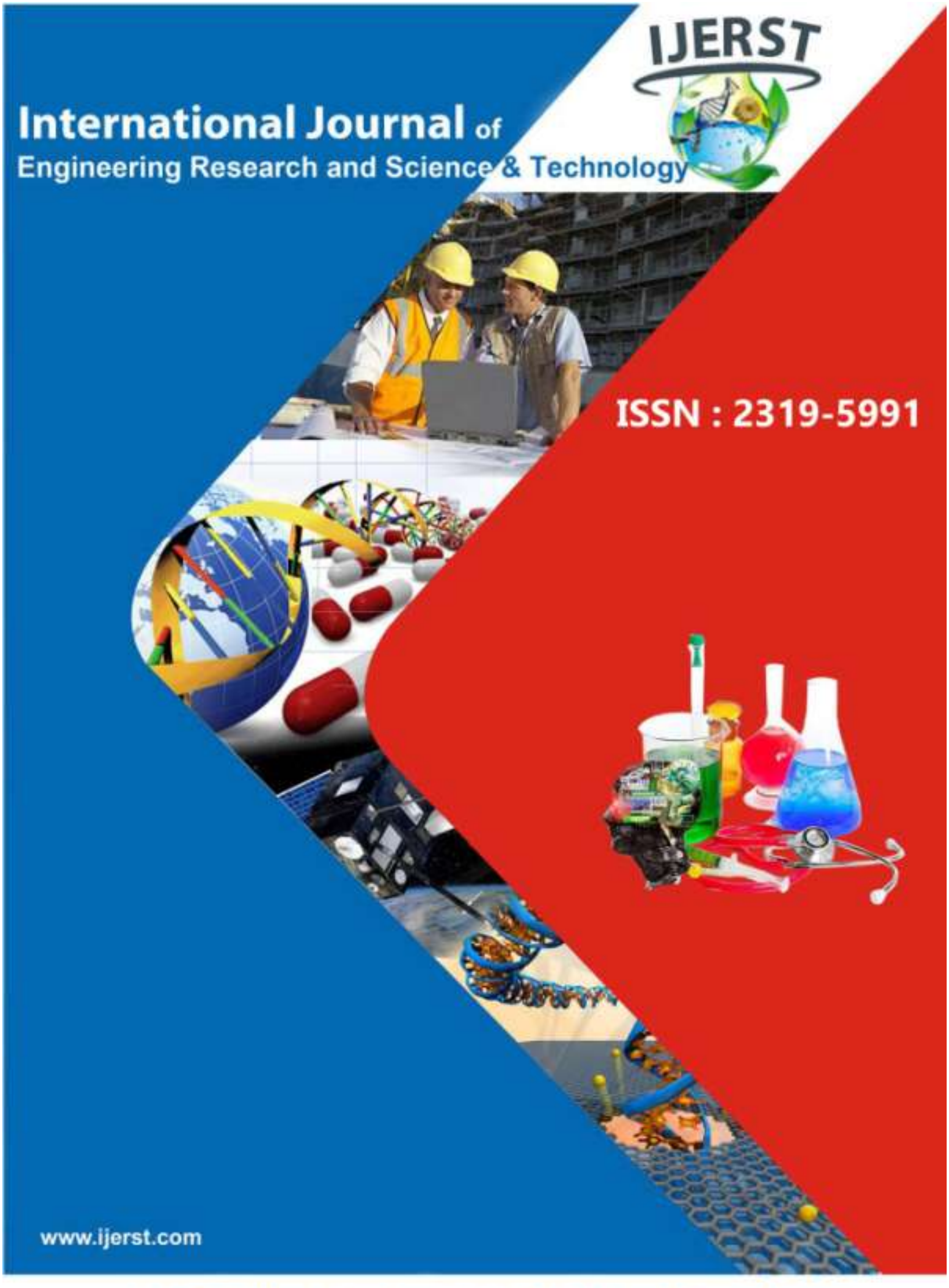

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STUDYONSEISMICEFFECTOFFLOATINGCOLUMNSINSTRUCTURALPERFORMANCE

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ABSTRACT

Multi-story buildings with floating columns play a virtual part in modern India's construction. Column-free gaps in structural buildings can be filled with these floating columns, which are primarily employed to provide a pleasing architectural perspective. In seismic zones, a floating column has been built for this building at one or more levels. Structures in active prone areas and earthquake zones are the focus of this study, which examines how floating columns affect structural performance. Response spectrum analysis has been presented as a method for studying the impact of earthquakes on structural buildings. Structural response of the structure in relation to time period, story drift and story displacement has been studied. The goal is to arrive at a definitive conclusion. ETABS has been used to conduct the research.

