# Dynamic Analysis of Reinforced Concrete Building with Floating Column

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***Abstract*— Building with floating columns is a typical feature in the multi storey construction in India. The main reason for this type of construction was these buildings are planned and constructed with architectural complexities. The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path, any deviation or discontinuity in this load transfer path results in poor performance of the building. The floating column cause vertical discontinuity in the load transfer path. Such feature is undesirable to seismically active area. In this study the performance of building with and without floating column under different soil condition and different zone conditions were discussed. Dynamic analysis was carried out for six storey building with eight numbers of floating column in between second and third floor were considered. The modelling and analysis was carried out with the help of ETAB 9.5 (Extended Three Dimensional Analysis of Building) software. This will help to understand the effect floating columns in building under seismic excitation in terms of storey drift, and storey shear.**

***Keywords*— Loating column, Response spectrum analysis, Storey shear, Storey drift**

## I. INTRODUCTION

The behaviour 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. The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path. Any deviation or discontinuity in this load transfer path results in poor performance of the building. Buildings with vertical setbacks (like the hotel buildings with a few storeys wider than the rest) cause a sudden jump in earthquake forces at the level of discontinuity. Buildings with columns that hang or float on beams at an intermediate storey have discontinuities in the load transfer path. Buildings with floating columns were mainly adopted to get more space for parking or reception lobbies collapsed and were severely damaged in earthquake. Many building with hanging or floating column severely damaged in Gujarat during the 2001 Bhuj earthquake.

In the recent years some studies regarding the effect of floating columns in multi storied building were carried out with help of different software packages. Nautiyal (2014) presents the performance of building with floating column under different soil condition. Rajasekhar. T (2014) states that building without floating column can be performed well in terms of displacement and base shear. M. K. Srikanth (2014) presenting the seismic response of complex building with floating column for zone II and zone IV. In this paper the performance of building with and without floating column under different soil condition and different zone conditions were discussed.

## II. FLOATING COLUMN

A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is also a vertical element which ends (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. Fig. 1 shows the building with floating columns.

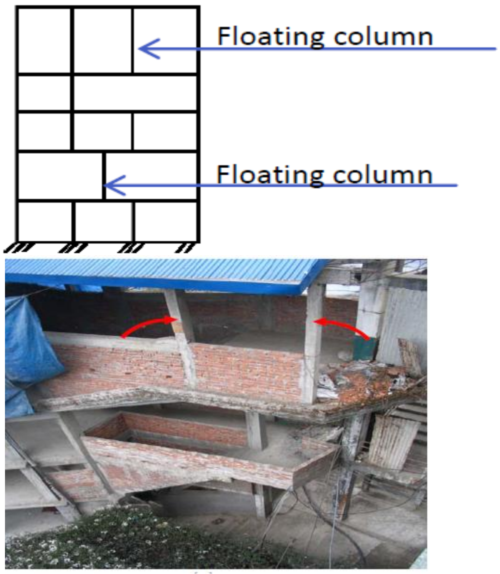


Fig. 1: Building With Floating Column

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. These open spaces may be required for assembly hall or parking purpose. The transfer girders have to be designed and detailed properly, especially in earthquake zones.

## III. OBJECTIVES OF PRESENT STUDY

1) To study the dynamic performance of building with and without floating column under different soil condition and in different seismic zones.
2) The results are studied in terms of Storey drift and Storey shear.

## IV. EXAMPLE BUILDING FRAME

The building considered is a airport fire station. The main functions of the stations are to view the Flights from the watch room, watch the whole airport and park the fire engines. Fig. 2 shows the third floor plan of the building with floating column positions.

