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SEISMIC ANALYSIS OF A HIGH RISE BUILDING WITH & WITHOUT FLOATING COLUMN USING STAAD PRO

AVINASH PRATAP SINGH THAKUR*, VIJAY BARADIA**
***M.Tech Scholar, Department of Civil Engineering, Institute of Engineering & Science, Indore**
****Associate Professor, Department of Civil Engineering, Institute of Engineering & Science, Indore**

ABSTRACT

The objective of this study is to analyze Ground+10 building with using STAAD Pro software. In this research we have to analysis regular & irregular structures for different location of Zone V. Total 16 models as being modeled to carry out the structural analysis and research using Staad Pro *software to know the behavior of floating column (with & without) of high rise regular and vertically irregular building subjected to earthquake forces. The different parameters compared in this analysis like Storey Drift, shear forces and bending moments.*

Keywords: *Floating Column, Storey Drift, Shear Force, Bending Moment*

I. INTRODUCTION

STAAD Pro is generally used to analyze the structures like multistoried building, bridges, foundation design, water tanks etc.. The high rise structure or multistoried storied structure are analyzed & designed through STAAD Pro software following Indian Standard code (IS Code). Now a day in the construction of commercial, office or other structure floating column has become a common feature because they required less space. In the past construction of commercial building or office building or industries large space is required for movement of people or movement of vehicle in the parking. So avoid such kind of problem floating column has come in to the practice.

II. OBJECTIVE OF STUDY

Following are the specific objectives of this research:-

1. Analyze the G+10 structure using STAAD PRO V8i software
2. Parameters compare for G+10 high rise structure are
   Shear force, Bending Moment & Storey drifts

III. MODELLING APPROACH & LOAD COMBINATION

I. Modelling:

Here the model is modeled with three different irregular shape and a normal building special moment resisting frame having position of floating column at three different location around the outer, middle and inner periphery of the structure and analysis being carried out by equivalent static analysis using Staad-Pro. The seismic zone considered is zone V and soil type II (Medium soil). For the structure being analyzed, loading with applied loads includes dead load, live load and

earthquake loads according to IS 875 Part I & II and IS 1893-(Part 1) : 2002. Total 16 models will be studied in the research to show the performance & behavior of RCC framed regular and vertical geometric irregular structure to calculate the various seismic responses like storey drift, shear forces and bending moment.

Various input parameters have been used to evaluate the effect of irregularity and floating column in the structures. A detailed information of input parameters has been shown in table:

I) Material Data		
1	Grade of concrete	M25
2	Grade of Steel	FE 415
3	Unit weight of RCC	25 kn/m3
4	Unit weight of Brick	19.2 kn/m3 = 20 kn/m3
II) Structural Data		
1	Type of structure	SMRF
2	Support	Fixed
3	Type of soil	Medium soil Type II
4	Size of beam	400mm X 400mm
5	Size of column	
	Upto 6^{th} Floor	400mm X 900mm
	Above 6^{th} Floor	400mm X 500mm
6	Depth of slab	125mm
7	Thickness of wall	200 mm
III) Architectural Data		
1	Number of stories	G+10
2	Floor height	3.2 m
3	Height of structure	35.2 m
4	Dimension of plan	28m X 25m
5	Size of Bay	4M in X direction & 5M in Z direction
6	Number of bay	7 in X direction & 5 in Z direction
IV) Seismic Data		
1	Seismic Zone	V
2	Response reduction factor	5
3	Importance factor	1
4	Damping ratio	5%
5	Zone Factor	0.36 (Zone V)
V) Loads		
1	Live load	3 kn/m2
2	Floor finish	1 kn/m2
3	Wall load on storey	11.2 kn/m2
4	Parapet Wall load	4 kn/m2

II. Load Combinations:

The following load combinations are considered for the design and analysis as per code IS 1893 (Part 1) : 2002 clause no.- 6.3.1.2,

