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A COMPARATIVE STUDY ON SEISMIC RESISTANCEOF A HIGH RISE STRUCTURE WITH FLOATING COLUMNS HAVING INFILL SHEAR WALL AT DIFFERENT LOCATIONS.

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Abstract- The construction of building with increased heights and with usage of lightweight, high strength leads to flexible structures. Recent earthquakes, where many concrete buildings are severely damaged or collapsed, suggest a need to assess the earthquake resistance of buildings. In present, a high rise building with floating column i.e. he column that rest on beams and do not have foundations is common in high rise buildings because of the reason they accommodate more space. These have discontinuities in load transfer path and are designed for gravity loads but not for earthquake loads. Since it is a typical feature, it has some advantages and disadvantages. To reduce damage due to earthquake, an attempt is made to study the behavior of high rise building by considering structural action of infill walls taken as diagonal struts and a shear wall which acts as lateral load resisting system. The building is modeled with floating column, diagonal strut and shear wall. Response spectrum analysis is carried out by using ETABS. The models are compared for different parameters like storey drift, story stiffness, displacement, time period and base shear.

Keywords: floating column, diagonal strut, shear wall, ETABS software.

I. INTRODUCTION

The buildings in modern construction is becoming more complex particularly because of mix use ones. There are different types of uses on different floors and hence it is making to follow its structural grid and thus it is becoming difficult as columns on any floor would become a hindrance. Floating columns are frequently used when shops on ground floor and residence is on upper floor is constructed. Floating column means removal of column on lower stories which is “a dangerous proposal”. The building with floating column takes only gravity loads. It is also called as hanging column or stub column and it does not rest on foundation. The transfer of load to the foundation or column is generally taken by designed regular columns while floating columns doesn’t transfer load directly. The floating column may be positioned on first floor or top floors or any intermediate floors based on requirements in design of structure.

II. LITERATURE REVIEW

Vikas V Miette(2018) : The structure is modeled with different storey cases such as 10,15,20,25 and 30. With the help of ETABS, each model is analyzed for conventional analysis and for construction stage analysis along with earthquake load and wind load. The shear force, bending moment and displacement are the three type of analysis done to know the behavior of transfer girders. Bending moment is maximum for conventional analysis and for wind analysis. The building is designed for conventional analysis by considering earthquake forces for the safety of structure. Transfer girder gives less bending moment with shear wall.

Kavya K.M (2017) : The building with G + 14 stories having shear wall and infill wall is concerned about analyzing the behavior of regular and mass irregular building. Response spectrum method and the equivalent lateral force are the methods used for analysis of building located in zone IV. As compared to that of bare frame and mass irregular structure, better seismic performance is done by regular structure.

VarunSourav (2017) : This paper aims to find out the prime location of shear wall and then investigate the effectiveness of beat shear wall in bare and infill frame system. The structure with G + 10 at bhuj located in zone V and is done with some investigations. The 3D building model is analyzed by using linear static method. The shear wall is done by surface messing with the help of STAADPRO. In increasing the performance of building under lateral force, shear wall plays a significant role

III. MODELLING

The structure chosen for a study is a G+11storied residential building. The building is situated in seismic zone III & zone IV on rough and medium stiff soils. Three dimensional mathematical models are generated in ETABS 2016 software. For structural elements, M40 grade of concrete is used. The floor diaphragms are assumed to be rigid. Using ETABS 2016 a G+11 RC structure is modeled and analyzed

