M.Hemanth, et. al. International Journal of Engineering Research and Applications
www.ijera.com
ISSN: 2248-9622, Vol. 10, Issue 7, (Series-VI) July 2020, pp. 39-47

RESEARCH ARTICLE OPEN ACCESS

Study on Seismic Effect on High Rise Buildings with a Combination of Bracings and Shear Wall.

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ABSTRACT
It is very important to study the effects of lateral displacements induced from earthquakes. Concrete shear walls are used to resist the lateral displacement due to earthquake. Shear walls can be placed around the building as periphery walls, around the lift and beside the staircase. In This Paper The Analytical Study On The Lateral Behaviour Of The Structure Is Mainly Concentrated And How It Is Varying In The Different Zones Of Zone II, III, and IV&V With Different Storey Heights Of G+ 10, G+ 15, And G+ 20. The Study Involves The Orientation Of Shear Wall. The Buildings Are Modelled With Floor Area Of 91mx60m. With 11 Bays Along 91m Span and 11 Bays Along 60m And Each Bay Width Of 9m and 6m .The Lateral Displacement of the Structure Is Compared In General frame, shear wall and bracing frame. The Lateral Displacement Values Of Current Floor Level To Another Floor Level Should Reach Storey Drift .The Design Loads Values Are Calculated From The Standard Is Codes Of IS 456-2000, IS 1893- IN 2000.The Analysis Is Done In Staadprov8i.

Keywords: Equivalent static method, shear wall and bracings, lateral displacement, staadproV8.

Date of Submission: 10-07-2020 Date of Acceptance: 26-07-2020

I. INTRODUCTION

A large portion of India is susceptible to damaging levels of seismic hazards. Hence, it is necessary to take into account the seismic load for the design of high-rise structure. In present study, the earthquake analysis of G+10, G+15, G+20 storied building was done by Equivalent static method. The main parameters considered in this study to compare the seismic performance of different Zones i.e. II, III, IV & V are lateral displacement. The building frame is modelled with a dimensions of 91m x 60m having columns & beams with a slab panel of 9m x 6m the model is made using STAAD.PRO Software. In case of building with shear wall the building frame is modelled as above dimensions only with alternate shear wall using 4 node plate proposed thickness of 150 mm along the half height of the structure. The new zone map will now have only four seismic zones – II, III, IV and V. The areas falling in seismic zone I in the current map are merged with those of seismic zone II. Also, the seismic zone map in the peninsular region is being modified. Madras will come under seismic zone III as against zone II currently. The national Seismic Zone Map presents a large scale view of the seismic zones in the country. Local variations in soil type and geology cannot be represented at that scale. Therefore, for important projects, such as a major dam or a nuclear power plant, the seismic hazard is evaluated specifically for that site. Also, for the purposes of urban planning, metropolitan areas are micro zoned. Seismic micro zonation accounts for local variations in geology, local soil profile, etc. In this paper to analyse a model for earthquake resisting structure. The model structure is located in Zone-II, III, IV & V. To calculate the lateral displacement, on buildings using equivalent static method. By using STAAD pro. And make a comparative analysis between general Frame & shear wall and bracing frame Structure in equivalent static method .Comparison between G+10, G+15, and G+ 20.

II. OBJECTIVE

1. To analyze a model for earthquake resisting structure.
2. The model structure is located in both Zone-II, III, IV&V.
3. And make a comparison between General Frame & shear wall and bracing frame structure.

4. Comparison between G+10, G+15, and G+ 20 storied buildings.

2.1 SCOPE

1. Only RC buildings are considered.
2. Entire analysis is carried out using STAAD.proV8i.
3.Linearstaticanalysesareperformedonthe considered frames.
4. The sizes of the beams, columns and slabs are kept constant for each model

