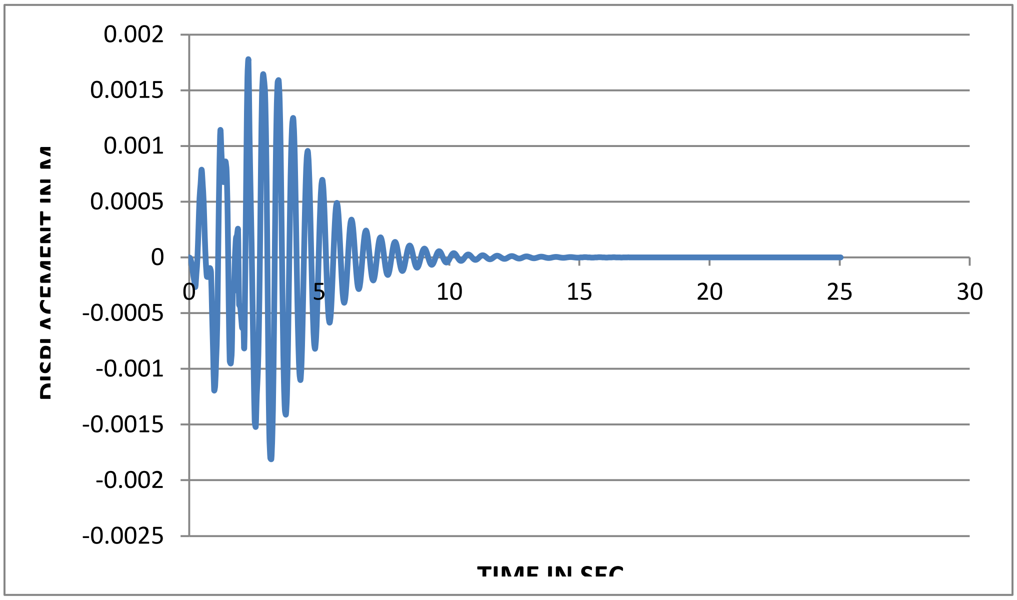

Fig no. 11. Plot of graph Displacement Vs Time.

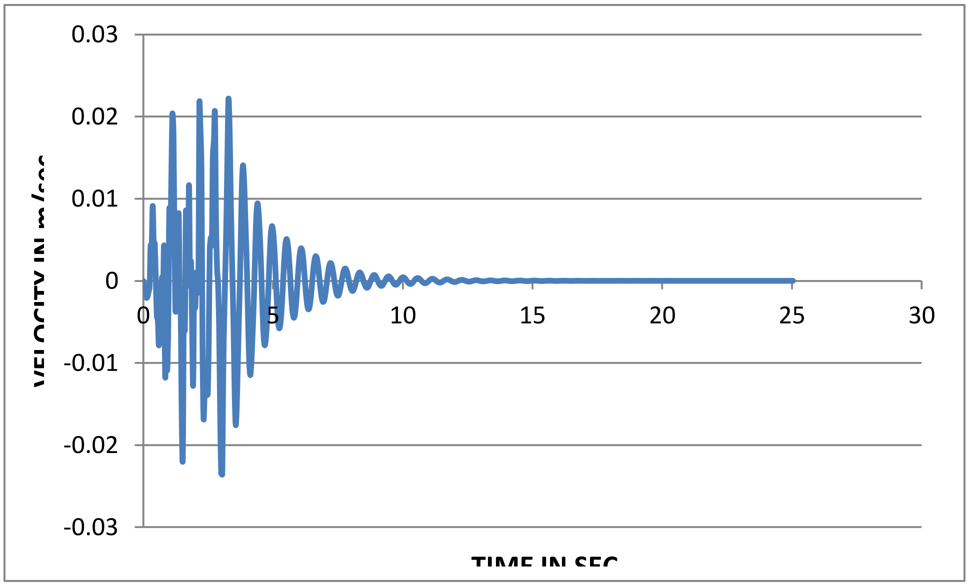

Fig no.12 Plot of graph Velocity Vs Time.

Floating column at 1st floor for bhuj earthquake.

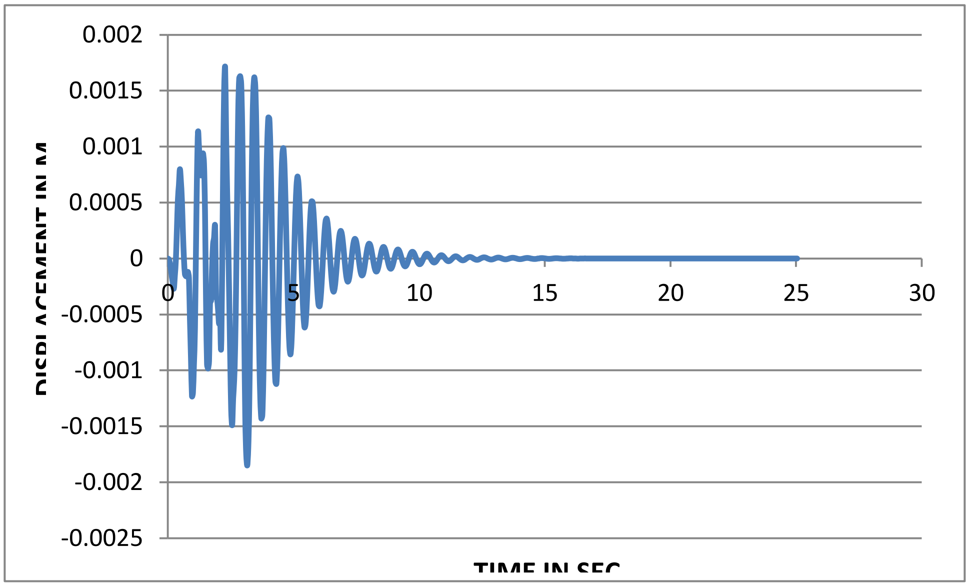

Fig no. 13. Plot of graph Displacement Vs Time.