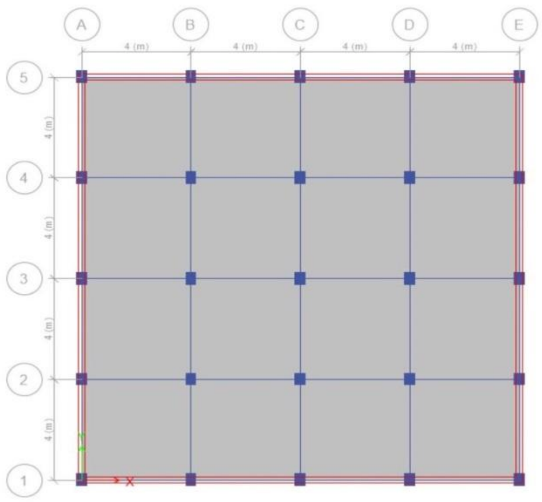


Fig. 1: Plan View

IV. METHODOLOGY

A study is undertaken which involves analysis, design of high rise structures with different loads. The design parameters are considered and the analysis is done using Etabs software.
Following data is used in the analysis of high rise Buildings

- Frame type: Bare frame
- Material type:Fe250
- Loads: Dead, Live and Wind speeds
- Building height:33.2m
- Length:20m
- Width: 40m
- Height of Column:3m
- Software used :Etabs
- Soil type: Hard, medium
- Geometry of building: Symmetric
- Material used :M 40
- Shear wall thickness: 230 mm
- slab thickness: 150 mm
- Dimension: 33.2 * 16m
- seismic zone: 3 & 4
- zone factor: 0.16 &0.24

V. Response Spectrum Method:

In the response spectral method, the ratio of the structure during tremor is obtained directly in the tremor (or design) cross section. This issue contains the maximum limit. It is a method for the application of structural design. For this procedure, we need to consider a sufficient number of modes to represent the structure. In each mode and very mode, the design mass is based on modal mass and modal frequency. Combinations of all the different modes must be combined to obtain a complete aggregate of structures using a modal combination method such as 'Complete Secondary Combination (CQC)', 'Square Root of Squared (SRSS)' or 'Square Root Sum (SRSS)' . ABS (absolute sum) method. The response spectral method should be done using the design spectrum specified for each code or using site-specific design spectra specifically tailored to the specific project site structure.

Load combination:
The analysis results obtained for the following load combination as per IS 456-2000 and IS 1893-2016 and we obtained 27 load combinations.

Design of seismic load by static analysis:

Natural period of vibration (Ta):

1) Assuming infill panels are provided

- **Ta = 0.09*h/d**
  = 0.09*19/16
  = 0.814 sec.

2)<u>Design horizontal seismic coefficient:</u>

- **Ah = Z/2*I/R*Sa/g**

For zone III,

Z = 0.16,
I = 1.0,
R = 5,
Sa/g = 2.5.

Therefore

- **Ah = 0.16/2*1.0/5*2.5**
  = 0.04

3)<u>Design base shear (V b)</u> :

Floor area A = 16*16
= 256 sq. m

Seismic load from1 to 11 = FA{D.D+0.25(L.L)}
= 256{4.2+0.25(3)}
= 1267.2 Kn.

Seismic load from 11 floor = 256*4.2
= 1075.2 Kn

Total seismic load W = 11*1262.2+1075.2
= 14959.4 Kn

Design horizontal shear

- **Vb = Ah*W**
  = 0.04*14959.4
  = 598.3Kn

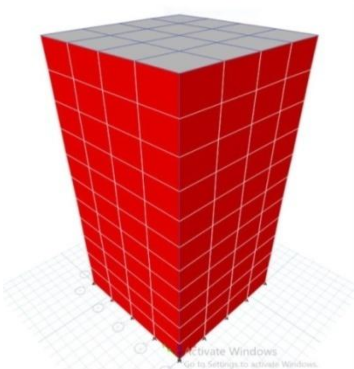


Fig: 4.2 3D model view of model – 1

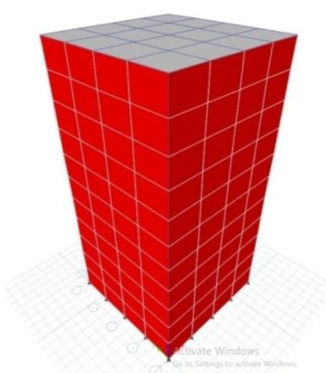
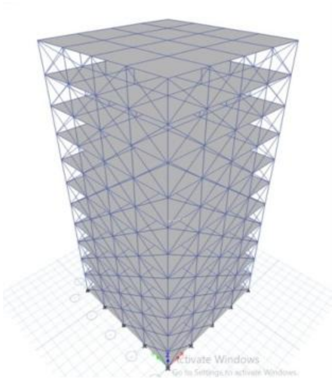


