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SEISMIC ANALYSIS OF RC BUILDING WITH FLOATING COLUMNS & SHEAR WALLS

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ABSTRACT

In the present study, a 10 storey RC building with floating column is considered and modelled with shear wall at different locations using STAAD. Pro software. Static analysis of earthquake is performed by using Equivalent static method. Different types of building models are created for the analysis. This research paper mainly concentrates on analyse the behaviour of structures and comparing the parameters like base shear, storey displacement, story drift. For the study total 6 models are considered. All models are considered as floating column building. Model 1 will be considered as shear wall located at centre of building, Model 2 will be considered as shear wall is provided as L-type shape, Model 3 will be considered as shear wall is provided as T-type, Model 4 will be considered as shear wall is provided as W-type, Model 5 will be considered as shear wall is provided as C-type, Model 6 will be considered as shear wall is provided at middle (outer side). The static analysis of building is carried out by using IS 1893 (Part 1) 2002 & also load combination is taken for the study is as per IS 1893 (Part 1) 2002. For the study Zone III will be consider. The whole analysis is done on STAAD. Pro V8i software.

1. INTRODUCTION

In present scenario buildings with floating column is a typical feature in the modern multistorey construction due to column free space because of shortage of space, population and also for aesthetic and functional requirements. In this case buildings are provided with floating columns at one or more storey. Such features are highly undesirable in building built in seismically active areas. When discontinuity is provided in the path of load transfer at different floor level, the earthquake forces are developed at different floor level in the buildings and this discontinuity leads to poor performance of the building. To overcome the poor performance of building shear wall is provided. Shear wall is a structural member designed to counteract the lateral forces acting on a structure. These walls are more important in seismically active zones when shear forces on the structure increases due to earthquakes.

Shear walls have more strength, stiffness and resist in-plane loads that are applied along its height. Buildings with shear walls which are properly designed and detailed have shown very good performance in past earthquakes. Various research studies have been conducted on the design of shear wall and its performance to seismic forces. The present study is on the factors which affect the performance of shear wall such as position of shear wall, configuration. This paper compiles the evaluation of seismic performance of floating column & shear wall. Positioning of shear wall has influence on the general behaviour of the building. For effective and economic performance of building it's essential to position shear enclose a perfect location.

The main aim of the project is to work out the solution for shear wall location in multi-storey floating column building.

1.1 Floating Column

A column is said to be a vertical member starting from foundation and transferring the load to the bottom level. When a vertical element ends at its lower level and rests on a beam which is a horizontal member that is known as floating column. The floating column is a vertical element which at its lower-level rests on a beam which is a horizontal member. Floating column rest on beams and do not go all the way to the foundation, the beams in turn transfer the load to other columns below it. Buildings having floating column have discontinuities in the load transfer path and this discontinuity can cause failure of building. When floating column is to be necessarily provided special care should be given to the transfer girders and column below the floating column. These beams and column should have sufficient strength to receive the load from floating column and convey it to foundation level.

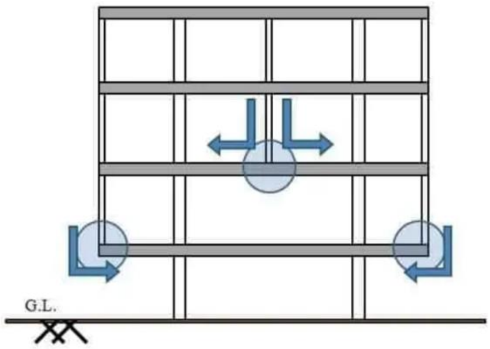

Fig 1.1 Floating Column

1.2 Shear Wall

Reinforced concrete (RC) buildings often have vertical plate-like RC walls called Shear Walls in addition to slabs, beams and columns. These walls generally start at foundation level and are continuous throughout the building height. Their thickness can be as low as 150mm, or as high as 400mm in high rise buildings. Shear walls are usually provided along both length and width of buildings. Shear walls are like vertically-oriented wide beams that carry earthquake loads downwards to the foundation. When walls are situated in advantageous positions in a building. They can be very efficient in resisting lateral loads originating from wind or earthquakes. Because a large portion of the lateral load on a building, if not the whole amount, and the horizontal shear force resulting from the load, are often assigned to such structural elements, they have been called shear wall.