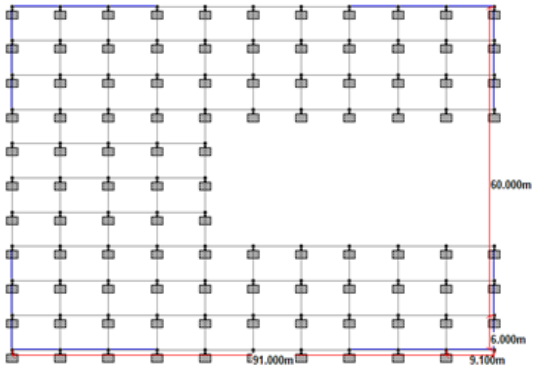
2.2 MODELING

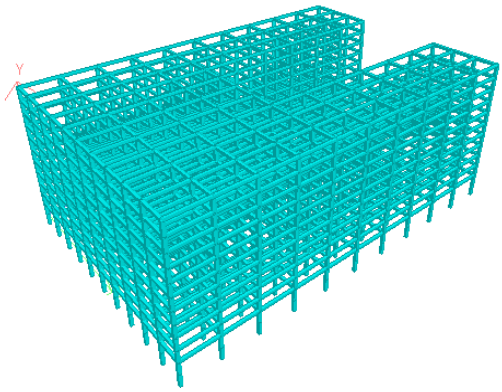
The (general frame, shear wall & bracing frame) structures of G+10, G+15, G+20, storied building is shown in Fig 1. The seismic analysis of building is done by Seismic Coefficient with given above procedures for Zone II, III, IV & V. The obtained results of both structures are compared with each other.

TABLE

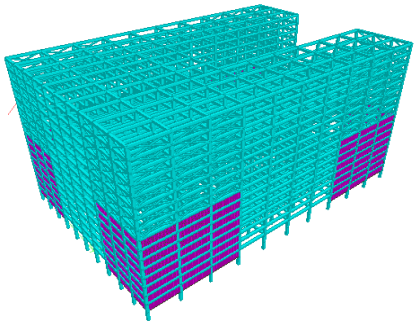
ZONE II,III, IV, V	G+5 OMRF	G+5 SMRF	G+10 OMRF
COLUMN DETAILS	0.65X0.6	0.65X0.6	0.65X0.6
BEAM DETAILS	0.6X0.55	0.6X0.55	0.6X0.55

G+10 SMRF	G+15 OMRF	G+15 SMRF
0.65X0.6	0.65X0.6	0.65X0.6
0.6X0.55	0.6X0.55	0.6X0.55





G+10 GENERAL FRAME



G+10 SHEAR WALL& BRACING AT CORNER

2.3 SESMIC COEFFIECIENT METHOD

As per IS 1893 (part1)-2002, Seismic Coefficient analysis Procedure is summarized in following steps

a) Design Seismic Base Shear:- The total design lateral force or design seismic base shear (V_B) along any principal direction of the building shall be determined by the following expression

$$V_B = Ah\ W$$

Where Ah = Design horizontal seismic coefficient

W = Seismic weight of the building.

b) Seismic Weight of Building: - The seismic weight of each floor is its full dead load plus appropriate amount of imposed load as specified. While computing the seismic weight of each floor, the weight of columns and walls in any storey shall be equally distributed to the floors above and below the storey. The seismic weight of the whole building is the sum of the seismic weights of all the floors. Any weight supported in between the storey shall be distributed to the floors above and below in inverse proportion to its distance from the floors.

c) Fundamental Natural Time Period-: The fundamental natural time period (Ta) calculates from the brick filling, then the fundamental natural period of vibration, may be taken as

$$T_a = \mathbf{0.09}\ \boldsymbol{h}/\sqrt{\boldsymbol{d}}$$

d) Distribution of Design Force: - The design base shear, V_B computed above shall be distributed along the height of the building as per the following expression

$$Q_i = V_B \frac{Wihi^2}{\sum_{j=1}^{n} Wihj^2}$$

The total base shear and lateral force is calculation by STAAD Pro

2.4 Ordinary Moment Resisting Frame

It includes the beams & columns along with fixed supports. These columns and beams are created with beam node elements and connected with beam elements of the software. Here the slab loading at each floor level is acting vertically on the slab and is calculated for square meter as its applied on the beam and the wall load is also assigned on the beams only . for horizontal loads , the physically present phenomena that the floor slab at each floor level is acting as very rigid horizontal beams which ensures that the lateral deformation of all the nodes at any particular floor level are the same. This is known as diaphragm action of the horizontal slabs.

2.5Special RC Moment Resisting Frame

It includes the columns and beams as the framing system but with four sides alternate shear walls on the structure on all the side instead of columns.