KEYWORDS:Stories in Drift, Stories in Displacement, ETABS, Floating Columns, Earthquake.

I. INTRODUCTION

Any vertical structural member that transmits load via compression is known as a "column." The structure's weight is dispersed downward from the upper levels to the lower ones. The term "floating column" refers to a column with a lower level that rests on a beam and does not extend to the foundation level. When a building has floating columns, they rest on an intermediate structural element, which does not extend all the way down to the foundation. Load transformation is disrupted in structures with floating columns.

Multi-story buildings with an open ground store, whether for residential, commercial, or industrial use, are becoming more frequent. Typically, the ground floor of a building is left untouched save for the columns that support the weight of the structure. Multi-story buildings in metropolitan locations are often constructed with floating columns at the ground level to provide the aforementioned functions. Gravity loads are taken into account when designing these floating column structures.

Many reinforced concrete (RC) buildings have been damaged by earthquakes in the past for a variety of reasons.

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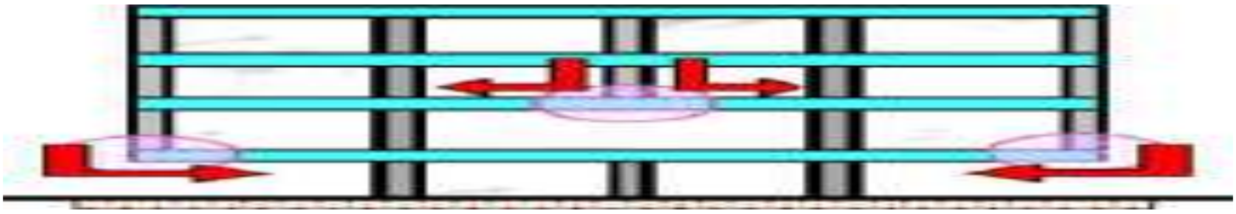
Inadequate ductile detailing of members and sagging of surrounding structures are all because of the buildings' soft stories, sagging foundations, floating columns, and other mass abnormalities. There has been a great deal of investigation into the procedural assumptions that have been made in various seismic codes in order to analyze seismic

capacity of existing buildings and the inertia force developed at different floor levels need to bebroughtdownalong theheight of framethroughthe shortestpossible pathandany discontinuityintransferpathresultsinpoorperformanceoftheRCbuildingunderearthquakeexcitation.

Fig1Typicalarrangementsoffloatingcolumn



II. METHODOLOGY

ETABS incorporates all aspects of the engineering design process, starting with the conceptual design and ending with the production of schematic drawings. With commands, we can quickly generate floor and elevation frames as well as execute capacity checks on steel connections and base plates, making the development of buildings much easier.

MODELINGOFBUILDING

Two types ofmodels are designedfor theanalysis of structure,whichis provided with andwithout floating columns in seismic and normal conditions. This analysis is carried out by usingresponsespectrummethodwhichisbasedonstructuralprogramfortheanalysisandtheinterpretationwhichofthewillbeexpressedintermsof story displacementsandstory drifts.