TABLE 1: DETAILS OF BUILDING

| | | |
|---|---|---|
| 1 | Type of structure | Ordinary Moment Resisting Frame(OMRF). |
| 2 | Number of stories | Ground + 4 floors. |
| 3 | floor height | 3.45m. |
| 4 | Infill wall | 230mm thick brick infill wall in both X-direction and Y-direction. |
| 5 | Type of soil | Type I (Hard), Type II (Medium soil),Type III(soft soil) |
| 6 | Seismic zone | Zone II, Zone III, Zone IV, Zone V |
| 7 | Importance factor | 1.5 |
| 8 | Damping in structure | 5% |
| 9 | Size of columns | 200 X 600<br>300 X 400 |
| 10 | Size of beam | 230 X 600<br>300 X 400 |
| 11 | Depth of slab | 150mm |
| 12 | Material | M25 grade concrete<br>Fe 415 steel |

## V. MODELING OF THE BUILDING

The entire work consist of two models (building with floating column, building without floating column) and these models were analysed for different seismic zones and under different soil condition. The results are presented in terms of storey shear and storey drift. The floating columns are present in between second and third floor. The present study is done by using ETAB 9.5. It is finite element based structural program for the analysis and design of civil structures. Fig. 4 shows the 3-D model of the building frame. The dead load, live load, floor finish, wind load were defined and assigned to the various models. The earthquake forces are defined as response spectrum method. The load combinations as per Indian standard codes are considered for the analysis.

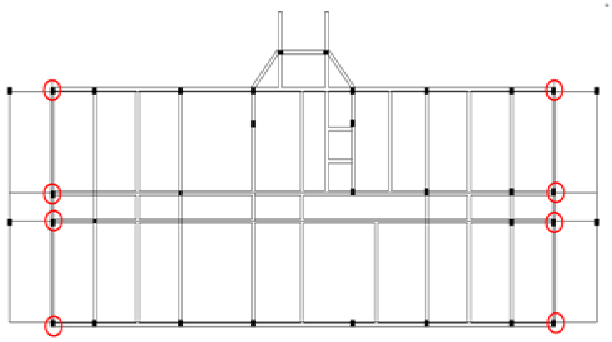

Fig. 2: Building plan with floating columns

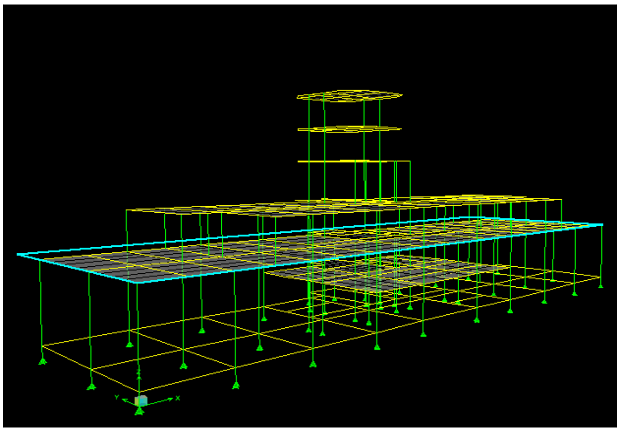

Fig. 3: ETAB 3-D model of the structure

## VI. RESPONSE SPECTRUM ANALYSIS

It is a dynamic linear method of analysis in which maximum structural response is plotted as a function of structural period for a given time-history record and level of damping. Response measures may be in terms of peak acceleration, velocity, or displacement relative to the ground or the structure. Structures must remain essentially elastic since response-spectrum analysis is dependent upon the superposition of gravity and lateral effects.

## VII. RESULTS AND DISCUSSIONS

The present study is to compare the performance of building with and without floating columns in different seismic zone and under different soil conditions. The analysis were carried out for diferent models and the results are presented in the form of graphs are presented here. The resulte are obtained in terms of storey drift and storey shear.