LOAD COMBINATIONS:

1. DL
2. LL
3. (DL+LL)
4. 1.5(DL+LL)
5. EQX+VE
6. EQX-VE
7. EQZ+VE
8. EQZ-VE
9. 1.5(DL+ EQX+VE)
10. 1.5(DL+ EQX-VE)
11. 1.5(DL+ EQZ+VE)
12. 1.5(DL+ EQZ-VE)
13. 1.2(DL+LL+E EQX+VE)
14. 1.2(DL+LL+E EQX-VE)
15. 1.2(DL+LL+E EQZ+VE)
16. 1.2(DL+LL+E EQZ-VE)
17. 0.9 DL+1.5 EQX+VE
18. 0.9 DL+1.5 EQX-VE

2.6 CODES USED FOR DESIGN

1. DEAD LOADS IS 875 PART 1
2. LIVE LOADS IS 875 PART 2
3. SEISMIC LOADS IS1893-2000 PART 1
4. FOR REINFORCED STRUCTURES IS 456-2000

2.7ANALYSIS DATA FOR THIS INVESTIGATION

Following data used in the analysis of the RC frame building model

Type of frame: RC frame (General frame, shear wall &bracing frame)

Seismic zone	: II, III, IV&V
Number of storey	: G+10, G+15, G+20
Floor height	: 3m
Depth of two-way slab	: 0.125m
Materials	: M25 concrete, Fe500 steel
Shear wall thickness	: 150mm
Type of soil	: medium
Density of concrete	: 25 KN/m^2
Equivalent static method	: IS-1893(part-1)2002
Damping of structure	: 0.05
Shear wall thickness	: 150mm

III. RESULTS

The comparative results of both General Frame & shear wall and bracing frame structure for Zone II and III is given in Table 1 and Table 2 respectively. The Lateral displacement of structure and model mass of the structure in both ZONE-II & ZONE-III compared and the storey displacement in each level are to be compared.

ZONE II Table 1

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	0.3001	0.3001
2	3	0.7168	0.7168
3	6	0.9928	0.9928
4	9	1.2424	1.2424
5	12	1.4832	1.4832
6	15	1.7460	1.7460
7	18	1.9372	1.9372
8	21	2.1320	2.1320
9	24	2.3066	2.3066
10	27	2.4495	2.4495
11	30	2.6178	2.6178
12	33	2.6292	2.6292

From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-II of G+10 Storey building

Table 2

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame

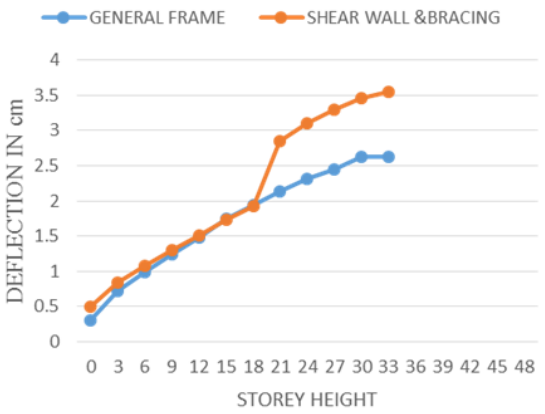
1	0	1.1221	0.7196
2	3	2.4117	0.8558
3	6	2.9648	1.0045
4	9	3.4685	1.0979
5	12	3.9682	1.2192
6	15	4.4633	1.3068
7	18	4.9498	1.4743
8	21	5.4244	1.6088
9	24	5.8818	1.7773
10	27	6.3164	2.3095
11	30	6.7231	2.4998
12	33	6.9095	2.6803
13	36	7.0959	2.8473
14	39	7.4258	2.9970
15	42	7.9324	3.1252
16	45	8.0115	3.2275
17	48	8.1830	3.3005

From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-II of G+15 Storey building