Fig: 4.4 3D model view of model -2



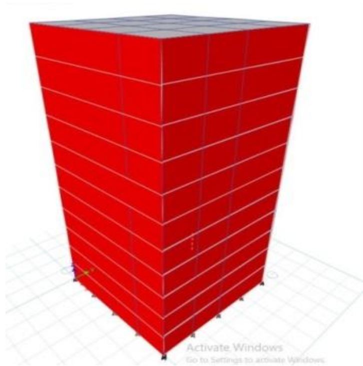
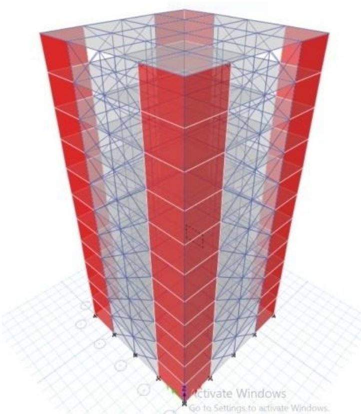


Fig: 4.6 3D model view of model -3 **fig :4: 8model view of model – 4**



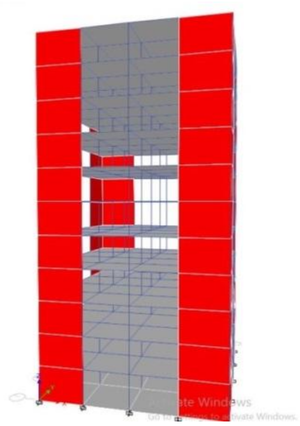


Fig: 4.103D model view of model – 5 **Fig:4.12 3d model view of model -6**

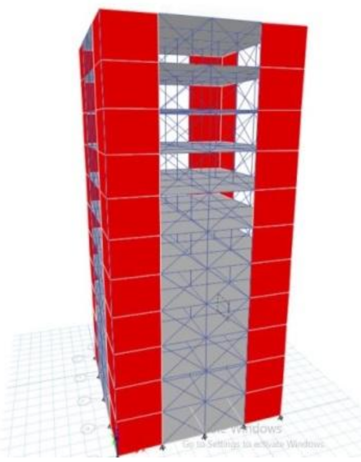


Fig: 4.14 3D model view of model – 7

VI. RESULTS & GRAPHS

Table 5.1: Comparison of base shear.

MODELS	BASE SHEAR						
	ELEVAT-ION	ZONE III			ZONE IV		
		TYPE1	TYPE2	TYPE3	TYPE1	TYPE2	TYPE3
1	**3.2**	2065.37	3442.3	5151.5	2073.6	3637.07	5163.4
2	**3.2**	3713.8	3754.9	5632.4	3986.0	5271.8	5650.4
3	**3.2**	1370.2	1418.5	1461.8	1562.7	2055.0	2192.8
4	**3.2**	2589.7	3436.2	3632.8	3142.3	4861.4	5510.23
5	**3.2**	551.053	1580.8	2432.6	1119.6	2226.14	2752.6
6	**3.2**	2137.9	2907.6	2946.6	3206.9	4361.0	4419.0
7	**3.2**	**549.5**	**1823.6**	**2735.4**	**1050.6**	**2216.79**	**2750.4**

