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Study The Behaviour Of Seismic Evaluation Of Multistoried Building With Floating Columns

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ABSTRACT

Structural Engineering is a piece of Civil Engineering managing the investigation and outline (Design) of structures that sustain or oppose loads. This undertaking managing the investigation of seismic examination of multi-storied building with and without floating column. The building containing G+8 structures has been chosen for completing the undertaking work. In present situation structures with Floating column is an ordinary component in the cutting edge multi-story development in urban India. Such elements are exceedingly undesirable in building inherent seismically dynamic territories (regions). This study highlights the significance of unequivocally perceiving the vicinity of the Floating column in the examination of building. The Equivalent Static Analysis and Response Spectrum Analysis is done by utilizing Extended Three Dimensional Analysis of Building Systems (ETABS) form 15.2.2 product., examination consequences of the multi-story building, for example, Building displacement, storey drift, and Base shear were thought about in this work. The qualities got from results are taken and graphs are plotted for both with and without Floating column models and after that examination of these models are been introduced. At last, this will help us to locate the different investigative properties of the structure and we might likewise have an extremely precise and conservative configuration for the structure.

1 INTRODUCTION

1.1 GENERAL

In modern period, multi-storey buildings in metropolitan cities are required to have column free space due to lack of space, more population and also for aesthetical point of outlook, functional requirements and also For the purpose of parking hall, usually the ground storey is kept free without any constructions, excluding the columns which transmit the structure weight to the land. For a lodge or commercial building, where the lower floors contain dinner halls, forum rooms, lobbies, show rooms or parking areas, large interrupted space necessary for the movement of people or vehicles. Narrowly spaced columns based on the plan of higher floors are not desirable in the lower floors. For this, buildings are provided with floating columns at different storey. These floating columns are highly inconvenient in a building which is built in high seismic areas. The seismic forces that are initiated at various stories in a structure need to be passed down throughout the elevation to the ground by the undeviating pathway. Divergence in this load transmits way results in reduced performance of the structure. The performance of a building at some point in seismic activity depends significantly on it's on the whole shape, dimension and geometry, in adding to how the earthquake forces are conceded to the land. Structures that have smaller number columns or walls in a particular floor or with oddly giant floor be likely to break or fail which is begined in that floor.

1.2 Definition of Floating Column

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

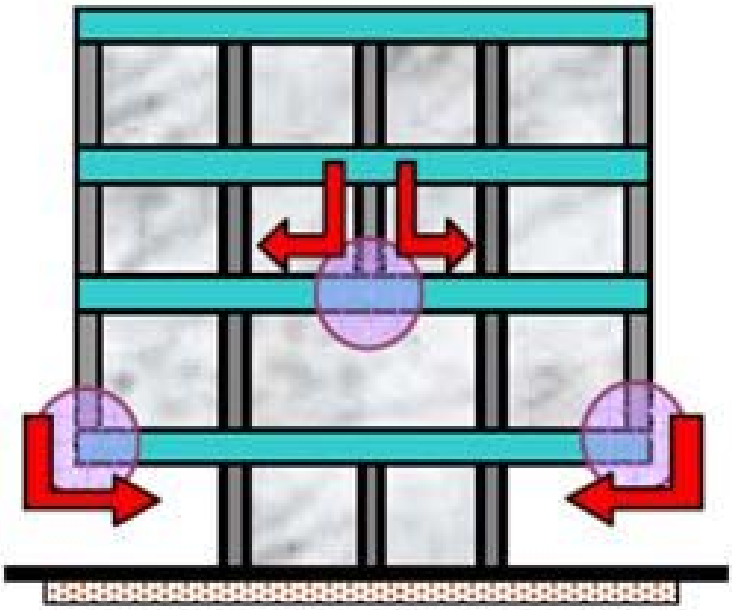

Fig. 1.1 Floating Column

Fig. 1.2 Park Avenue South in New York

1.3 Objectives and scope of present work

Following are the objectives of the present study

1. To analyse the RCC multi-storey structure with and without floating column for seismic forces.
2. Modelling has to be done by using Extended Three Dimensional Analysis of Building System (ETABS) of version 15.2.2
3. The Equistatic Analysis and Response Spectrum Analysis is carried out for the multi-storey building with and without floating column.
4. Examine various responses such as Base shear, Lateral displacement, and Storey drift of building with floating column & without floating column.