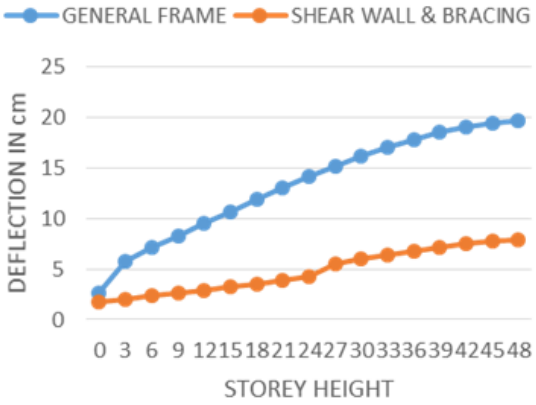
Table 3

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	0.3340	0.3836
2	3	0.7992	1.1056
3	6	1.1121	1.2893
4	9	1.4007	1.4557
5	12	1.6873	1.6190
6	15	1.9749	1.7819
7	18	2.2628	1.9450
8	21	2.5499	2.1048
9	24	2.8349	2.1719
10	27	3.1161	2.4351
11	30	3.3919	2.5980
12	33	3.6605	2.7613
13	36	3.9198	3.2502
14	39	4.1679	3.4479
15	42	4.4024	3.6377
16	45	4.6211	3.8176
17	48	4.8215	3.9854
18	51	5.0009	4.1387
19	54	5.1567	4.2748
20	57	5.2862	4.3912
21	60	5.3872	4.4853
22	63	5.4611	4.5572

From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-II of G+20 Storey building.

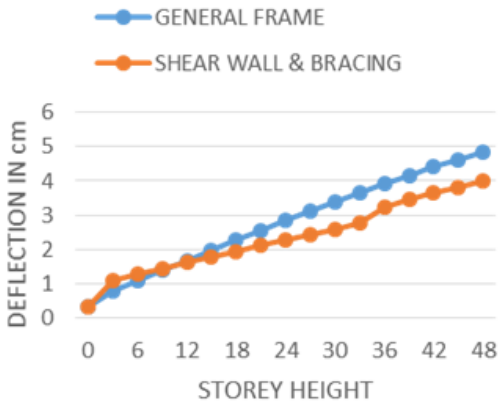


GRAPH: Comparison between General Frame,



Shear Wall & Bracing in Zone II (G+10)

Comparision Between General Frame, Shear Wall & Bracing In Zone Ii (G+15)



Comparision Between General Frame, Shear Wall & Bracing In Zone Ii (G+20)

ZONE III

Table 4

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	0.4800	1.1846
2	3	1.1464	1.3392
3	6	1.5877	1.7270
4	9	1.9865	2.0774
5	12	2.3733	2.4206
6	15	2.7404	2.7586
7	18	3.0882	3.8980
8	21	3.4118	4.5514
9	24	3.6912	4.9483
10	27	3.9201	5.2780
11	30	4.0877	5.225
12	33	4.1896	5.6726

From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-III of G+10 Storey building.

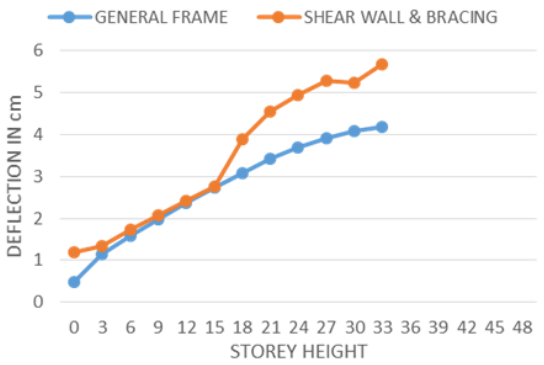
Table 5

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	1.7953	1.1513
2	3	3.8587	1.3692
3	6	4.7436	1.5587
4	9	5.5496	1.7503
5	12	6.4390	1.9474
6	15	7.1408	2.1492
7	18	7.9194	2.3552
8	21	8.6783	2.5665
9	24	9.4100	2.8380
10	27	10.1058	3.6902
11	30	10.7565	3.9942
12	33	11.3518	4.2823
13	36	11.8805	4.5489
14	39	12.3306	4.7878
15	42	12.6894	4.9923
16	45	12.9437	5.1554
17	48	13.0898	5.2716