**Soil type: I (rock or hard soil) and Earthquake Zone: II (Z=0.1)**

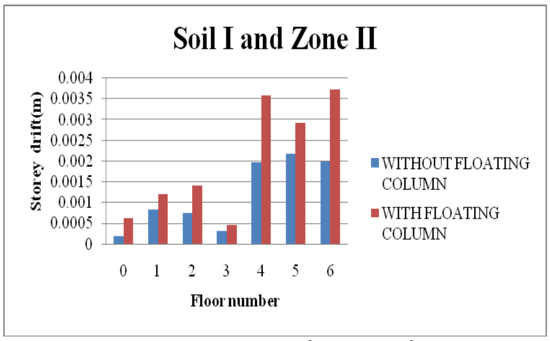


Fig. 4: Comparison of Storey Drifts

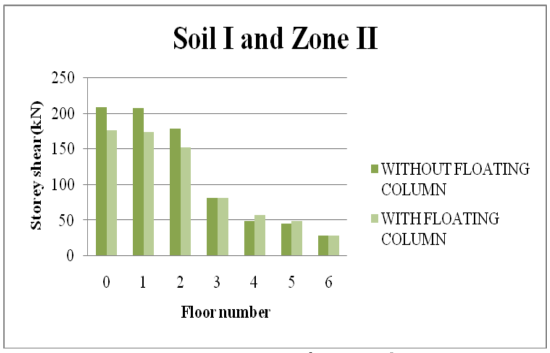


Fig. 5: Comparison of Storey Shear

**Soil type: I (rock or hard soil) and Earthquake Zone: III (Z=0.16)**

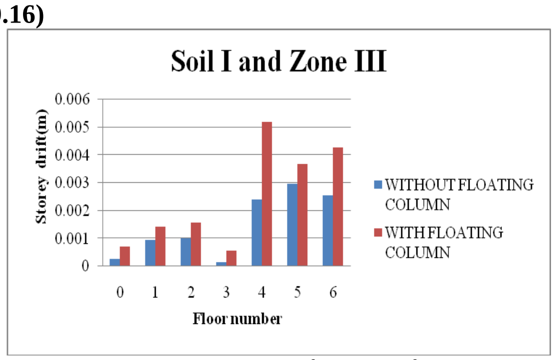


Fig. 6: Comparison of Storey Drifts

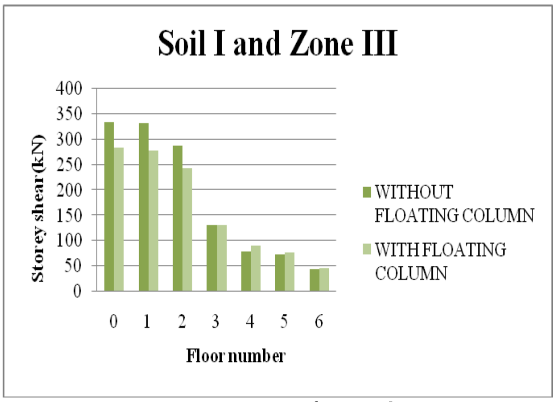


Fig. 7: Comparison of storey shear

**Soil type: I (rock or hard soil) and Earthquake Zone: IV (Z=0.24)**

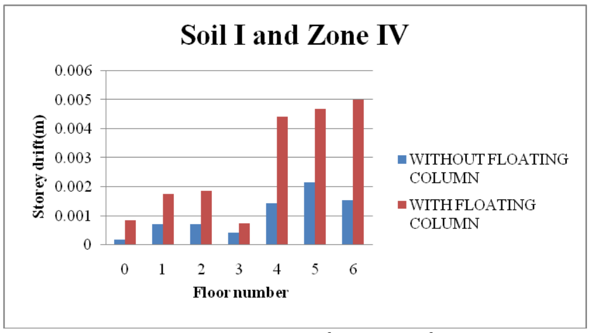


Fig. 8: Comparison of Storey Drifts

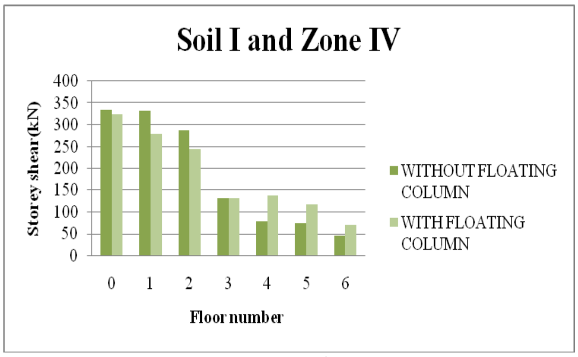


Fig. 9: Comparison of Storey shear

**Soil type: I (rock or hard soil) and Earthquake Zone: V (Z=0.1)**

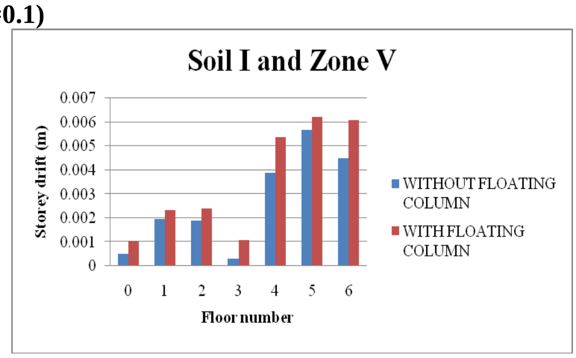


Fig. 10: Comparison of storey drifts