Where,

DL= Dead load LL = Live load EL = Earthquake Load

EQX, EQY= Earthquake load in the X and Y directions, Respectively

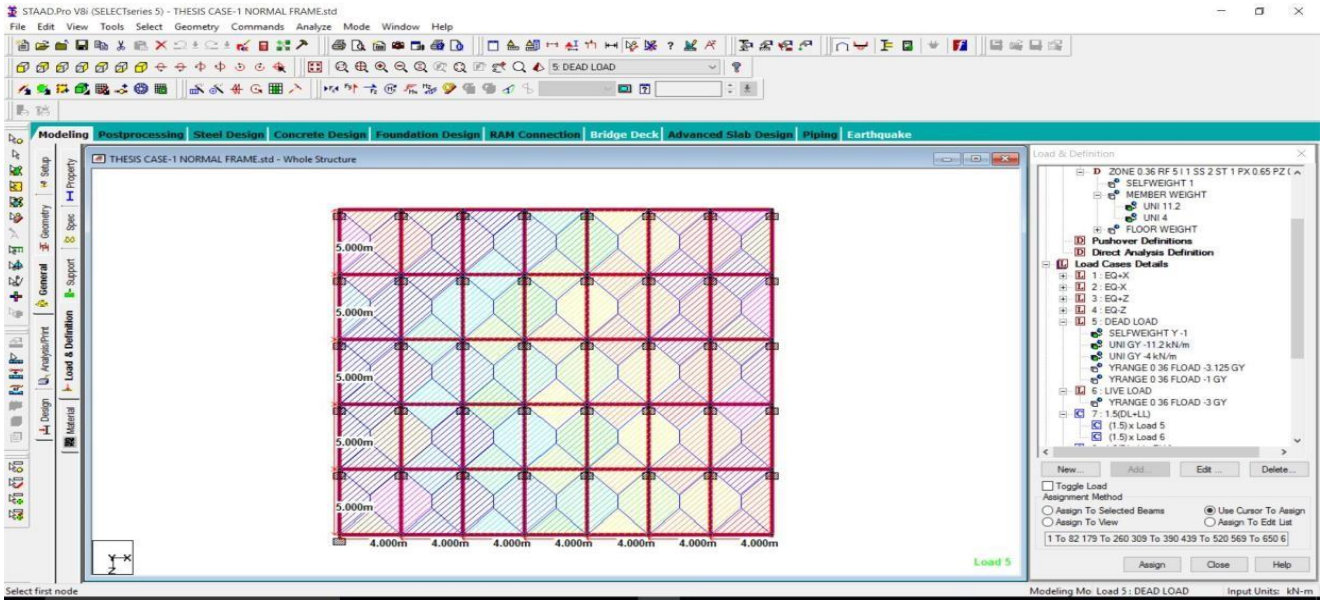
1) 1.5(DL + IL)

2) 1.2(DL+ IL ± EL)

3) 1.5(DL ± EL)