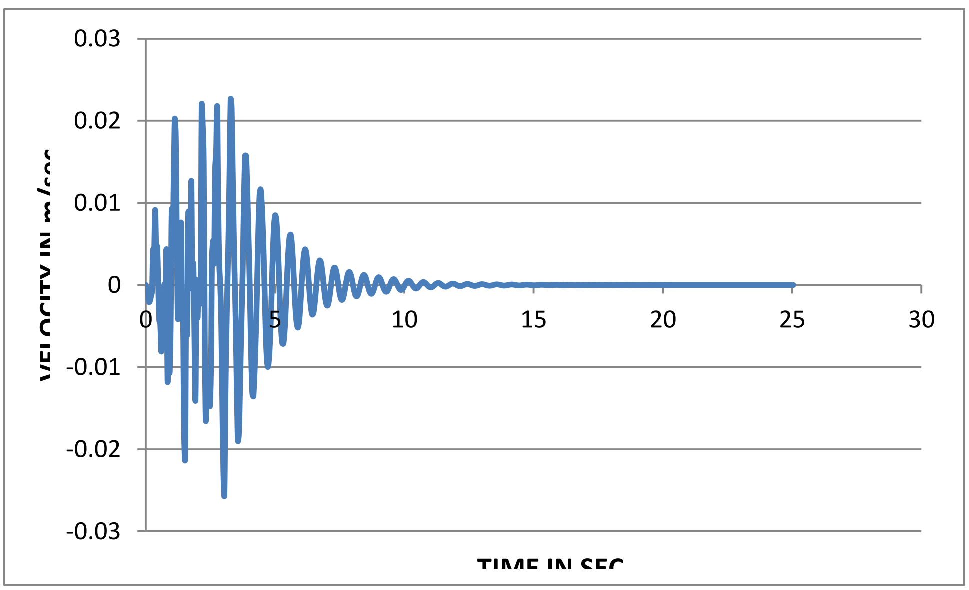

Fig no.14. Plot of graph Velocity Vs Time

Floating column at 2nd floor

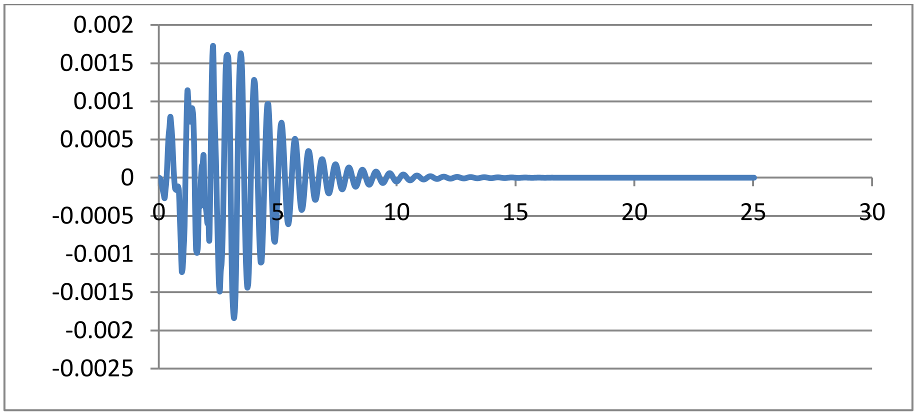

Fig no. 15. Plot of graph Displacement Vs Time.

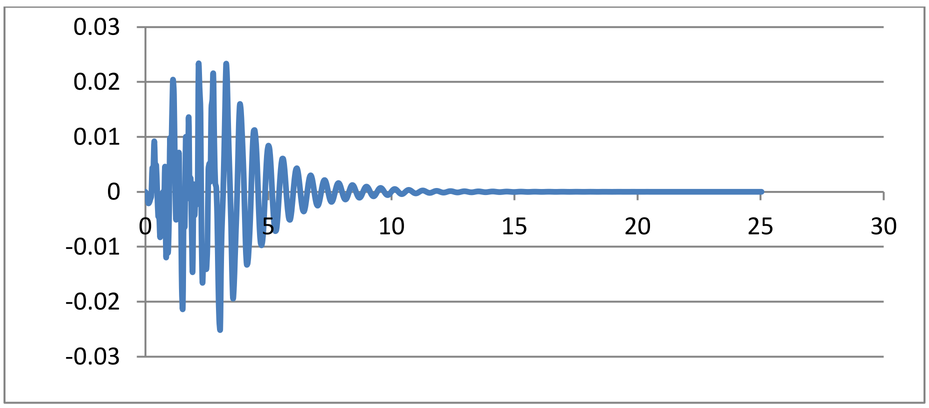

Fig no.16. Plot of graph Velocity Vs Time

V. Conclusion

Following are some of the conclusions which are drawn on the basis of this comparative study.

1 .It was observed that in building with floating column has more time period as compared to building without floating columns.

2. It was also observed that shifting of floating column towards top of the building results in increasing time period which is majorly because of decreased lateral stiffness of the building

3. It was observed that in building with floating column has less base shear as compared to building without floating column

4. It was also observed that shifting of floating column from 1st storey towards top storey of the building results in increasing base shear.

5. It was observed that displacement floating column building is more as compared to without floating column building.

6. It was also observed that shifting of floating column from 1st storey towards top storey of the building results in increasing storey displacement.

7. It was observed that building with floating column has more storey drift as compared to building without floating column.

8. It was also observed that shifting of floating column from 1st storey towards top storey of the building results in increasing storey drift.

9. From dynamic analysis it was observed that floating column at different location results into variation in dynamic response.

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