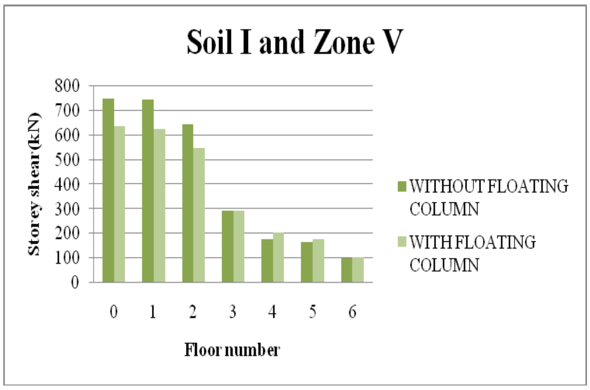


Fig. 11: Comparison of Storey Shear

**Soil type: II (medium soil) and Earthquake Zone: II (Z=0.1)**

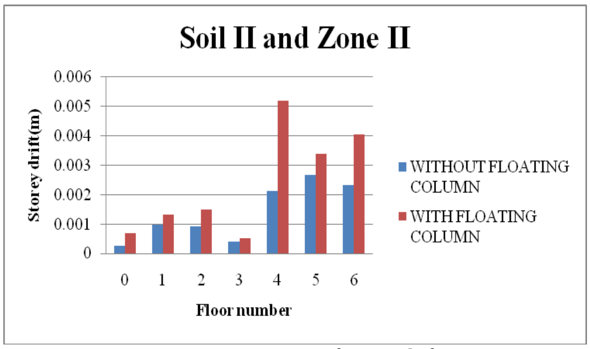


Fig. 12: Comparison of storey drifts

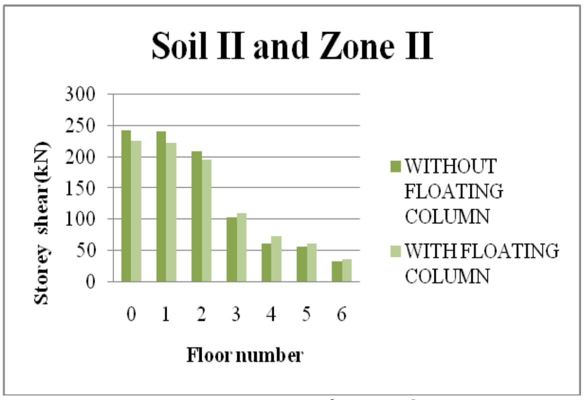


Fig. 13: Comparison of Storey Shear

**Soil type: II (medium soil) and Earthquake Zone: III (Z=0.16)**

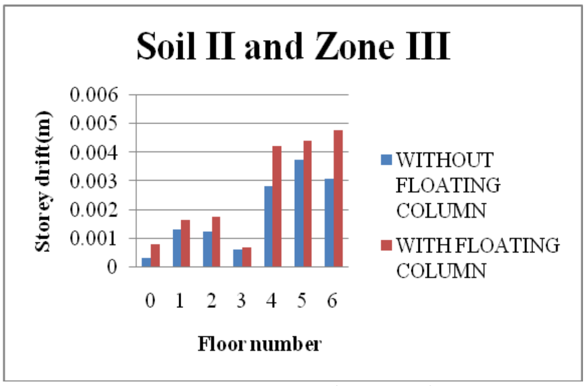


Fig. 14: Comparison of storey drifts

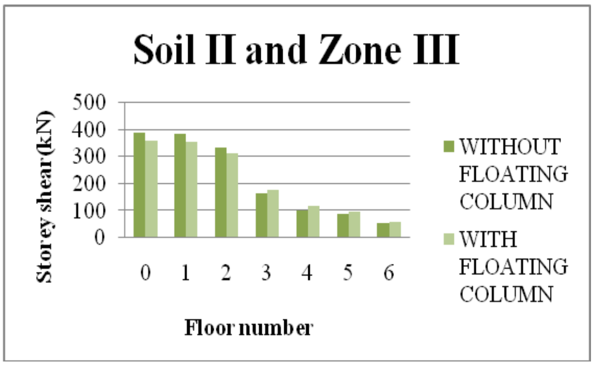


Fig. 15: Comparison of Storey Shear

**Soil type: II (medium soil) and Earthquake Zone: IV (Z=0.24)**

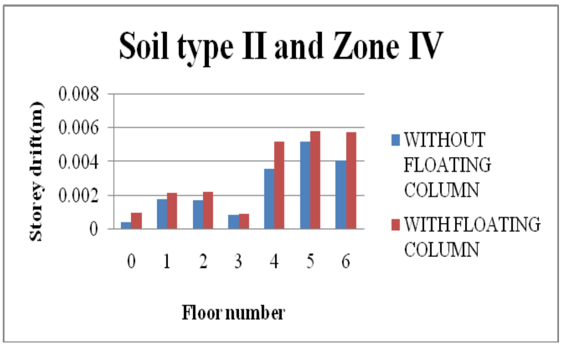


Fig. 16: Comparison of storey drifts

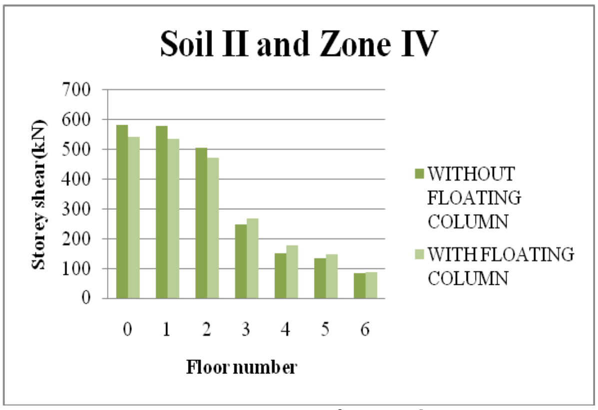


Fig. 17: Comparison of Storey Shear