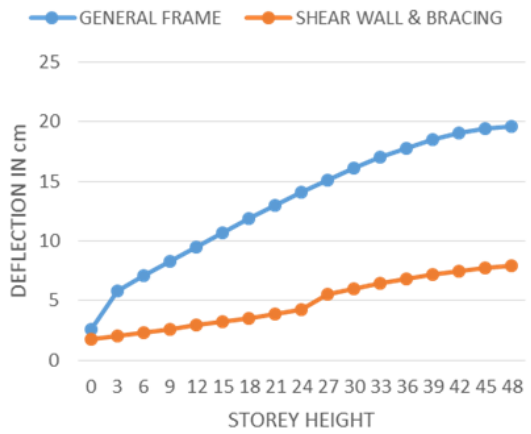
Table 6

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	0.3340	0.3836
2	3	0.7992	1.1056
3	6	1.1121	1.2893
4	9	1.4007	1.4557
5	12	1.6873	1.6190
6	15	1.9749	1.7819
7	18	2.2628	1.9450
8	21	2.5499	2.1048
9	24	2.8349	2.1719
10	27	3.1161	2.4351
11	30	3.3919	2.5980
12	33	3.6605	2.7613
13	36	3.9198	3.2502
14	39	4.1679	3.4479
15	42	4.4024	3.6377
16	45	4.6211	3.8176
17	48	4.8215	3.9854
18	51	5.0009	4.1387
19	54	5.1567	4.2748
20	57	5.2862	4.3912
21	60	5.3872	4.4853
22	63	5.4611	4.5572

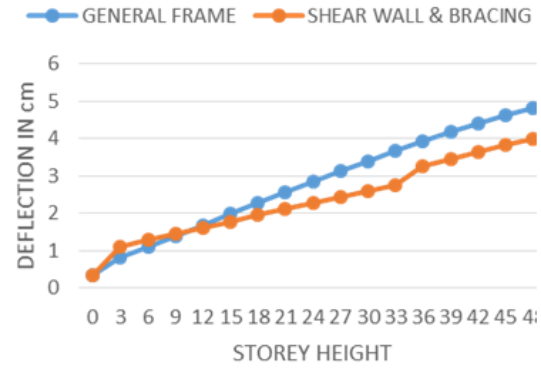
From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-III of G+20 Storey building.



Comparison between General Frame, Shear Wall & Bracing in Zone III (G+10)



Graph: Comparison between General Frame, Shear Wall & Bracing in Zone III (G+15)



Comparison between general frame, shear wall & bracing in zone iii (g+20)

ZONE IV

Table 7

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	0.7201	1.7768
2	3	1.7191	2.2497
3	6	2.3809	2.6652
4	9	2.9786	3.0749
5	12	3.7013	3.4811
6	15	4.3253	3.8844
7	18	4.9079	4.6355
8	21	5.4352	6.8279
9	24	5.8906	7.4234
10	27	6.2564	7.9180
11	30	6.5160	8.2849
12	33	6.6664	8.5103

From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-IV of G+10 Storey building.

Table 8

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	2.6930	1.7263
2	3	5.7880	2.0538
3	6	7.1154	2.3382
4	9	8.3244	2.6258
5	12	9.5236	2.9233
6	15	10.7112	3.2244
7	18	11.8792	3.5335
8	21	13.0176	3.8494
9	24	14.1150	4.2577
10	27	15.1500	5.5387
11	30	16.1349	5.9950
12	33	17.0279	6.4277
13	36	17.8210	6.8280
14	39	18.4962	7.1868
15	42	19.0343	7.4939
16	45	19.4150	7.7389
17	48	19.6349	7.9086

From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-IV of G+15 Storey building.