2. LITERATURE REVIEW

Arpit Shrivastav, Aditi Patidar (5–May 2018) discussed the behaviour of multi-storey buildings having floating columns under seismic forces. For this purpose, three cases of multi-storey buildings are considered having 8 storey, 12 storey and 16 storeys. All the three cases are considered having floating columns provided with and without shear wall, and also analysed for zone III, zone IV and zone V by using software STAAD. Pro.

On the basis of analysis and results following conclusions have been made:

1) The drift value is similar along the storey height of building and maximum value lying somewhere near about middle story.
2) For all the model's displacement values gradually increasing straight path along the height of building.
3) The values of storey drift and displacement are less for lower zones & more for higher zones because of intensity is more for higher zone.
4) The values of storey drift and displacement are more for floating column building because columns are removed the mass get increased and hence drift and displacement also increases.
5) By providing shear wall drift and displacement values reduces as compared to without shear wall models for all the zones.
6) If the drift values are safe within maximum permissible limits there is no need to provide shear walls from drift point of view.

Kanchan Rana, Vikas Mehta (April - September 2017) discussed the behaviour for seismic analysis of RCC building with shear wall at different locations using STAAD pro. A 6-storey building is taken under consideration. Four different Model of RCC building are used, one with no shear wall and other four models with different position of shear wall. The parameters like storey drift, lateral displacement, and base shear will be studied and suitable location of shear wall will be determined among these models. The seismic analysis is carried out in Zone V.

On the basis of analysis and results following conclusions have been made:

1) The less value of storey drift in X & Z direction is found out for Model 3 (Shear wall at centre of sides) and more value of storey drift for Model 1 (No Shear wall).
2) The storey shear is maximum for model 2 (Shear wall at edge) and minimum for model 1 (No Shear wall).
3) Overall conclusion shows model 3 Shows most effective location of shear wall among of them.

3. METHODOLOGY

In this paper a RC multi-storey building has been modelled and analyse with considering all loads like Dead load, Live load and Seismic load as per as IS standard. The structure details take from reference is given below.

Building Parameters -

Table No.3.1 Various Input Parameters

Sr. No.	Particulars	Dimensions
1	Length of Building	36 m
2	Width of Building	36 m
3	Height of Building	30 m
4	Height of each floor	3.00 m
5	Beam size	380 x 600 mm
6	Beam size (Below FC)	550 x 600 mm
7	Column Size	550 x 550 mm
8	Slab Thickness	150 mm
9	Shear Wall Thickness	200 mm
10	Live Load on floors	2 KN/m^2
11	Materials	M_{25} & Fe_{500}

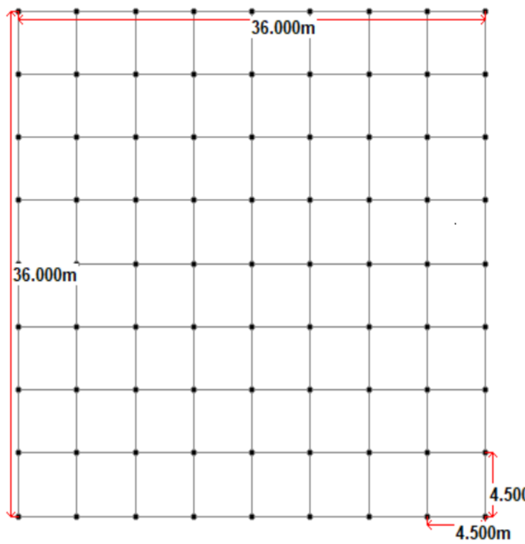

Fig. 3.1 STAAD. Pro plan

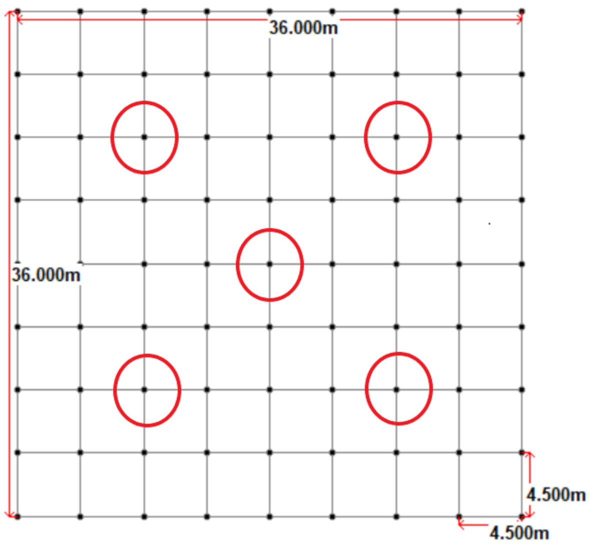

Fig. 3.2 STAAD. Pro plan (FC stars from 2nd slab)