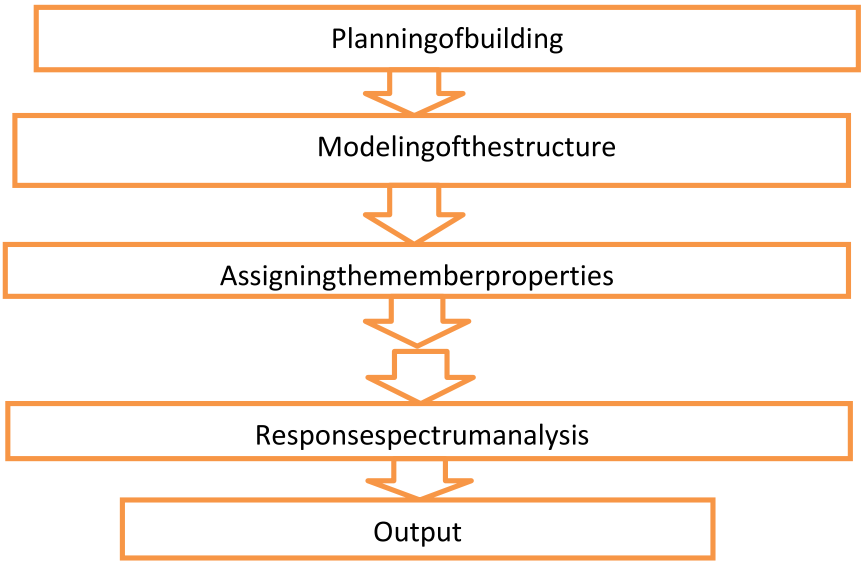
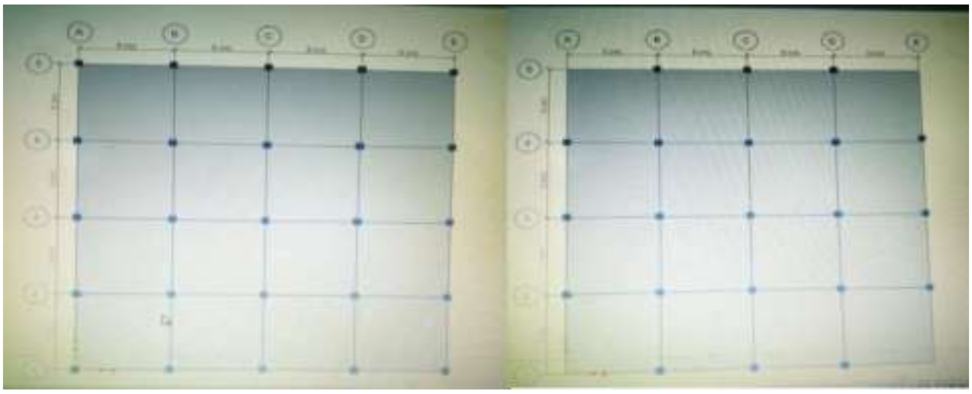


Fig2Proposedmethodologyofanalysisoffloatingcolumn.

III. SEISMICBEHAVIOROFBUILDINGWITHFLOATINGCOLUMN

3.1. During an earthquake, a structure that appears to be robust enough crumbles like a house of cards. Buildings that are built to withstand earthquakes are known as earthquake resistant constructions. The open first floor is a frequent characteristic of many modern multistory structures in India. In accordance with Indian building rules, these structures are meant to withstand large earthquakes. When structures like parking garages or reception lobbies are built with floating columns, earthquakes can quickly bring them down. The response of a structure to an earthquake is largely determined by the structure's size, shape, and geometry, as well as the manner in which earthquake forces are transferred to the soil. A building's seismic forces must be channeled down the structure's height to the foundation using the shortest path possible when the structure is irregular and the load transfer path is unclear, resulting in poor building performance. When compared to a structure with vertical setbacks, such as a commercial building with a few floors that are more extensive than the rest of the stories, a dramatic jump will occur. During the 2001 Bhuj earthquake, numerous structures in Gujarat fell or were seriously damaged.

3.2. Seismicanalysisofbuildingwithfloatingcolumn



3.2.1. ETABS can be used to analyze floating column structures utilizing the response spectrum approach. It is utilized to provide a dynamic connection between the floating column and the rest of the floating structure in residential buildings. Under both static and dynamic loads, ETABS can simulate the member linear dynamic performance of plan and space frames. Section geometry's linear dynamic and the material's inelasticity are taken into account. The study of a building's seismic reaction and seismic forces is an important part of structural engineering. In earthquake-prone areas, structural design and analysis must include seismic analysis. Investigate story drifts and displacements using response spectrum analysis.