2 BUILDING CONFIGURATIONS

2.1 Model 1: In this model the building without floating column is considered, this model is analyzed for zone 2, zone 3, zone 4 and zone 5

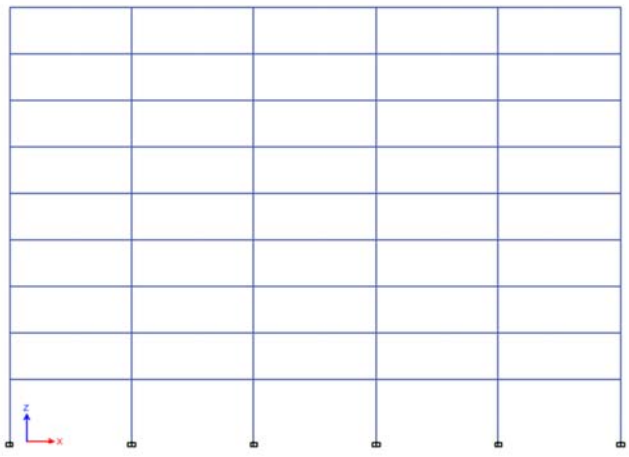

Fig 2.1: Elevation of Model 1

2.2 Model 2: In this model 2 the floating column is introduced at 1st floor at the outer section of the plan. This is analyzed for all the zones like zone 2, zone3, zone4 and zone 5

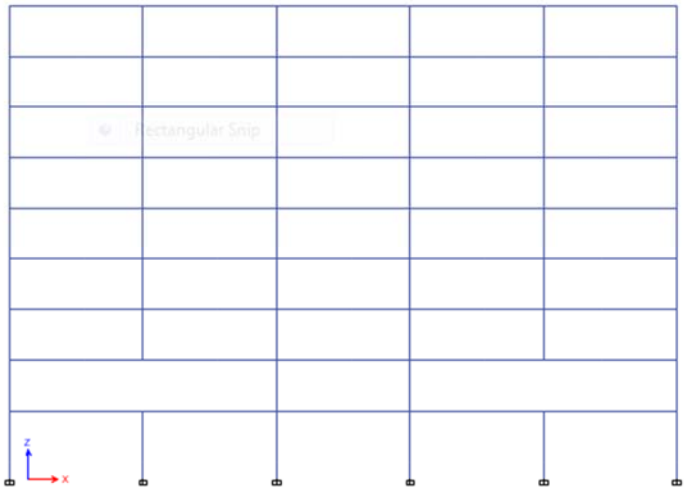

Fig 2.2: Elevation of the Model 2

2.3 Model 3: In this model 3 the floating column is introduced at 5th floor at the outer section of the plan. This is analyzed for all the zones like zone 2, zone3, zone4 and zone 5

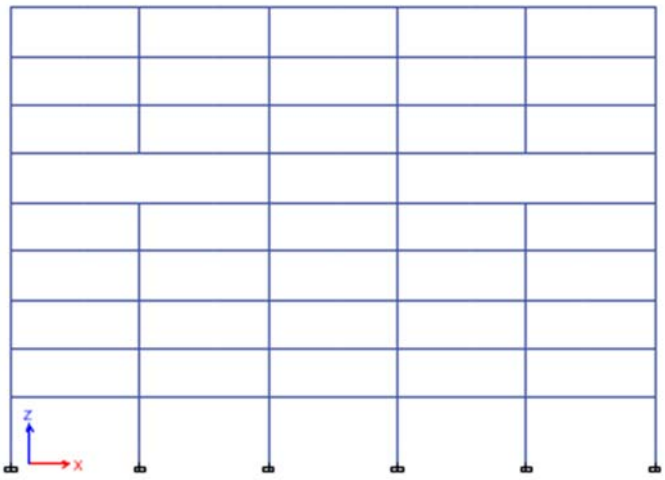

Fig 2.3: Elevation of the Model 3

3 METHODOLOGY

1. In this work G+8 storey building is analysed using ETABS 2015 software with regular plan
2. Floating column is introduced according to the functional requirement
3. Equivalent static force method (static analysis) and Response spectrum method (Dynamic analysis) carried for different zones
4. Generation of response spectrum for soil type medium for the seismic zone2 to 5 according to IS 1893: 2002 has been used for the dynamic analysis.
5. The results obtained from the finite element analysis are listed, discussed and finally drawn the conclusion.