Seismic Details -

Table No.3.2 Seismic Parameters

Sr. No.	Particulars	Values
1	Seismic Zone	III
2	Zone Factor	0.16
3	Importance Factor	1.0
4	Response Reduction Factor	5.0
5	Soil Type	Medium
6	Damping Ratio	5 %

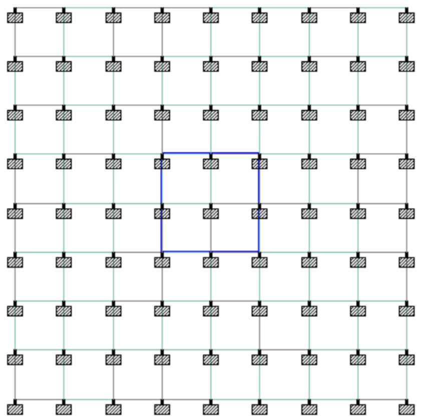

Fig. 3.3 Model-1

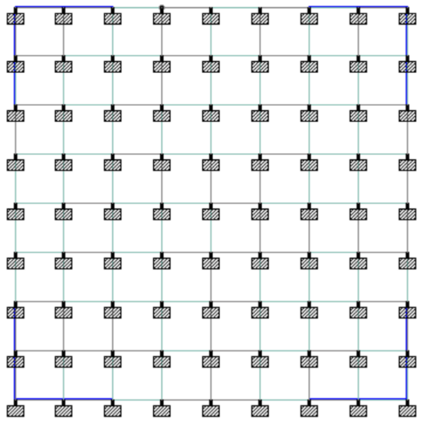

Fig. 3.4 Model-2

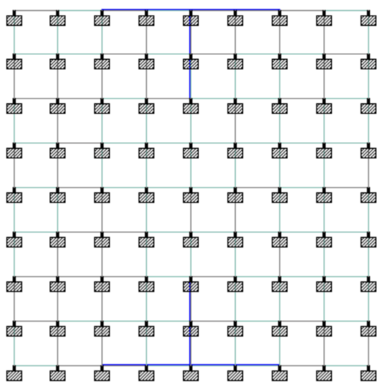

Fig. 3.5 Model-3

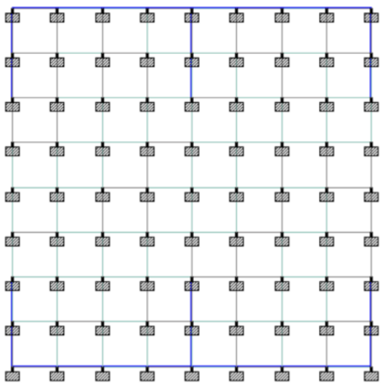

Fig. 3.6 Model-4

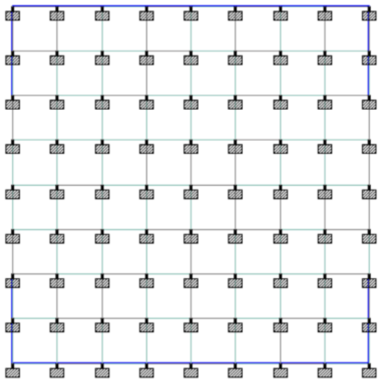

Fig. 3.7 Model-5

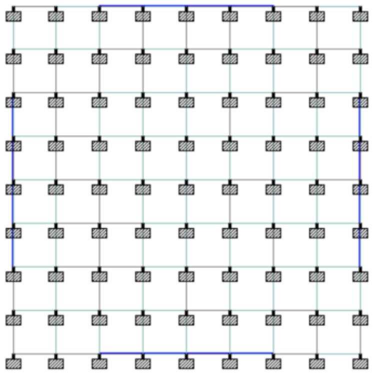

Fig. 3.8 Model-6

Models Description

Table No.3.3 Models Descriptions

Model No.	Description
Model-1	Shear wall at centre of building
Model-2	Shear Wall at edges of building
Model-3	T shape Shear wall
Model-4	W shape Shear wall
Model-5	C shape Shear wall
Model-6	Shear wall at Outside (Centre)

4. RESULTS & DISCUSION

The study is done on seismic parameters like base shear, story displacement, storey drift.