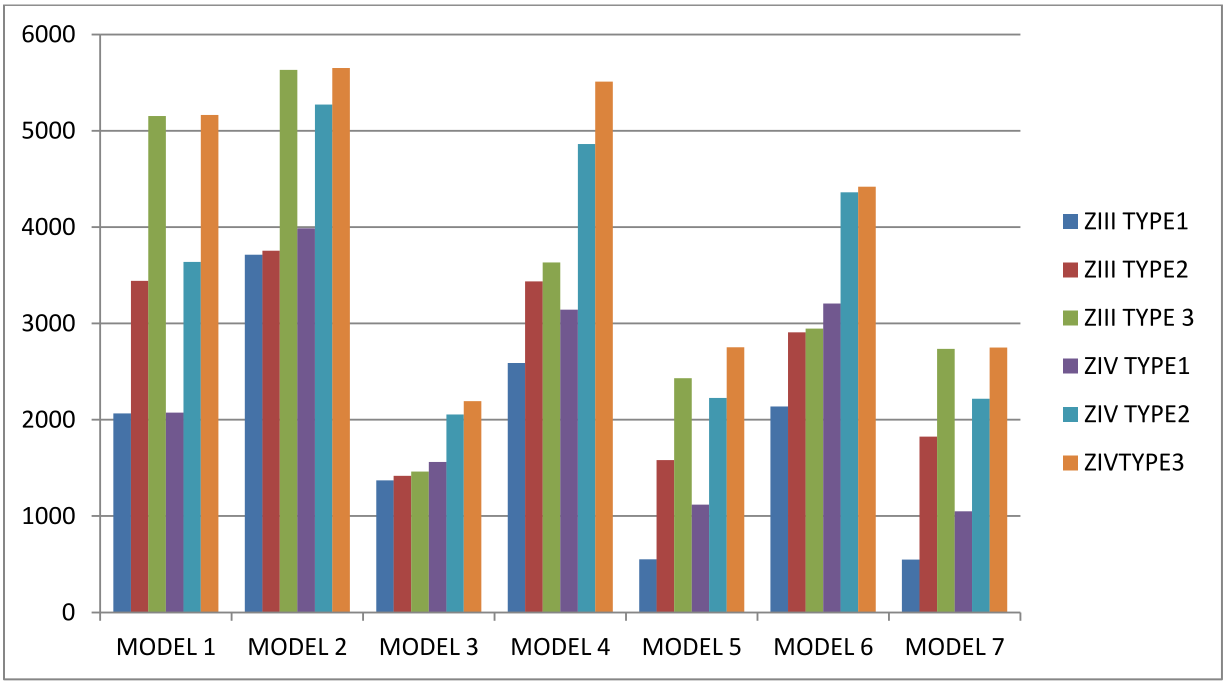


Figure 1: Shows base shear of model 1-7 in zone III and zone IV

The base shear is very high in the model 1 (bare frame with floating columns) because floating columns doesn't carry earthquake loads and it carries only gravity loads. When compared to bare frame, the base shear decreases when diagonal strut and shear wall is provided at center. On providing only floating columns to a building, base shear increases very highly. When a building is provided with diagonal strut, floating column and shear wall, base shear reduces when compared to bare frame.

Table 5.2: Comparison of Storey Drift:

MODELS	STORY DRIFT						
	ELEVAT-ION	ZONE III			ZONE IV		
		TYPE1	TYPE2	TYPE3	TYPE1	TYPE2	TYPE3
1	**3.2**	0.00008	0.000108	0.000158	0.000086	0.000112	0.000172
2	**3.2**	0.000084	0.000097	0.000112	0.000106	0.000112	0.000124
3	**3.2**	0.00014	0.000144	0.000155	0.00018	0.000197	0.000232
4	**3.2**	0.0013	0.0045	0.00586	0.0019	0.0079	0.00850
5	**3.2**	0.000003	0.000012	0.000105	0.00093	0.000113	0.000122
6	**3.2**	0.000468	0.000631	0.00064	0.000695	0.000939	0.000952
7	**3.2**	**0.000055**	**0.000075**	**0.000081**	**0.00097**	**0.00012**	**0.00017**