3.1 METHODS OF SEISMIC ANALYSIS OF STRUCTURE

Different strategies for contrasting complication have been created for the seismic examination or analysis of structures. They can be named below:

- Equivalent Static analysis or Static analysis
- Dynamic analysis

The methods of Dynamic analysis are:

- Response Spectrum Method

3.1.1 EQUIVALENT STATIC ANALYSIS

In the equivalent static analysis, the theory is made that the structure will react in its basic mode. This method is well suited for normal building, small rise and average rise buildings. And the building should not twist as the ground moves and the response is studied from the designed response spectra. The method followed by calculating the lumped weight and then fundamental natural period to estimate the base shear and the lateral force distribution at each storey level using IS 1893(part 1)-2002. Static loads don't vary with time as like dynamic. The static analysis is the mainly simple one-it necessitate a smaller amount computational endeavours and is in view of formulation given in the code of practice. The drawback of this is that only single mode of vibration of structure is used for analysing.

3.1.2 RESPONSE SPECTRUM METHOD

The spectrum, which is utilize as seismic in order is the response spectrum of a quake. Actually, response spectrum of a quake is the most supported seismic info for Earthquake Engineers. There are various response spectra that are characterized for speaking to the ground movement, for example, Pseudo speed response spectrum, Displacement response spectrum, Energy spectrum and Absolute acceleration response spectrum. These spectra additionally demonstrate the frequency substance of the ground movement, however not as specifically as the Fourier range does. The absolute acceleration response spectrum is ordinarily utilized as a data for the response spectrum methods for examination of structures.

The linear dynamic analysis method is also called as Response spectrum method. In this techniques the ultimate response of a building during a tremor is found specifically from the quake responses (or design) range. The representation of the max responses of ideal SDOF frameworks having notable period and damping, during seismic tremor ground motion, the max response is plotted against the un damped natural period and for different damping values, and can be communicated regarding most extreme relative displacement or most extreme relative speed.

The static (corresponding) horizontal force for a tremor is found via completing a modal analysis of building, and afterward a static analysis of the structure with corresponding (static) lateral force in every method of vibration is executed to get the wanted responses.

4 RESULTS AND DISCUSSIONS

4.1 STATIC ANALYSIS

4.1.1 Lateral Displacement

The below results shows the variation of Displacement in X-direction for Zone 2 and Soil condition is Medium.

	MODEL 1	MODEL 2	MODEL 3
STOREY	UX IN MM	UX IN MM	UX IN MM
0	0.313	0.225	0.305
1	2.004	1.95	2.008
2	4.755	5.261	4.762
3	8.369	9.402	8.332
4	12.316	13.662	12.238
5	16.122	17.818	16.012

6	19.61	21.708	19.687
7	22.636	25.193	22.904
8	25.094	28.093	25.72
9	26.892	30.385	27.957

Table 4.1 Displacement in X-Direction for Zone 2

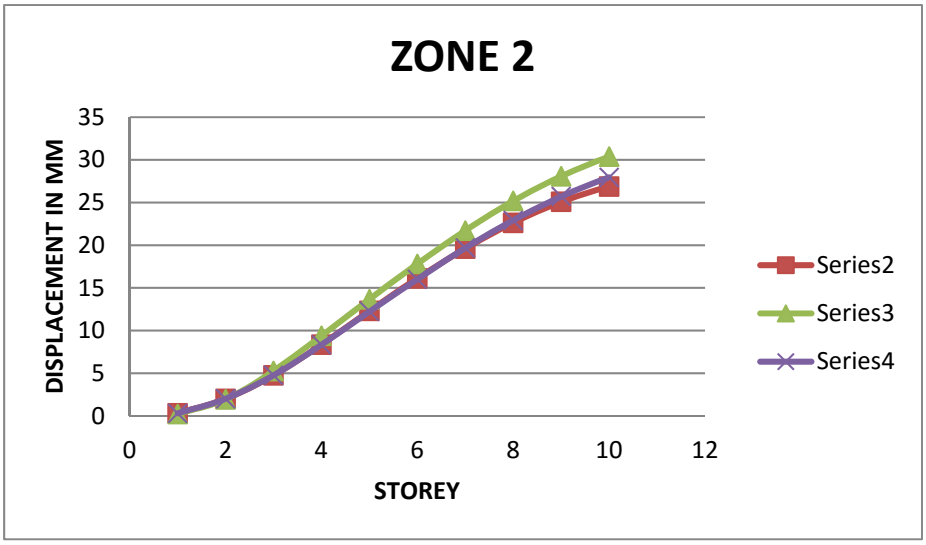

Fig. 4.1 Displacement in X-Direction for Zone 2

The below results shows the variation of Displacement in Y-direction for Zone 2 and Soil condition is Medium.