3.2.2. **ResponseSpectrumAnalysis**

There are curves drawn between maximum responses of single-degree-of-freedom systems exposed to their time period or frequency, which are referred to as response spectra. It is possible to obtain the seismic forces created in a building by measuring the peak structural response under a linear range using response spectrum. Similar to each node of vibration in an elastic structure, response spectrum analysis is measured. In order to observe the consequences of earthquakes on a structure, this magnitude of forces must be taken into account. The frequency record is necessary for earthquake analysis of a building in a specific area. In order to determine the design earthquake force, a linear dynamic statistical analysis approach should be used to determine the distribution of this force along the structure's height and to various lateral load resisting parts.

MODELLING&ANALYSIS

.The column space center-to-center distance is 5 meters in a multi-story building 20 meters by 20 meters of size G+1 and G+5. It is expected that the floor is 3.0 meters high. Seismic loads was assessed on two buildings, one with and one without floating columns. The chosen structures ranged in height from 6 meters to 18 meters. On Type II (medium) soil, it's situated in Zone II &model2 in Zone-V.

A non-floating and a floating column, the floor elevations of which are depicted in the

It is divided into X and Y directions in the plan's layout. With respect to X-Direction, the grids are displayed in alphabetical sequence (A through E), separated by a distance of five meters (m). There is a 5 m separation between each Y-Direction grid, hence the grids are shown in numerical order, starting with 1, 2, 3, 4, and 5. Between each floor, there is a space of 3 meters. The total number of tales is supplied. "G+1" and "G+5"
Fig3G+1&G+5structurewithoutfloatingcolumn
Fig4G+1&+5structurewithfloatingcolumn

picture, are initially modeled in this work.

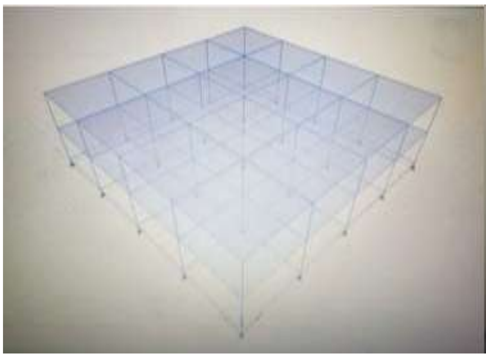
4.1. ModelingoftheStructure

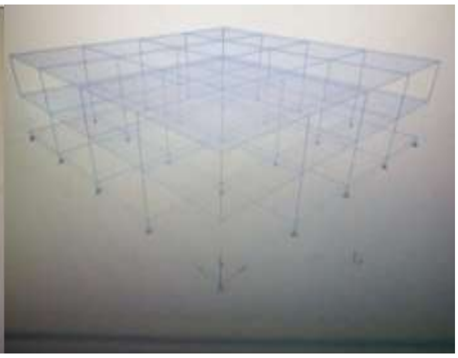
4.2. Four separate building modifications were made to examine the impact of seismic loading, resulting in a total of four distinct examples. Seismic zones are taken into consideration when selecting building models in this step.

4.3. For the Model 1 FC: G+1 Columns can be floated.

4.4. Non-floating columns are used in place of floating columns in the Model 1 WFC.

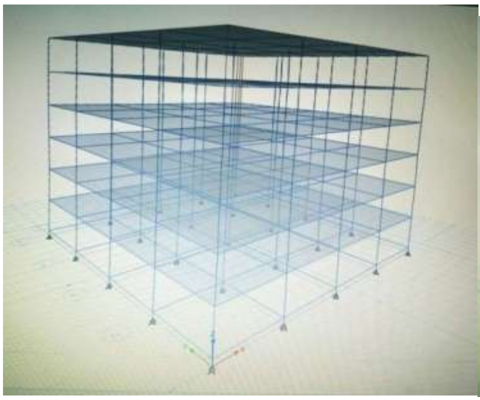
4.5. G+5 floating columns are also supplied in the Model 2 FC building.