1) Base Shear

Table No.4.1 Base Shear

Model No.	Base Shear (KN)
Model-1	7513.71
Model-2	7629.07
Model-3	7571.39
Model-4	7802.1
Model-5	7744.4
Model-6	7595.48

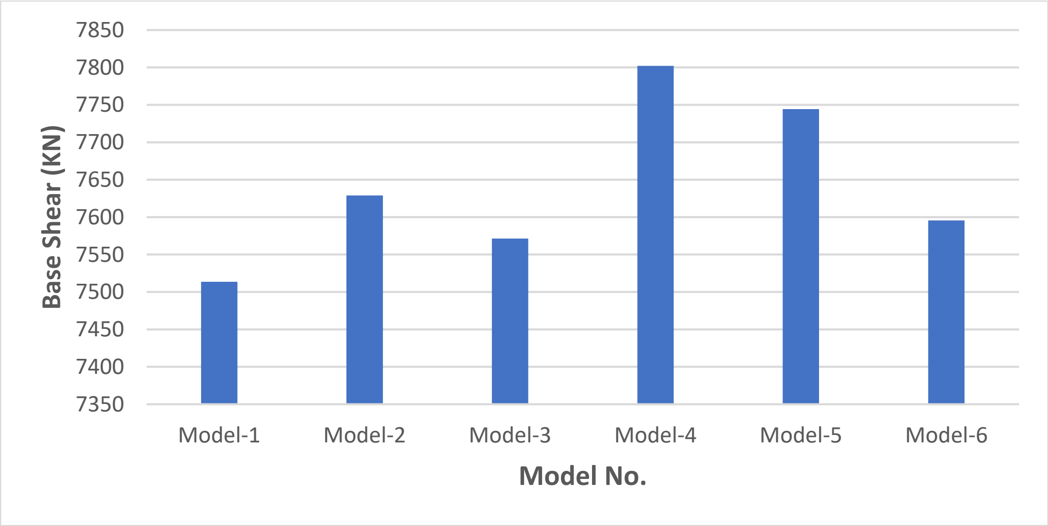

Fig. 4.1 Base Shear Graph

2) Storey Displacement

A) Storey Displacement in X direction

Table No.4.2 Storey Displacement in X direction

Storey Height (m)	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6
Base	0	0	0	0	0	0
3	1.159	0.748	0.805	0.608	0.608	0.809
6	2.749	1.87	1.774	1.07	1.065	1.793
9	4.466	3.169	2.81	1.437	1.429	2.84
12	6.281	4.592	3.911	1.786	1.775	3.95
15	8.229	6.143	5.109	2.148	2.135	5.158
18	10.189	7.736	6.331	2.506	2.491	6.39
21	12.101	9.321	7.541	2.852	2.834	7.612
24	13.907	10.855	8.705	3.175	3.155	8.787
27	15.536	12.281	9.771	3.459	3.438	9.862
30	16.835	13.492	10.624	3.699	3.674	10.731