4.1.2 Storey Drift

The below results shows the variation of Drift in X-direction for Zone 2 and Soil condition is Medium.

	MODEL 1	MODEL 2	MODEL 3
Storey	DRIFT X IN MM	DRIFT X IN MM	DRIFT X IN MM
0	0.000372	0.00036	0.000375
1	0.000636	0.000616	0.000636
2	0.000932	0.001122	0.000934
3	0.001281	0.001404	0.001275
4	0.001339	0.001448	0.00133
5	0.00129	0.001409	0.001279
6	0.001182	0.001319	0.0013
7	0.001028	0.001181	0.001132
8	0.000833	0.001002	0.000979
9	0.000615	0.000777	0.000758

Table 4.2 Drift in X-Direction for Zone 2

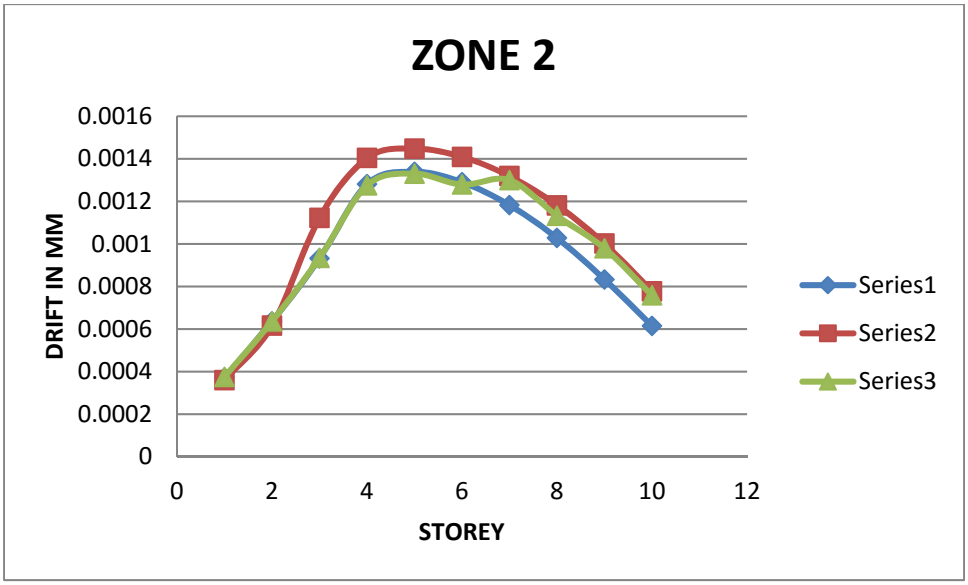

Fig. 4.2 Drift in X-Direction for Zone 2

From this graph it is clear that drift in X –Direction for model 3 and model 2 is max when compared to the model 1

4.1.3 Base Shear

The below results shows the variation of Base Shear in X-direction for Zone 2 and Soil condition is Medium.

	Model 1	Model 2	Model 3
Storey	**VX in KN**	**VX in KN**	**VX in KN**
Base	1205.773	1204.254	1204