4) 0.9DL ± 1.5 EL

Fig. - Plan view of applied load



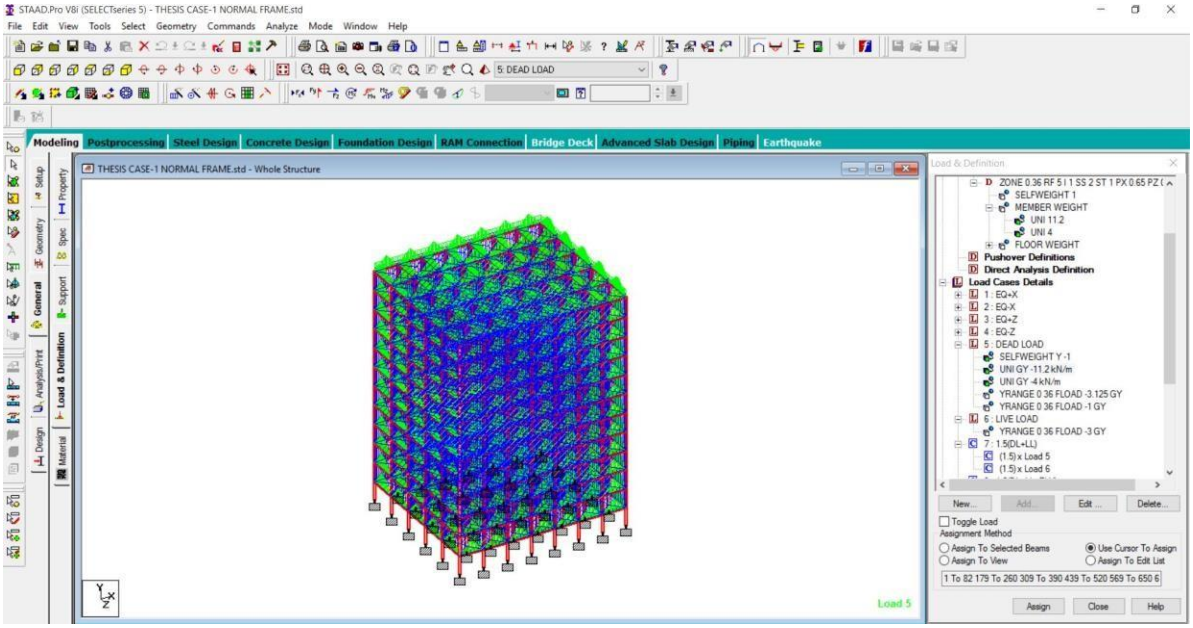


Fig. 3D view showing applied wall load

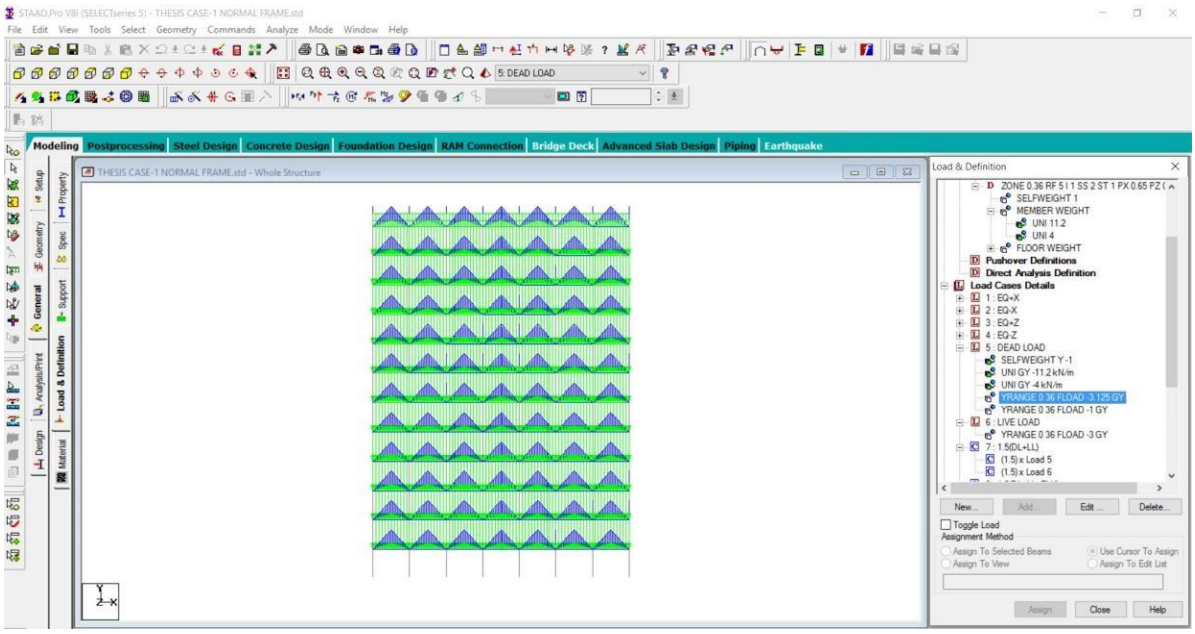


Fig. - Elevation view of applied floor load (slab load)