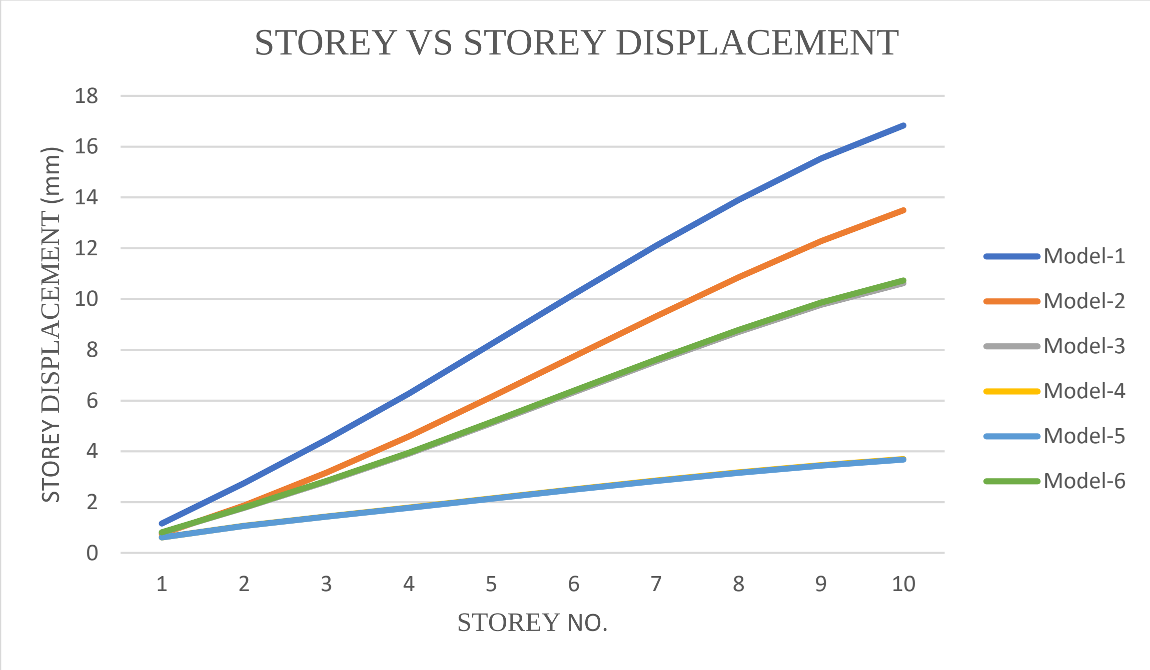

Fig. 4.2 Storey Displacement Graph in X direction (mm)

B) Storey Displacement in Z direction

Table No.4.3 Storey Displacement in Z direction

Storey Height (m)	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6
Base	0	0	0	0	0	0
3	1.159	0.748	1.195	0.599	0.788	0.809
6	2.749	1.87	2.909	1.5	2.01	1.793
9	4.466	3.169	4.791	2.58	3.435	2.84
12	6.281	4.592	6.774	3.786	4.995	3.95
15	8.229	6.143	8.903	5.096	6.694	5.158
18	10.189	7.736	10.045	6.45	8.439	6.39
21	12.101	9.321	13.131	7.809	10.177	7.612
24	13.907	10.855	15.097	9.139	11.865	8.787
27	15.536	12.281	16.861	10.415	13.452	9.862
30	16.835	13.492	18.279	11.592	14.839	10.731