Table 4.3 Base Shear in X-Direction for Zone 2

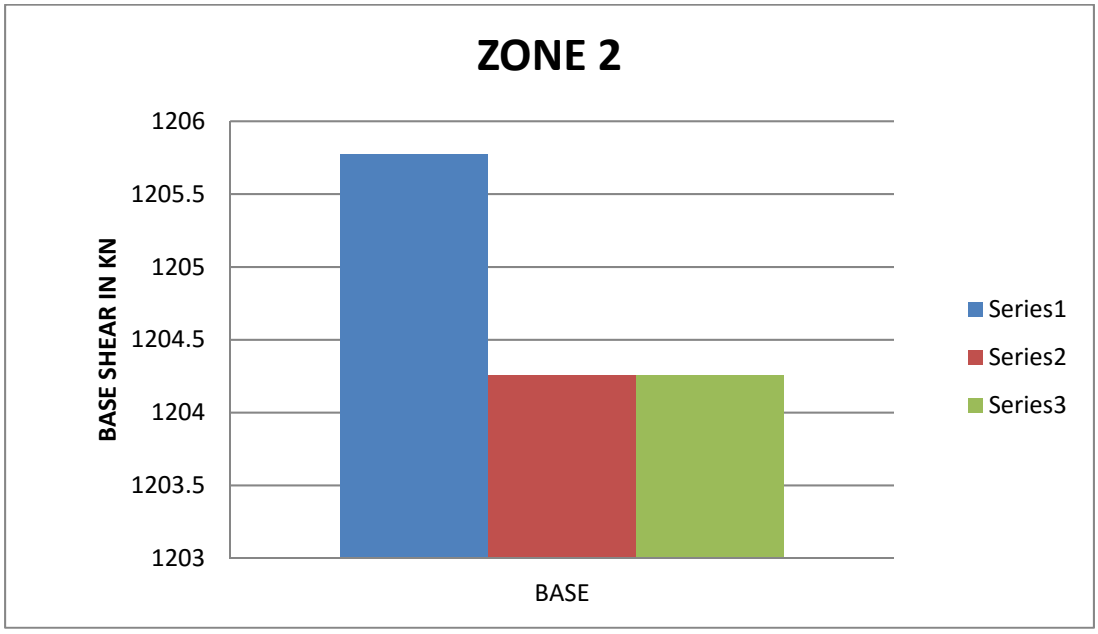

Fig. 4.3 Base Shear in X-Direction for Zone 2

From the above charts it is clear that model 1 has maximum Base shear compared to other models, hence the stiffness of model 1 is more than the other models

4.2 RESPONSE SPECTRUM ANALYSIS

4.2.1 Lateral Displacements

The below results shows the variation of Displacement in X-direction for Zone 2 and Soil condition is Medium.

	MODEL 1	MODEL 2	MODEL 3
STOREY	UX IN MM	UX IN MM	UX IN MM
0	0.089	0.334	0.337
1	0.579	1.95	2.008

2	1.366	5.261	4.762
3	2.396	9.402	8.332
4	3.469	13.667	12.078
5	4.52	17.82	15.767
6	5.517	21.709	19.592
7	6.43	25.193	22.904
8	7.225	28.136	25.763
9	7.85	30.385	27.957

Table 4.4 Displacement in X-Direction for Zone 2

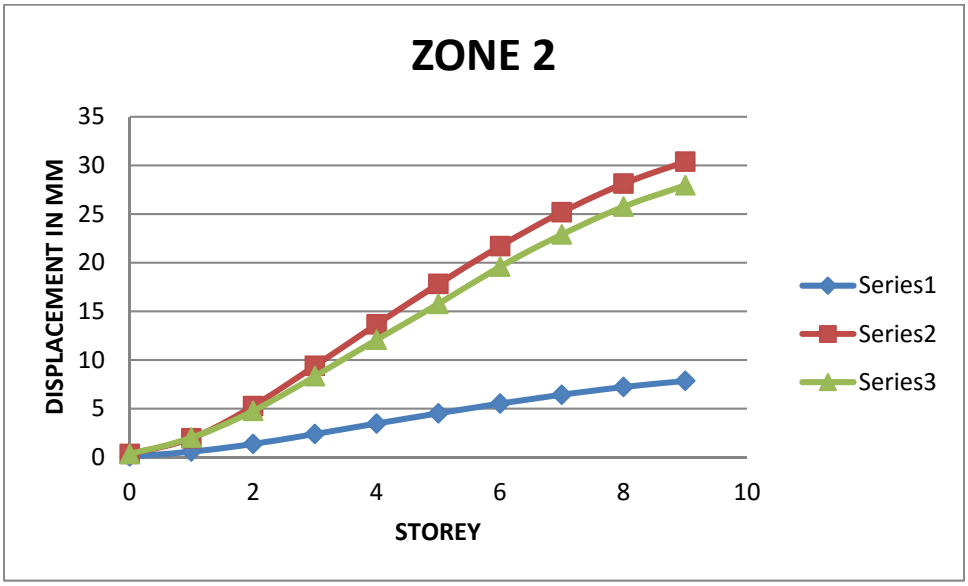

Fig. 4.4 Displacement in X-Direction for Zone 2

From this graph it is clear that displacement in X –Direction for model 3 and model 2 is max when compared to the model 1

4.2.2 Storey Drift

The below results shows the variation of Drift in X-direction for Zone 2 and Soil condition is Medium.