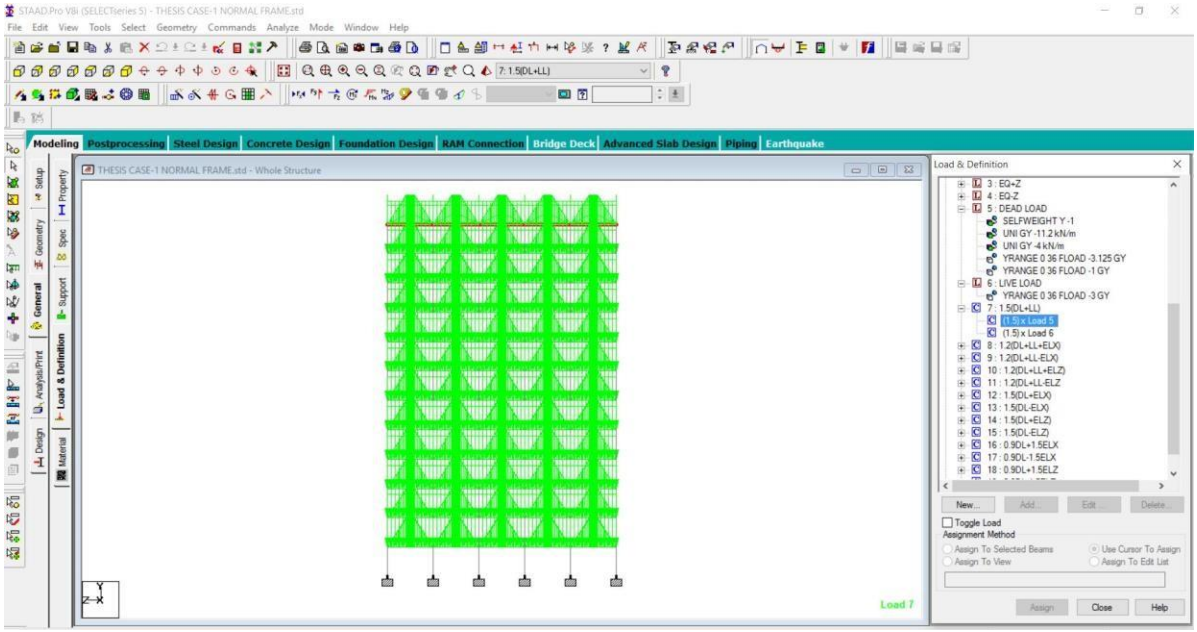
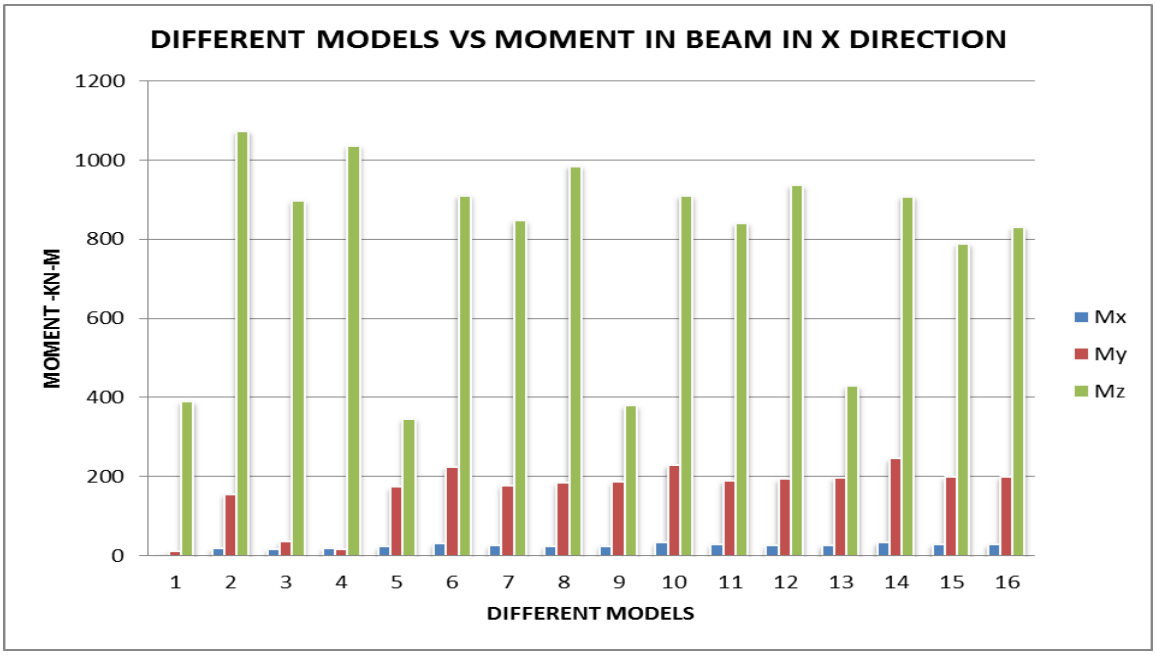