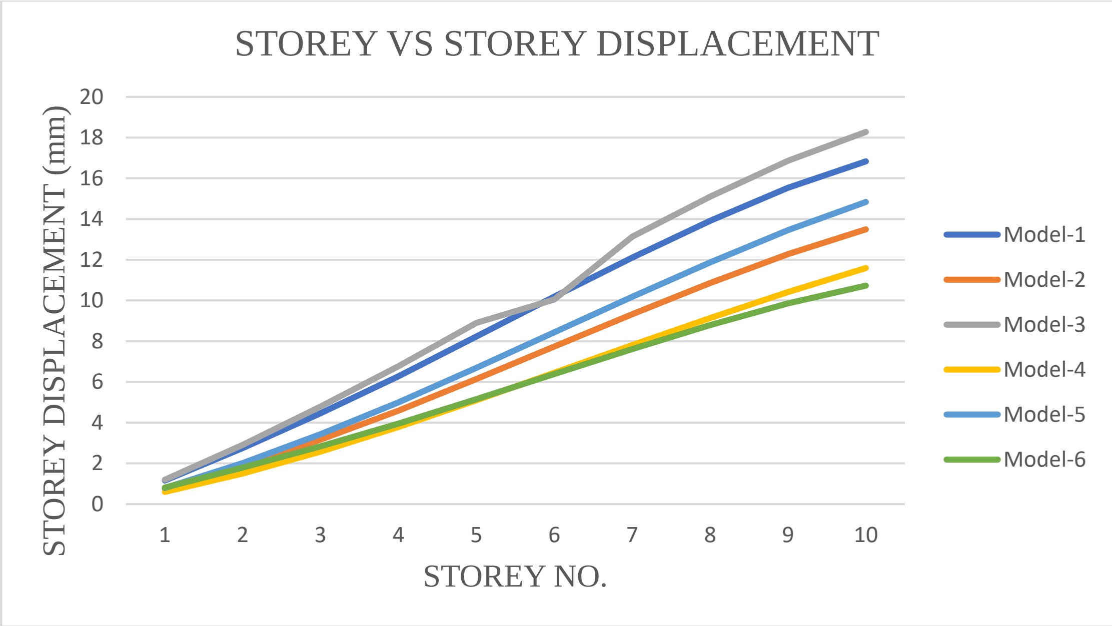

Fig. 4.3 Storey Displacement Graph in Z direction (mm)

3) Story Drift

A) Storey Drift in X direction

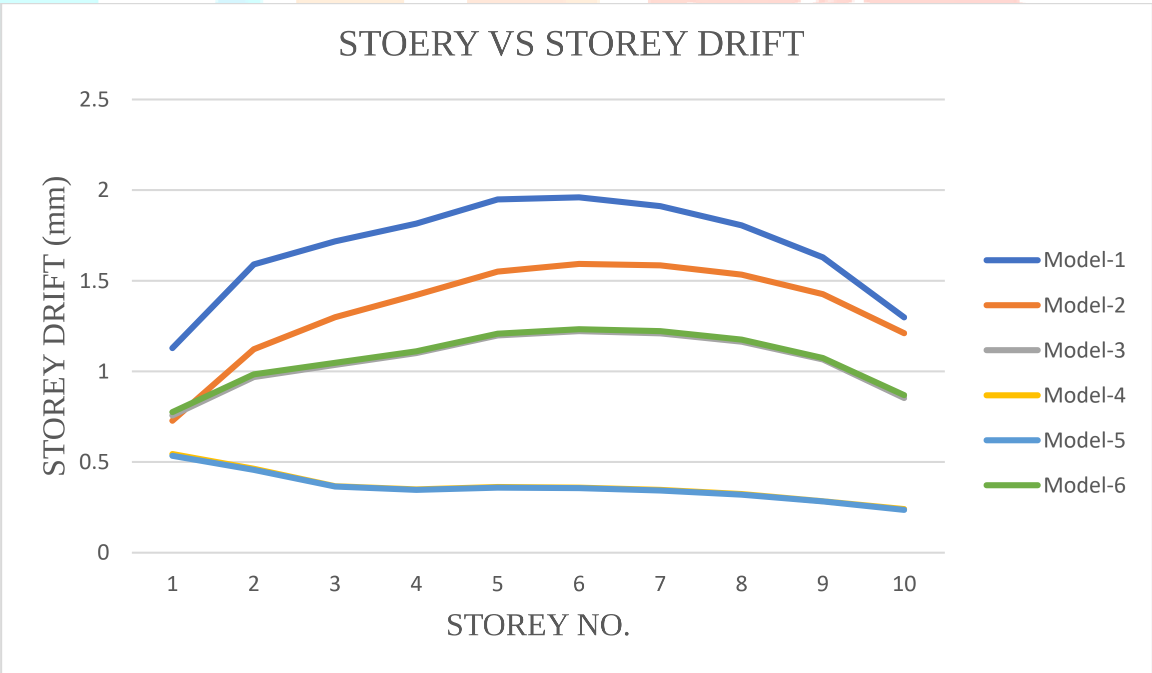

Fig. 4.4 Storey Drift Graph in X direction (mm)

Table No.4.4 Storey Drift in X direction (mm)

Storey Height (m)	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6
Base	0	0	0	0	0	0
3	1.129	0.728	0.757	0.544	0.534	0.775
6	1.59	1.122	0.969	0.463	0.457	0.984
9	1.717	1.299	1.036	0.367	0.365	1.047
12	1.815	1.422	1.101	0.349	0.346	1.111
15	1.949	1.551	1.198	0.362	0.359	1.208
18	1.96	1.593	1.222	0.359	0.356	1.233
21	1.912	1.585	1.21	0.346	0.343	1.222
24	1.806	1.534	1.164	0.323	0.32	1.175
27	1.629	1.426	1.066	0.284	0.283	1.074
30	1.298	1.211	0.853	0.24	0.236	0.869