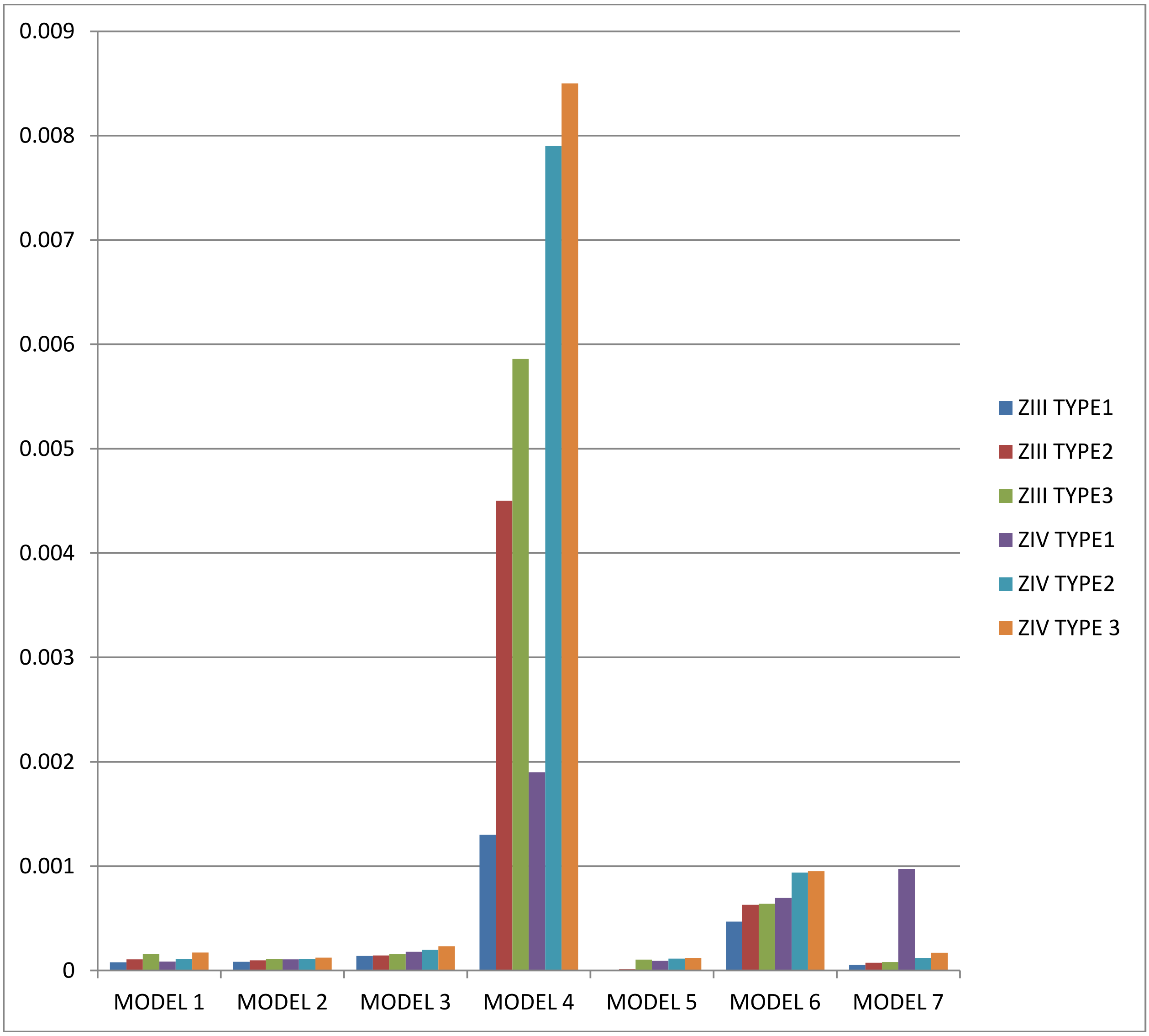


Figure 2: Shows storey drift of model 1-7 in zone III and zone IV

Story drift is very less in all the models. When shear wall is provided at center of building along with diagonal strut, the story drift reduces much when compared to bare frame. Story drift is high in buildings when floating column is provided without any shear wall and it reduces gradually when shear wall is provided to a building.