Fig. - Elevation showing applied load combination

IV. RESULTS & DISCUSSIONS

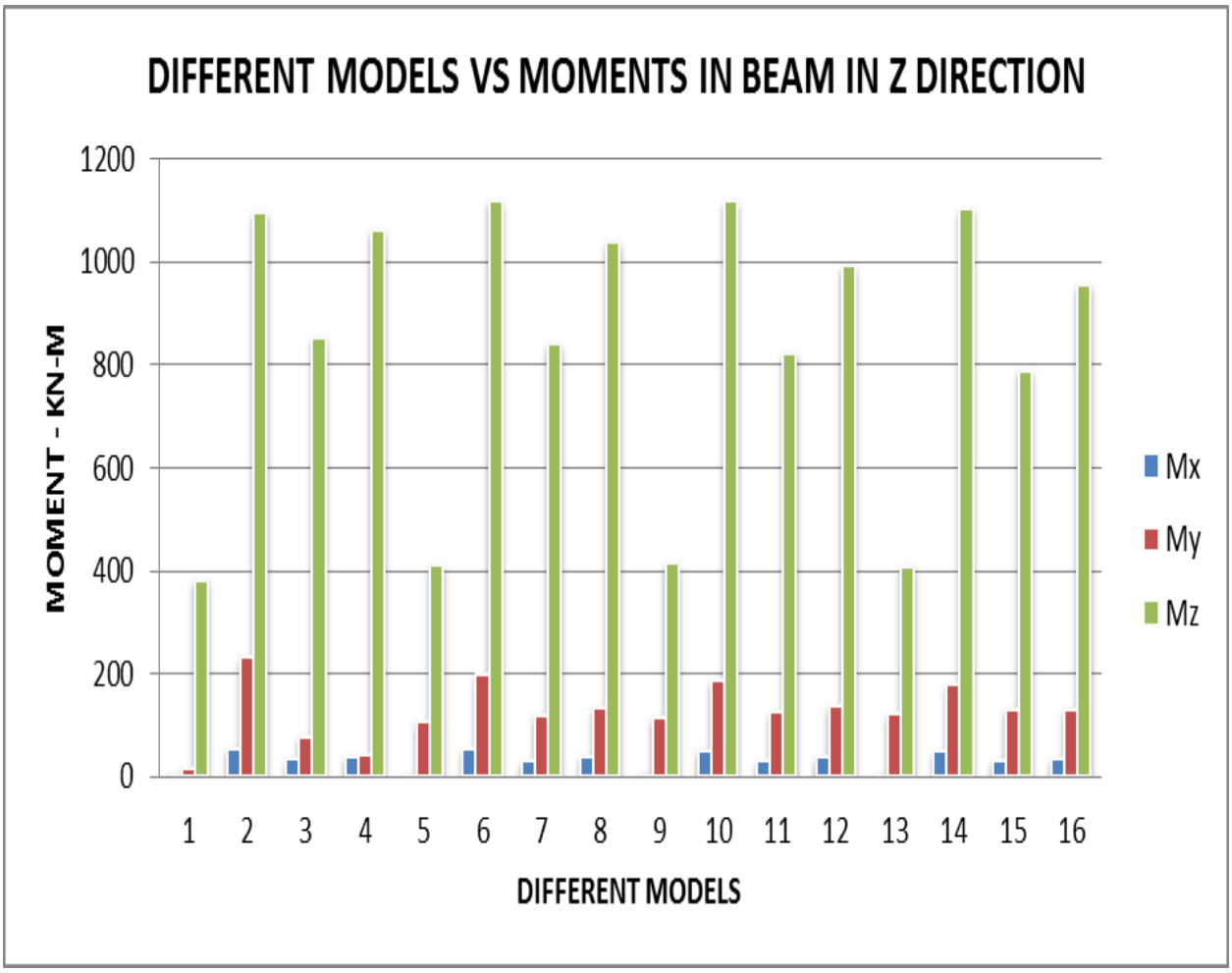
The seismic response of G+10 regular and irregular structure with and without floating columns has been analysed to determine response parameters and the results of the moments & storey drift are presented through tables and graphs for all the models.