B) Storey Drift in Z direction

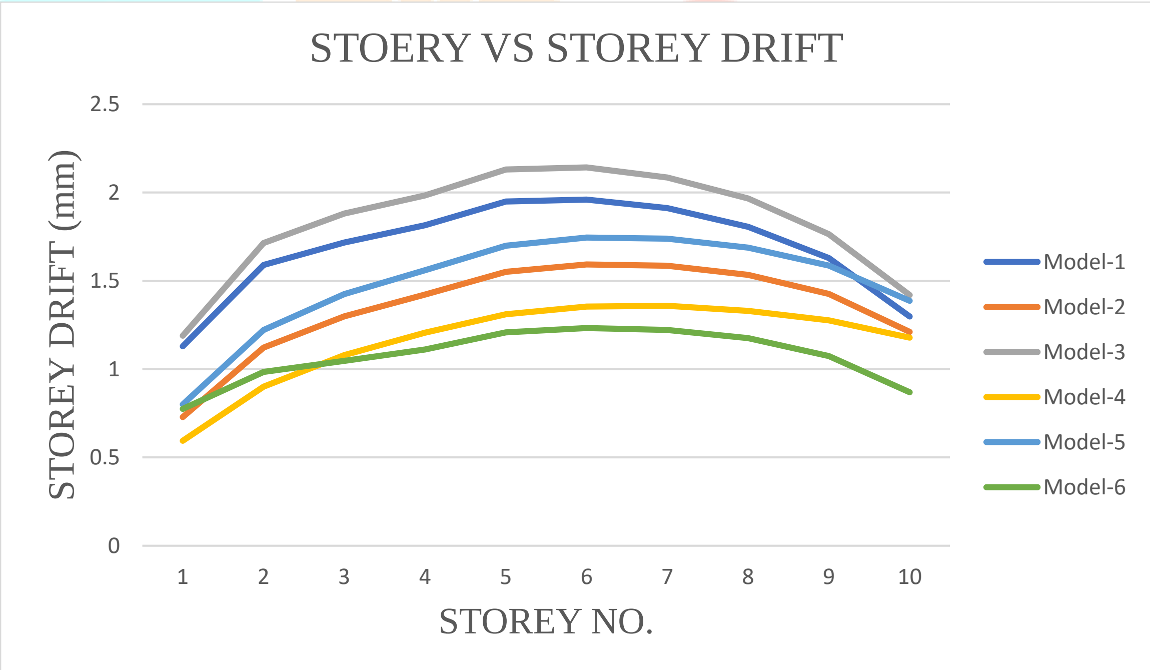

Fig. 4.5 Storey Drift Graph in Z direction (mm)

Table No.4.5 Storey Drift in Z direction (mm)

Storey Height (m)	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6
Base	0	0	0	0	0	0
3	1.129	0.728	1.189	0.594	0.8	0.775
6	1.59	1.122	1.714	0.901	1.222	0.984
9	1.717	1.299	1.881	1.079	1.425	1.047
12	1.815	1.422	1.983	1.206	1.56	1.111
15	1.949	1.551	2.13	1.311	1.699	1.208
18	1.96	1.593	2.142	1.354	1.745	1.233
21	1.912	1.585	2.085	1.359	1.739	1.222
24	1.806	1.534	1.966	1.33	1.688	1.175
27	1.629	1.426	1.764	1.276	1.586	1.074
30	1.298	1.211	1.419	1.178	1.387	0.869

5. CONCLUSION

From the linear static analysis of building subjected to floating column & shear walls the following conclusion can be made –

1) Finding out the optimum locations of Shear walls in all the 6 models of the structure & here the model 1 & model 3 shows the minimum base shear values among the 6 models of building.
2) From the analysis it observed that model 4 & model 5 shows the maximum base shear value.
3) It is observed that there is increase in storey drift in building from where the floating columns starts.
4) From above observation it is clear that the value of storey drift in X & Z direction from base is less, maximum at 5 & 6 storey of building & at top value become less.
5) Model-4 Shows the maximum value of base shear but value of storey displacement & storey shear is less.

6. REFERENCES

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