Table 9

The results of General Frame & shear wall and bracing frame structure

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	0.3340	0.3836
2	3	0.7992	1.1056
3	6	1.1121	1.2893
4	9	1.4007	1.4557
5	12	1.6873	1.6190
6	15	1.9749	1.7819
7	18	2.2628	1.9450
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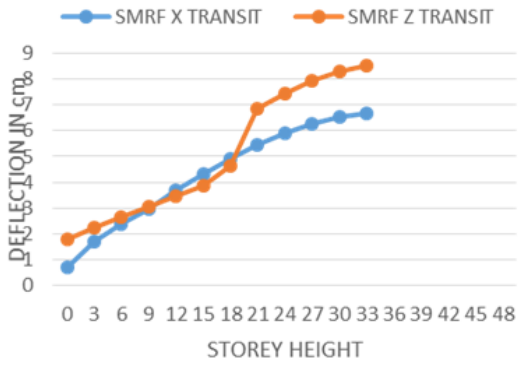
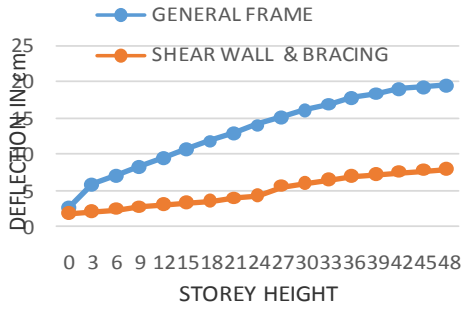
18	51	5.0009	4.1387

19	54	5.1567	4.2748
20	57	5.2862	4.3912
21	60	5.3872	4.4853
22	63	5.4611	4.5572

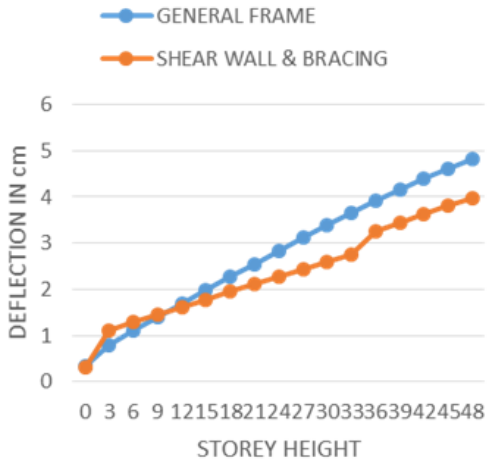
From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-IV of G+20 Storey building.



COMPARISION BETWEEN IN ZONE IV (G+10)



COMPARISION BETWEEN GENERAL FRAME, SHEAR WALL & BRACING IN ZONE IV (G+15)



GRAPH: COMPARISION BETWEEN GENERAL FRAME, SHEAR WALL & BRACING IN ZONE IV (G+20)

ZONE V

Table 10

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	1.0800	2.6651
2	3	2.5782	3.3739
3	6	3.5715	3.9984
4	9	4.5690	4.6105
5	12	5.5515	5.2190
6	15	6.4873	5.8230
7	18	7.3610	6.9497
8	21	8.1517	10.2380
9	24	8.8347	11.1305
10	27	9.3832	11.8718
11	30	9.7724	12.4214
12	33	9.9980	12.7587

From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-V of G+10 Storey building.

Table 11

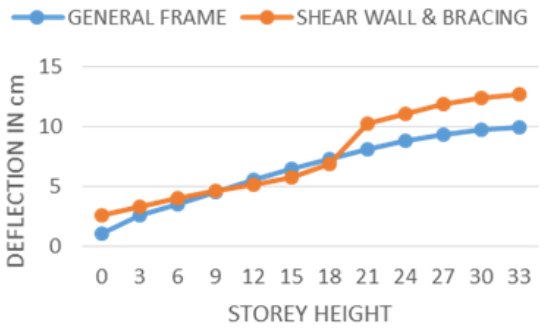
S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	4.0394	2.5905
2	3	8.6820	3.2440
3	6	10.6730	3.6503
4	9	12.4864	3.9714
5	12	14.2852	4.3851
6	15	16.0665	4.8403
7	18	17.8185	5.3057
8	21	19.5260	5.7813
9	24	21.1721	6.3915
10	27	22.7377	8.3038
11	30	24.2017	8.9928
12	33	25.5410	9.6373
13	36	26.7305	10.2423
14	39	27.7432	10.7805
15	42	28.5502	11.2412
16	45	29.1223	11.6088
17	48	29.4509	11.8709

From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-V of G+15 Storey building.