**Soil type: II (medium soil) and Earthquake Zone: V (Z=0.36)**

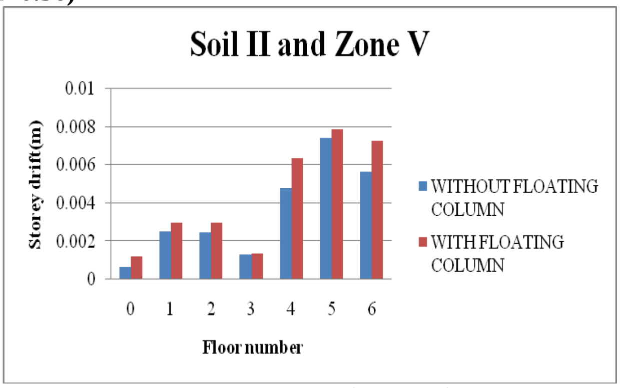


Fig. 18: Comparison of storey drifts

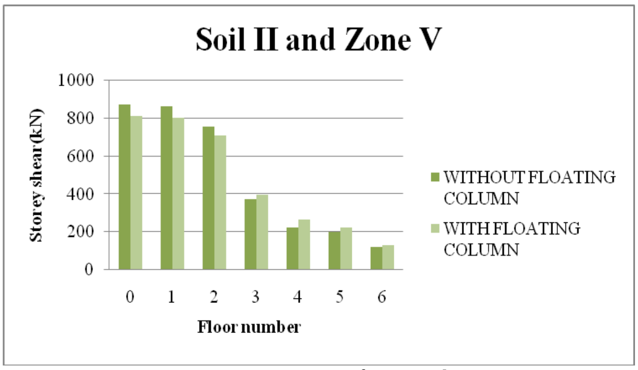


Fig. 19: Comparison of Storey Shear

**Soil type: III (soft soil) and Earthquake Zone: II (Z=0.1)**

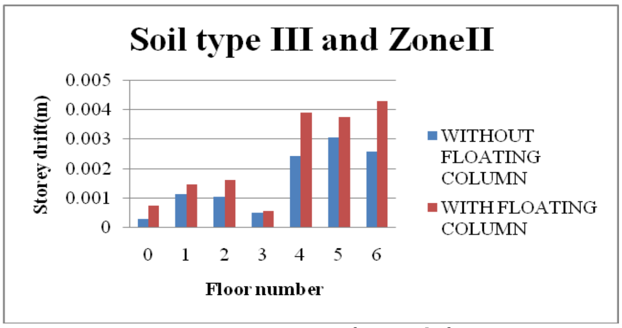


Fig. 20: Comparison of storey drifts

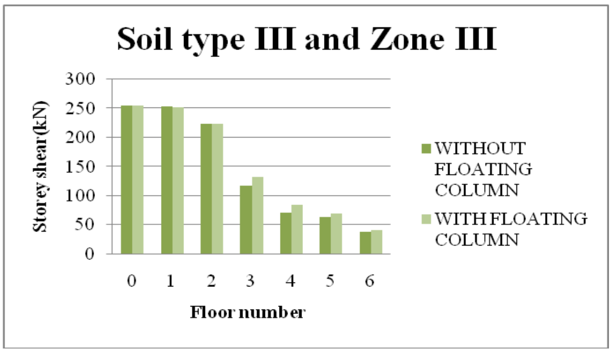


Fig. 21: Comparison of Storey Shear

**Soil type: III (soft soil) and Earthquake Zone: III (Z=0.16)**

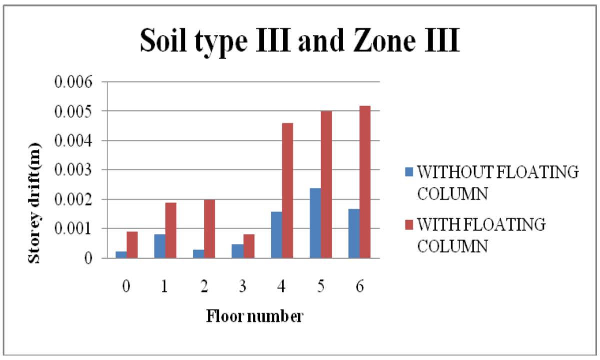


Fig. 22: Comparison of storey drifts

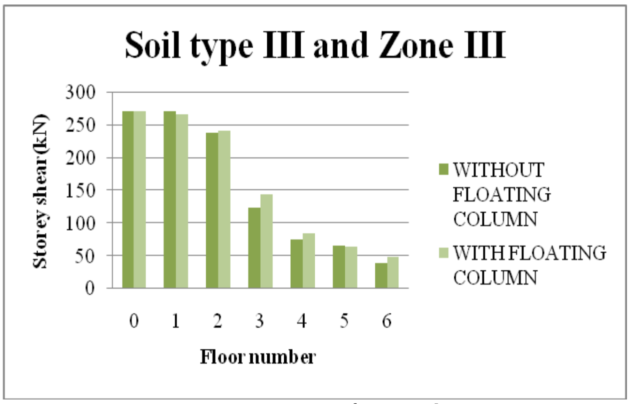


Fig. 23: Comparison of Storey Shear

**Soil type: III (soft soil) and Earthquake Zone: IV (Z=0.24)**

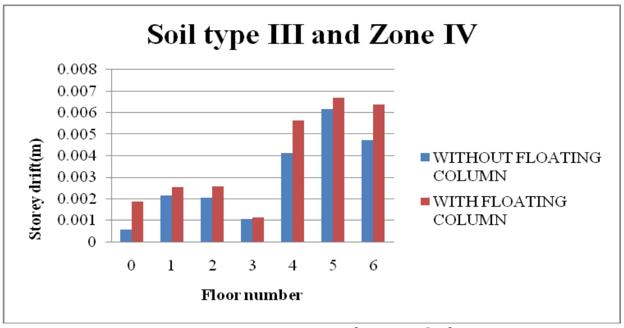


Fig. 24: Comparison of storey drifts

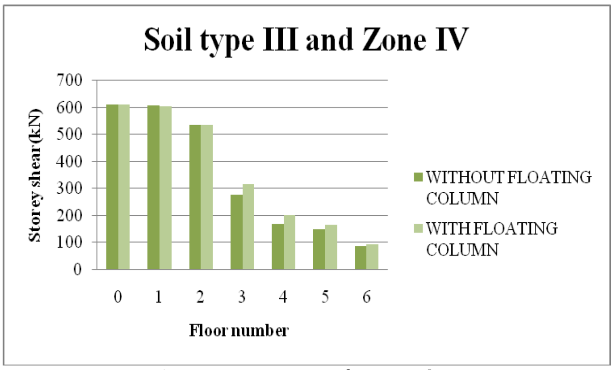