4.6. • Model 2 WFC: This model is identical to Model 2 FC, except that floating columns are transformed to non-floating columns in this version.

Fig5G+1structurewithoutfloatingcolumn **Fig6G+1structurewithfloatingcolumn**



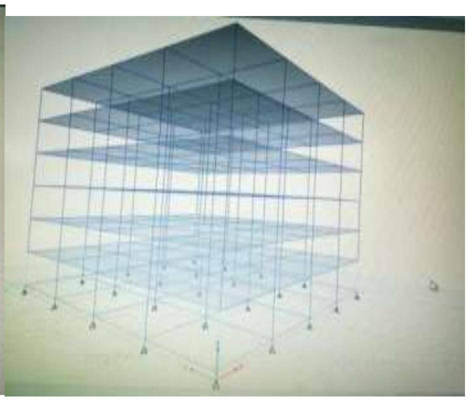


Fig7G+5structurewithoutfloating column **Fig8G+5structurewithfloatingcolumn**

4.7. GeometricalProperties

4.8. 1. Storey height is 3 meters.

4.9. 2. 3 m is the height of the ground floor.

4.10. 3. The building's total length is 20 meters.

4.11. 4. The building's total width is 20 m.

4.12. 6. The buildings' heights are 6 m and 18 m.

4.13. 6 = G+1 &G+5 = Number of stories

4.14. 7. The wall's thickness is 230 mm.

4.15. 8. The slab's thickness is 120 mm.

4.16. 9. The concrete grade is between M25 and M30.

4.17. HYSD415 is the steel grade.

4.18. Defintion of support:

4.19. Sizes of columns The distance from the ground floor to the fifth storey is 0.45 m X 0.45 m.

4.20. Sizes of the beams 0.30 0.45 m from ground to fifth floor

4.21. 14. Transfer Beam diameters ranging from 300 to 500 m

4.22. Dimensions of plinth beams = 350m450m

4.23. SoilProperties

Zone:-II&V

4.24. - II soil type (Medium) Reduction Factor(R):- 5 Importance Factor(I):- 1

4.25. LoadCombinations

i. 1.5(DL+LL)
ii. 1.2(DL+LL+EL)
iii. 1.2(DL+LL–EL)
iv. 1.5(DL+EL)
v. 1.5(DL-EL)
vi. 0.9DL +1.5EL
vii. 0.9DL–1.5EL

4.26. Earthquake loads are imparted in the X- and Y-direction directions. DL stands for "dead load."

4.27. LL stands for "live load" and refers to the weight of the object under consideration. Earthquake load (EL).

4.28. ResponseSpectrumAnalysis:

It is a linear dynamic statistical method known as response spectrum. The following steps are taken into consideration when analyzing this approach.

For further information, see "Define," then "Load Cases." add the seismic load, as updated by Indian standard IS1893-2002, by clicking on it.

The EX-Direction should be chosen eccentrically under seismic zones II and V with medium-type soil.

EX-direction earthquake loads are identical to Y-direction earthquake loads.

• In the next step, which is the updated load factor entry, enter the values of the dead load, live load, and masonry load.

In order to define and add a new model case, name it Model, you must first define the model cases.

Adding a new fictitious name has a response spectrum, which is the final stage.

IV. RESULTSANDDISCUSSION

5.1. StoryDisplacementValues

Lateral loads applied on the structure in the X-direction and Y-directions. The structure can beanalyzed for various load combinations for the load combinations maximum story displacementvaluesinmodel1andmodel2underdifferentzonesi.e.ZoneIIandZoneVgivenbelow.