Results of Moments in Beam in X Direction



In the beams in the X direction, Fx is maximum for Model-14 – Type 3 Irregularity model with outer periphery floating column. The Fx is maximum for all the models with floating column as compared to models without floating column. The shear force Fy is higher for all the models as compared to the Fz . Also the shear force Fy is higher for all the models with floating column as compared to models without floating column.

Results of Moments in Beam in Z Direction



The moments Mz is higher for all the models both regular in irregular which have floating column and has lower values for the one without floating columns. The moments My & Mx is very low as compared to Mz. The highest value occurs for the models 2, 6, 10 & 14. Hence the structure without floating column has fewer moments in them due to seismic forces

Result of Storey Drift in X Direction

Storey Drift In X - Direction													
S.No	**Model/Story Number**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Storey Height	**0 M**	**3.2 M**	**6.4 M**	**9.6 M**	**12.8 M**	**16 M**	**19.2 M**	**22.4 M**	**25.6 M**	**28.8 M**	**32 M**	**35.2 M**
	Story Drift values in -	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**
Case 1	1	6.5	12.32	13.35	13.35	13.01	12.4	11.55	12.30	10.46	8.13	5.31	2.40
	2	18.63	18.29	19.12	19.04	18.64	17.98	17.12	17.86	16.01	13.67	10.84	8.03
	3	9.76	12.57	13.32	13.29	12.94	12.33	11.49	12.23	10.40	8.09	5.28	2.39
	4	11.67	18.66	20.00	19.99	19.47	18.55	17.29	18.40	15.65	12.17	7.95	3.59
Case 2	5	5.55	10.50	11.41	11.35	10.96	10.26	9.38	13.89	12.99	10.30	6.82	3.22
	6	16.35	17.95	18.25	18.51	18.03	16.89	16.06	24.27	25.64	23.10	19.64	16.19
	7	8.35	10.76	11.43	11.37	10.93	10.30	9.38	15.34	15.27	12.13	9.16	5.65
	8	6.64	10.64	11.39	11.31	10.91	10.17	9.21	16.90	16.92	14.39	10.96	7.34
Case 3	9	5.26	9.95	10.74	10.65	10.21	9.41	8.52	15.18	14.59	11.75	7.89	3.90
	10	15.56	17.47	18.12	17.96	17.00	16.64	15.40	30.01	31.69	29.13	25.32	21.47
	11	7.89	10.16	10.76	10.66	10.22	9.47	8.56	17.62	17.72	14.91	10.39	7.16
	12	6.28	10.04	10.72	10.62	10.15	9.37	8.35	19.13	19.71	17.02	13.22	9.21
Case 4	13	4.94	9.36	10.09	9.96	9.43	8.57	7.57	17.07	17.39	14.23	9.79	5.20
	14	15.01	17.38	17.97	17.77	17.18	16.32	15.58	38.62	42.21	41.17	36.92	32.40
	15	7.41	9.55	10.08	9.94	9.42	8.53	7.58	20.70	22.1	19.16	14.79	10.23
	16	5.92	9.43	10.06	9.90	9.37	8.49	7.43	21.26	22.56	19.60	15.21	10.64