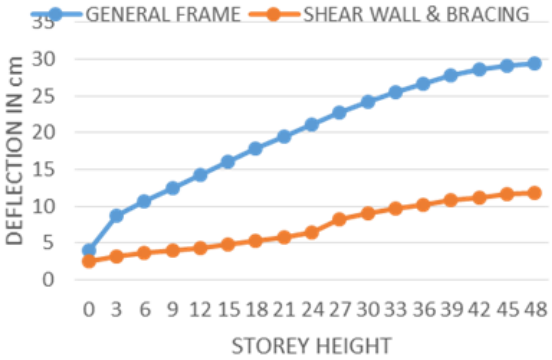
Table 12

S.No	Storey Height	Lateral displacement in cm	
		General frame	Shear wall and bracing frame
1	0	1.7681	2.0307
2	3	4.2307	5.8612
3	6	5.8871	6.8206
4	9	7.4148	7.7077
5	12	8.9322	8.7434
6	15	10.4542	9.4254
7	18	11.9782	10.2831
8	21	13.4980	11.1415
9	24	15.0063	11.9998
10	27	16.4949	12.8562
11	30	17.9547	13.7106
12	33	19.3762	14.5886
13	36	20.7849	17.1560
14	39	22.0619	18.1969
15	42	23.3032	19.1963
16	45	24.4605	20.1435
17	48	25.5209	21.0267
18	51	26.4705	21.8331
19	54	27.2950	22.5493
20	57	27.9803	23.1611
21	60	28.5150	23.6551
22	63	28.9055	24.0330

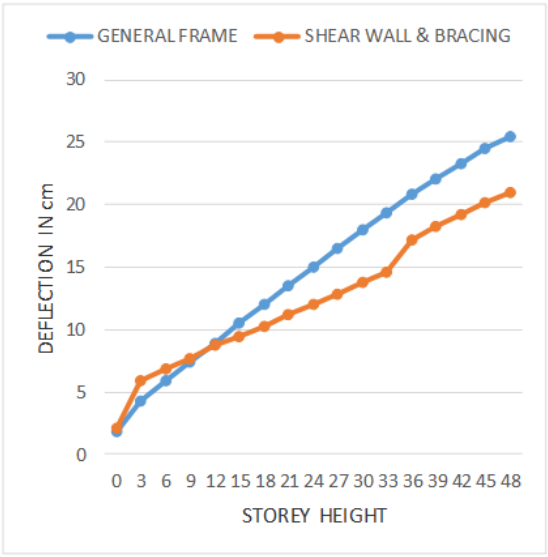
From above table shows the Storey Displacement Values in Transverses (Z) Direction in ZONE-V of G+20 Storey building.



Graph: comparision between general frame, shear wall & bracing in zone v (g+10)



graph: comparision between general frame, shear wall & bracing in zone v (g+15)



Graph: comparision between general frame, shear wall & bracing in zone v (g+20)

IV. CONCLUSION

ZONE II

- when coming to G+10 storey building the variation of storey drift between without shear wall and bracings and with Shear wall & bracing structure 0.26%
- when coming to G+15 Storey building the variation of Storey drift between without shear wall and bracings and with Shear wall & bracing structure 1.47%
- when coming to G+20 Storey building the variation of Storey drift between without shear wall and bracings and with Shear wall & bracing structure is 0.19%

ZONE III

- when coming to G+10 storey building the variation of storey drift between without shear wall and bracings and with Shear wall & bracing structure 0.26%

- when coming to G+15 Storey building the variation of Storey drift between without shear wall and bracings and with Shear wall & bracing structure 1.45%
- when coming to G+20 Storey building the variation of Storey drift between without shear wall and bracings and with Shear wall & bracing structure 0.46 %

ZONE IV

- when coming to G+10 storey building the variation of storey drift between G without shear wall and bracings and with Shear wall & bracing structure 0.21%
- when coming to G+15 Storey building the variation of Storey drift between without shear wall and bracings and with Shear wall & bracing structure 1.48%
- when coming to G+20 Storey building the variation of Storey drift between without shear wall and bracings and with Shear wall & bracing structure 0.41%

ZONE V

- when coming to G+10 storey building the variation of storey drift between without shear wall and bracings and with Shear wall & bracing structure 0.21%
- when coming to G+15 Storey building the variation of Storey drift between without shear wall and bracings and with Shear wall & bracing structure 1.48%
- when coming to G+20 Storey building the variation of Storey drift between without shear wall and bracings and with Shear wall & bracing structure 0.35%

When compared to zone II, III, IV&V the lateral displacement is less in zone II

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