5.1.1. Storydisplacementvaluesinmodel1

Table1Storydisplacementvaluesinmodel1

Story	StorydisplacementinX-Direction				StorydisplacementinY-Direction			
	Model1 FC ZoneII	Model 1WFC ZoneII	Model1 FC ZoneV	Model1 WFC ZoneV	Model1 FC ZoneII	Model1 WFC ZoneII	Model1 FC ZoneV	Model1 WFC ZoneV
0	0	0	0	0	0	0	0	0
1	0.539	0.420	1.158	0.952	0.583	0.495	0.838	0.537

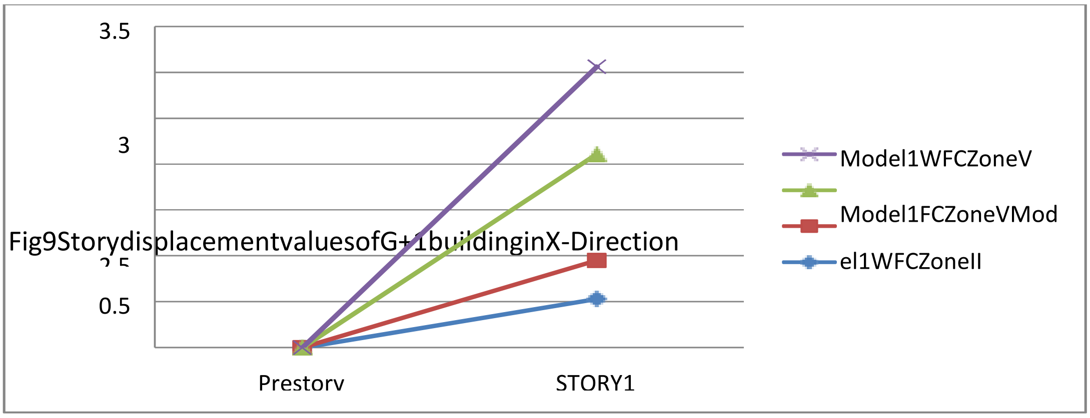


Fig9StorydisplacementvaluesofG+1buildinginX-Direction

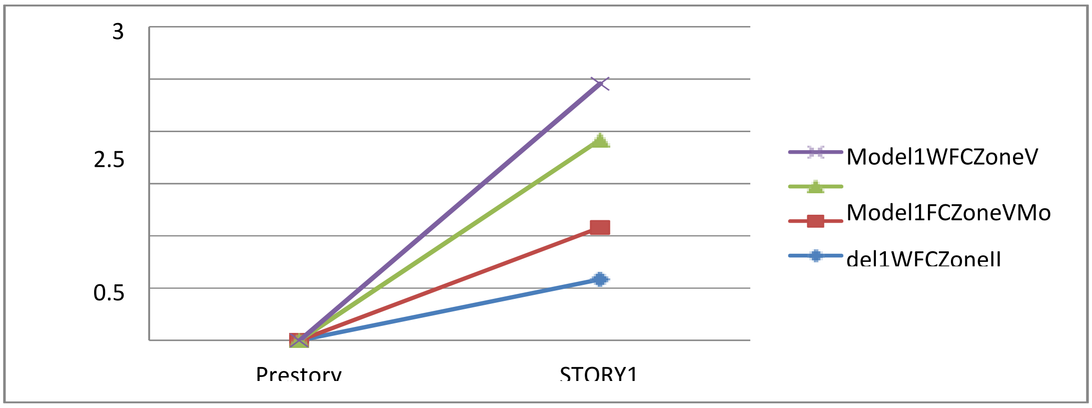


Fig10StorydisplacementvaluesofG+1buildinginY-Direction

5.1.2. Storydisplacementvaluesinmodel2

Table2Storydisplacementvaluesinmodel2

Story	StorydisplacementinX-Direction				StorydisplacementinY-Direction			
	Model 2FC ZoneII	Model2 WFC ZoneII	Model 2FC ZoneV	Model 2WFC ZoneV	Model 2FC ZoneII	Model 2WFC ZoneII	Model 2FC ZoneV	Model 2WFC ZoneV
0	0	0	0	0	0	0	0	0
1	0.532	0.402	2.840	1.705	0.586	0.522	2.020	1.101
2	2.189	2.017	69.230	6.125	2.549	2.242	8.481	7.895
3	4.293	3.328	16.970	14.527	4.728	4.422	15.960	15.70
4	6.285	5.934	24.050	20.020	6.389	6.628	23.270	22.896
5	8.790	8.343	29.870	26.048	9.002	8.428	31.120	30.380