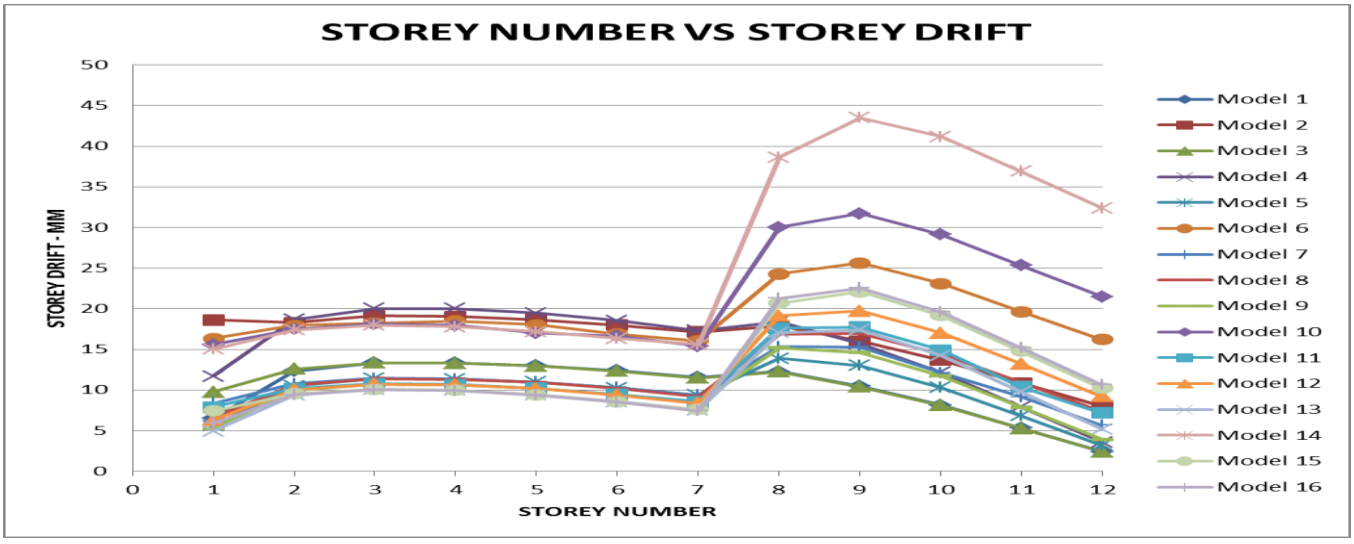


Fig. - Graph for storey drift in X direction

From the above graph it is concluded that the value of storey drift increases from 7th model to 9th model after that value of storey drift decreases.