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Table 5.3: Comparison of Lateral Displacement:

MODELS	ELEVAT-ION	Lateral Displacement					
		ZONE III			ZONE IV		
		TYPE1	TYPE2	TYPE3	TYPE1	TYPE2	TYPE3
1	**33.2**	1.29	2.076	3.085	2.0	2.789	3.185
2	**33.2**	2.0	2.63	3.37	2.73	3.0	3.37
3	**33.2**	3.2	4.42	6.00	3.59	4.86	6.62
4	**33.2**	6	12.5	14.7	6..6	17.3	19.65
5	**33.2**	1.136	2.5	3.12	2.1	2.8	3.381
6	**33.2**	11.71	17.27	17.51	19.053	25.89	26.24
7	**33.2**	**1.2**	**2.25**	**2.528**	**1.89**	**2.8**	**3.36**

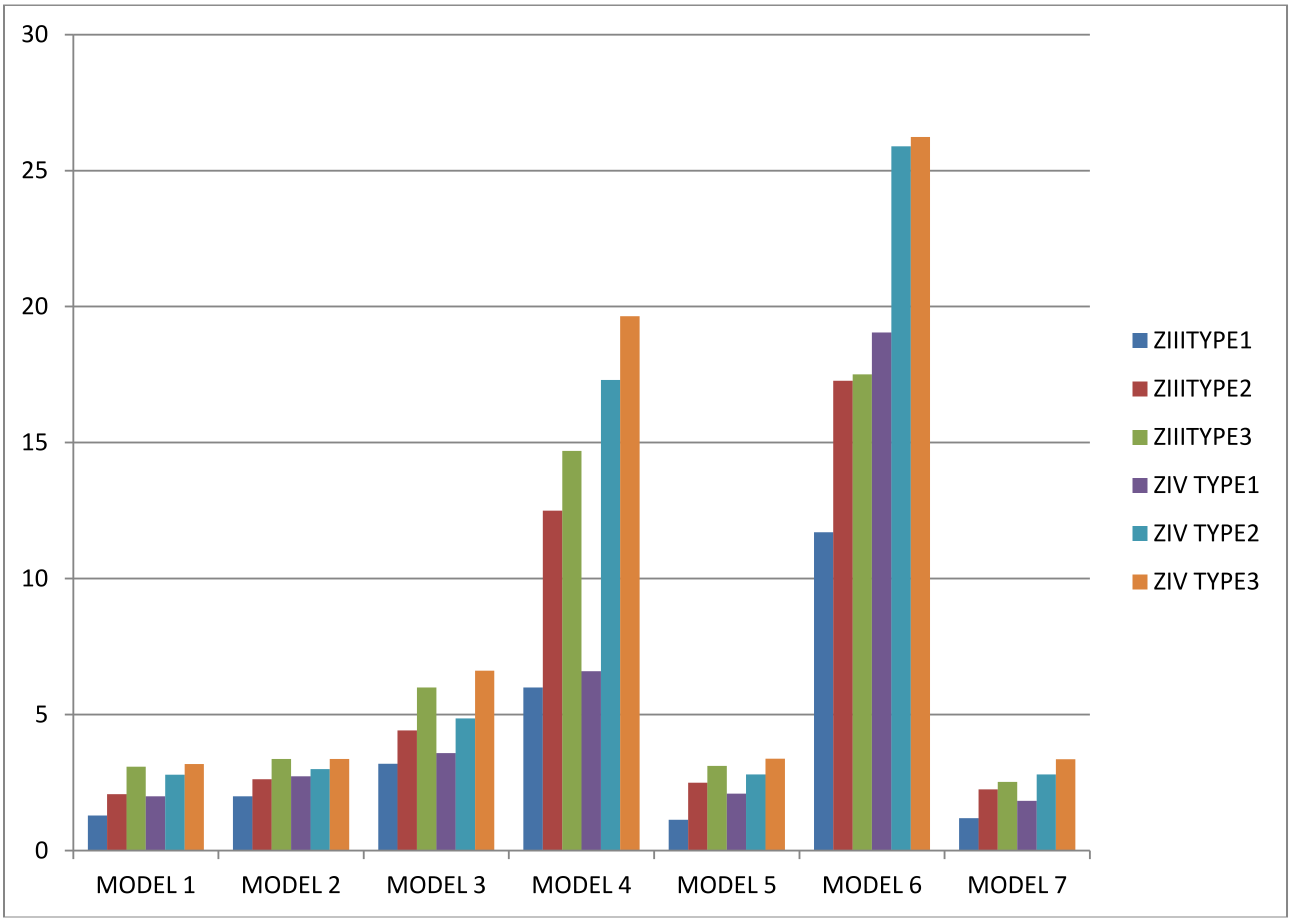

Figure 3: Shows lateral displacement of model 1-7 in zone III and zone IV

From the above table, it can be clearly seen that the lateral displacement in model 1 i.e. bare frame is 1.29 and is least when compared to all models. Lateral displacement in model 6 i.e. bare frame with floating column and provided shear wall at edges has higher displacement when compared to all models.

VII.CONCLUSION:

1. For a structure , shear walls plays a significant role in resisting seismic forces.
2. Floating columns, the most critical members for the building. To have a good control over the forces and displacements, it is desired and preferable to locate the shear wall towards the center.
3. It is noted that the base shear of a structure without shear wall is high when compared to a structure with shear wall.

4. It is observed that the presence of shear wall influences the overall behavior of structures when subjected to lateral forces. Lateral displacements are considerably reduced about 40 to 89% while contribution of the different position of shear wall in plan.
5. The presence of diagonal strut influences the overall behavior of structures when subjected to lateral forces. Lateral displacements and story drift are considerably increased about 20% while base shear of a building decreases about 60%.