**Fig. 25:** Comparison of Storey Shear

**Soil type: III (soft soil) and Earthquake Zone: V (Z=0.36)**

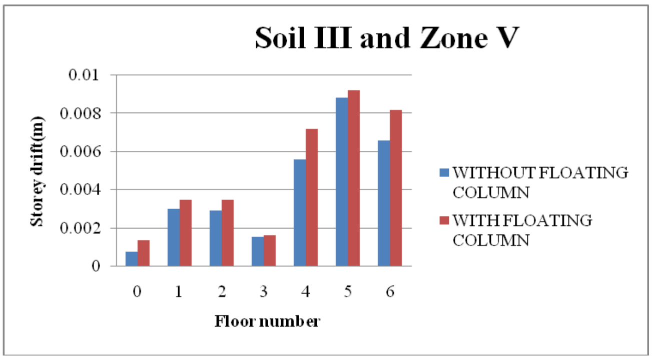


Fig. 26: Comparison of storey drifts

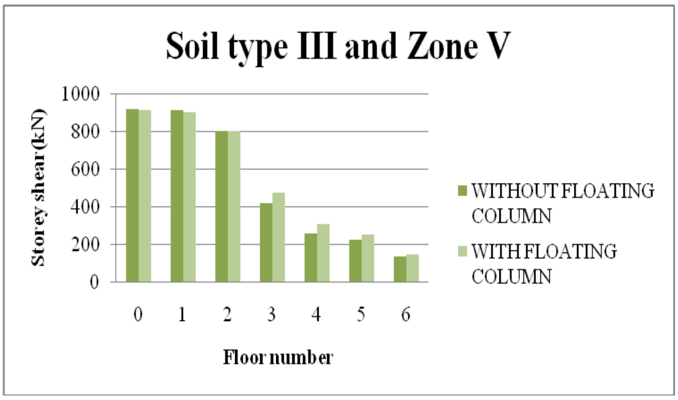


Fig. 27: Comparison of Storey Shear

## VII. CONCLUSIONS

In this study an effort was taken to compare the seismic performance of multistoried structure with and without floating column under different soil condition and seismic zone effect. Followwing are the conclusions obtained from the graphs by comparing storey drift and storey shear,

1. The storey drift values are increased from lower zones to higher seismic zones in both cases that is building with and witout floating column. The storey drift shows an increase in its value when move from type I soil to type III soil.
2. Storey shear values are increased from lower zones to higher zones in the both case ie. building with and without floating columns. The maximum storey shear values are obtained for the soil type III and seismic zone V combination.
3. Storey shear will be more in the case of lowet floors of building without floating column. In top stories the building with floating column shows an increase in torey shear compared to building without floating columns.
4. Horizontal symmeetry of second and third floor will cause sudden drop of storey drift in third floor in both case that is building with and without floating column models.
5. The storey drift values and storey shear values are maximum in tthe case building with floating column in type III soil condition and seismic zone V.

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