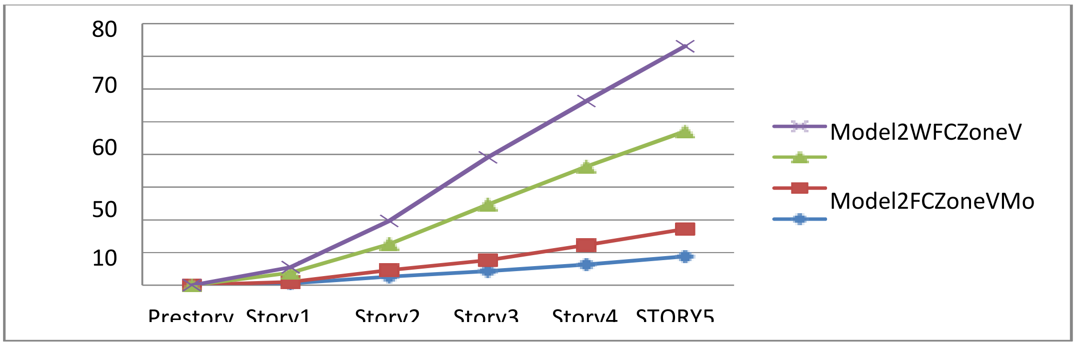


Fig11StorydisplacementvaluesofG+5buildinginX-Direction

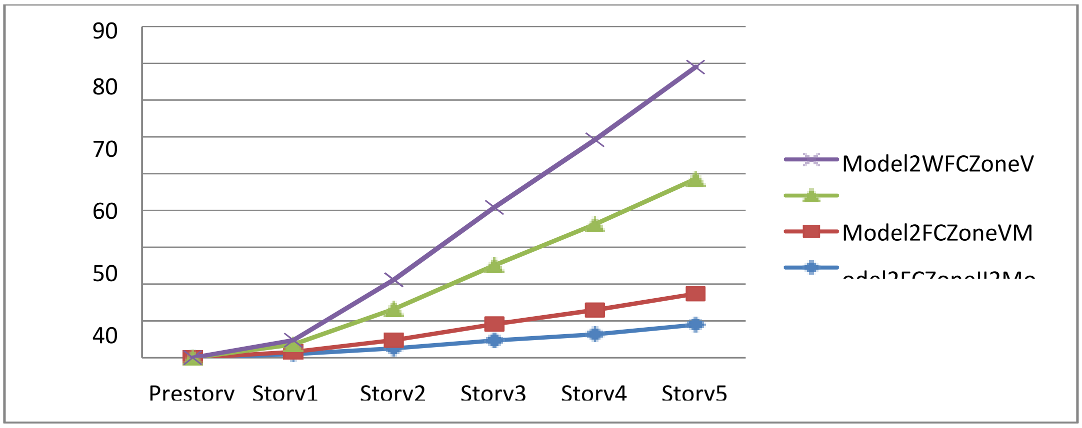


Fig12StorydisplacementvaluesofG+5buildinginY-Direction

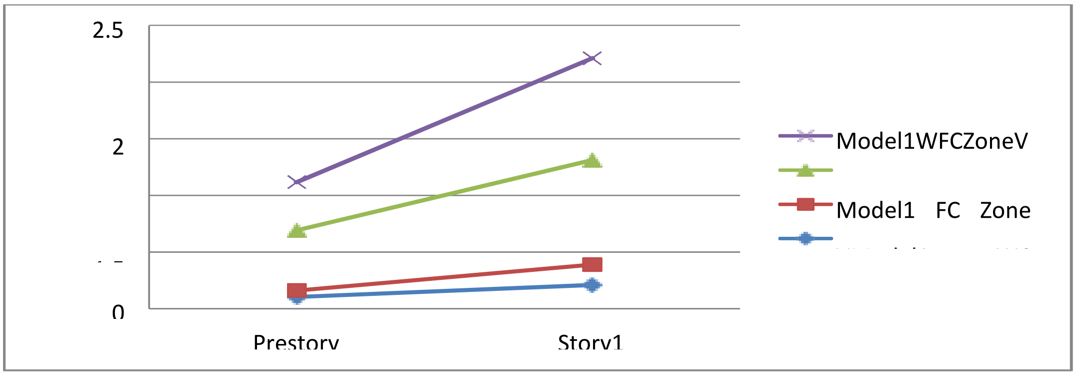
5.2. StoryDriftsValues:

The structure is subjected to lateral loads in the X and Y directions. Various combinations of the Indian standard IS1893:2002 can be assessed for the structure. Following are the maximum story drift values in models 1 and 2 for the various load combinations under Zones II and V..