Result of Storey Drift in Z Direction

Storey Drift In Z - Direction													
S.No	**Model/Storey Number**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
	Storey Height	**0 M**	**3.2 M**	**6.4 M**	**9.6 M**	**12.8 M**	**16 M**	**19.2 M**	**22.4 M**	**25.6 M**	**28.8 M**	**32 M**	**35.2 M**
	Story Drift values in-	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**	**MM**
Case 1	1	3.46	8.44	10.75	11.71	11.91	11.70	11.26	12.36	10.37	8.02	5.27	2.60
	2	9.29	15.95	18.18	19.09	19.25	19.01	18.57	19.69	17.73	15.37	12.64	10.07
	3	4.46	9.35	11.16	11.87	11.97	11.69	11.24	12.31	10.32	7.98	5.25	2.59
	4	3.87	8.87	10.95	11.78	11.94	11.69	11.25	12.33	10.34	8.00	5.26	2.60
Case 2	5	2.94	7.15	9.08	9.80	9.85	9.51	9.01	27.39	11.94	9.29	6.10	2.98
	6	7.96	13.69	15.58	16.27	16.30	15.95	15.46	38.71	18.96	16.31	13.14	10.13
	7	3.79	7.92	9.42	9.93	9.88	9.50	8.98	27.53	11.88	9.24	6.07	2.97
	8	3.30	7.53	9.24	9.86	9.86	9.50	8.99	27.37	11.91	9.26	6.08	2.97
Case 3	9	2.77	6.72	8.51	9.14	9.12	8.71	8.16	34.82	12.76	9.94	6.54	3.20
	10	7.51	12.93	14.67	15.29	15.25	14.84	14.31	49.51	19.96	17.18	13.80	10.58
	11	3.57	7.44	8.82	9.26	9.15	8.70	8.14	35.03	12.68	9.88	6.50	3.19
	12	3.10	7.07	8.66	9.19	9.13	8.71	8.15	34.77	12.72	9.91	6.52	3.19
Case 4	13	2.60	6.29	7.92	8.45	8.34	7.86	7.23	41.56	13.639	10.72	7.07	3.48
	14	7.04	12.14	13.74	14.26	14.14	13.65	13.05	59.46	21.13	18.21	14.60	11.12
	15	3.34	6.95	8.21	8.56	8.37	7.84	7.21	41.80	13.60	10.65	7.03	3.46
	16	2.90	6.60	8.06	8.50	8.35	7.85	7.22	41.47	13.65	10.68	7.05	3.47

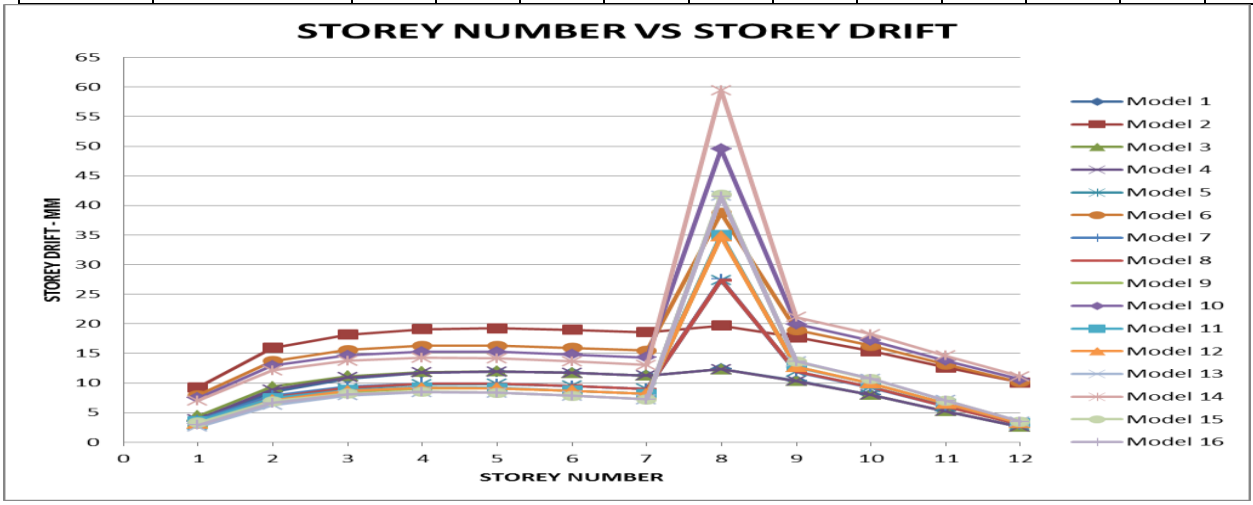


Fig. - Graph for storey drift in Z direction

From the above graph it is concluded that the value of storey drift increases from 7th model to 9th model after that value of storey drift decreases. So we can say that higher the vertical irregularity in the structure value of storey drift increases.

V. CONCLUSION

- After analyze the structure of G+10 it is concluded that the earthquake performance of regular structure is found enhanced than irregular structure for all the cases.
- After analysis the structure the various result were compared so it is concludes that bending moments & storey drift is greater for regular structure for floating column. Therefore we can't provide floating column in high rise building in an earthquake zone area.

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