	MODEL 1	MODEL 2	MODEL 3
STOREY	DRIFT X IN MM	DRIFT X IN MM	DRIFT X IN MM
0	0.00009	0.00036	0.000375
1	0.000175	0.000616	0.000636
2	0.000279	0.001122	0.000934

3	0.00037	0.001404	0.001275
4	0.000387	0.001448	0.00133
5	0.000381	0.001409	0.001279
6	0.000362	0.001319	0.0013
7	0.000332	0.001181	0.001132
8	0.000289	0.001002	0.000979
9	0.000234	0.000777	0.000642

Table 4.5 Drift in X-Direction for Zone 2

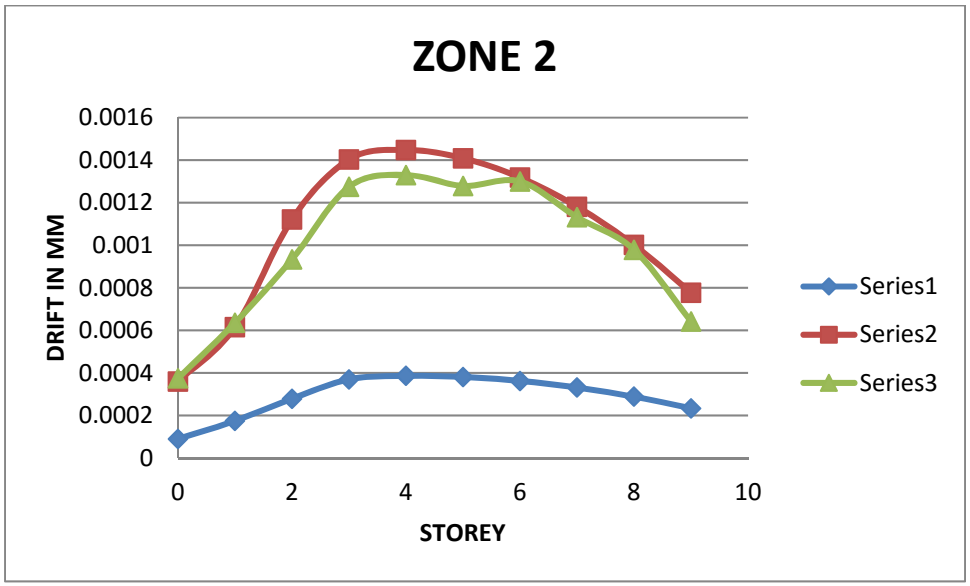

Fig. 4.5 Drift in X-Direction for Zone 2

From the above graph it is shows that compared to model 1 the storey drift in X-Direction increases for model 2 and for model 3.

CONCLUSION

From this present work the following observations were made and concluded the things which is stated as below

- The structure without floating column is much more stiffer than the structure with floating column

- It is observed that the displacement of the structure with floating column is maximum when compare to the structure without floating column
- The displacement of the structure increases with increase the storey number so the displacement is increases from lower storey to higher storey
- It is also observed that the lateral displacement of the structure increases when we shift the floating column towards the higher storey
- The lateral displacement values increases with increase in the zones displacement values increase for zone 2, zone 3, zone 4 and zone 5 respectively
- The Base Shear is minimum for the structure without floating when compared to the structure with floating column
- Hence it is observed that the structure without floating column is more stiffer when compared to structure with floating column
- The structure without floating column the storey drift is minimum when compared to the structure with floating column
- From this experiment it is concluded that the structure with floating column at higher floor is must be avoided

If floating column is more needed as the aesthetic and functional point view, it is advisable to perform the sequentional analysis.

Future scope

- This analysis can be carried out for remaining soil types like Hard soil and Soft soil
- This analysis can be carried out for irregular building shapes
- This can be carried out for different location of the floating columns
- This work can be made for the floating columns with bracings

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