5.2.1. **StorydriftvaluesinModel1**

Table3StorydriftvaluesinModel1

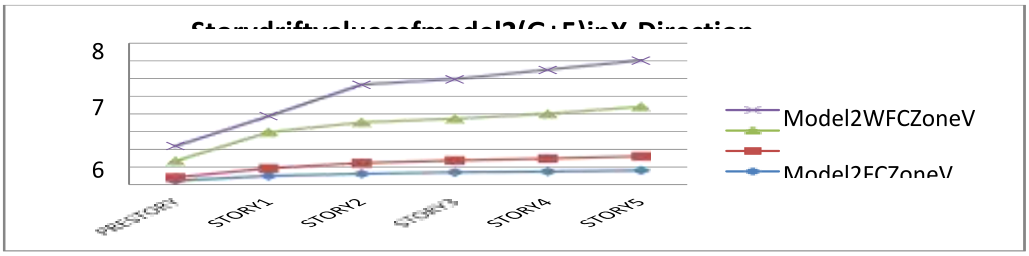
Story	Story driftinX-Direction				StorydriftinY-Direction			
	Model1 FC ZoneII	Model 1WFC ZoneII	Model1 FC ZoneV	Model1 WFC ZoneV	Model1 FC ZoneII	Model1 WFC ZoneII	Model1 FC ZoneV	Model1 WFC ZoneV
0	0.103	0.059	0.530	0.425	0.092	0.086	0.580	0.459
1	0.210	0.180	0.920	0.898	0.220	0.198	0.962	0.925



5.2.2. StorydriftvaluesinModel2

Table4StorydriftvaluesinModel2

Story	Story driftinX-Direction				StorydriftinY-Direction			
	Model 2FC	Model2 WFC	Model 2FC	Model 2WFC	Model 2FC	Model 2WFC	Model 2FC	Model 2WFC
	ZoneII	ZoneII	ZoneV	ZoneV	ZoneII	ZoneII	ZoneV	ZoneV
0	0.227	0.183	0.925	0.842	0.259	0.202	0.953	0.865
1	0.502	0.427	2.031	0.910	0.625	0.595	2.123	1.923
2	0.623	0.599	2.296	2.125	0.715	0.693	2.415	2.326
3	0.710	0.659	2.350	2.225	0.759	0.726	2.495	2.486
4	0.752	0.723	2.520	2.485	0.799	0.750	2.612	2.586
5	0.815	0.792	2.790	2.610	0.834	0.783	2.832	2.625



V. **CONCLUSIONS**

In this study, an attempt has been made to study on seismic effect of floating column and itsstructural performance. The following conclusions are taken by observing the above results. Theanalysis and its results were noted in terms of story displacement and story drift. Based on thestudy,we canconclude that,

Each and every floor of the structure is subjected to lateral loads in the X and Y orientations. Model 1 WFC and Model 2 WFC values have less story displacement than Model 1 FC and Model 2 FC. As a result, unlike conventional structures, floating column buildings pose a safety risk.

• Loads applied to the structure in the X and Y axes at every floor level. Model 1 WFC and Model 2 WFC values drift less than the Model 1 FC and Model 2 FC drifts. As a result, unlike conventional structures, floating column buildings pose a safety risk.

The values of story displacements and story drifts increase as the height of the building's floating column rises.

• With rising load combination, tale displacement and story drift rise.

According to the analysis, it is not recommended to supply floating columns in a seismically prone area zone V.

Model2 FC in zone V story displacement and drift values have been increased, therefore the maximum load combination of floating column structures in higher seismic zones is a little rejected.

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