6.From the present work it has been identified that story drift of a structure with floating column are found to be more compare to normal building. By providing shear wall to a building with floating column, story drift reduces to about 40%.
7. Story drift are considerably increased about 10 to 25%, base shear is considerably reduced about 50% i.e. base shear is reduced when diagonal strut is added to the building.
8. It is also observed that the maximum value of base shear that occurred at lower story is decreased when we provide shear wall to a building at the center.
9. It is observed that a structures with RC structure with floating column in plan are having relatively higher base shear values than the other models.
10. It is observed that the models with diagonal strut and shear wall at center of building are having considerably low base shear, lateral displacement and story drift when compared to a regular normal building.

VIII.SCOPES OF FUTURE WORK:

1. The studies can be carried out for an irregular building with floating columns on different slopes.
2. This study is based on linear dynamic analysis using response spectrum. The results need to be verified with the non-linear dynamics analysis.
3. The study can be further extended to the buildings by in corporating bracings and dampers along with floating column by carrying out wind analysis.

REFERENCES:

1.A.S Patel and P.D Lumbar - " Time history analysis of high rise RCC buildings for different seismic zones ", International Journal of structural and civil engineering research (IJSCER),Vol. 2, No. 3, August 2013.

2. C.V.R. Murthy, IIT Kanpur, BMPTC, New Delhi Earthquake Tips February 2004.

3. IS 13920: 2016 -Ductile Design and Detailing of Reinforced Concrete Structures subjected to seismic forces-Code of practice?

4. IS 1893(Part 1): 2016 Earthquake Resistant Design of Structures, Part1 General Provisions and building, Bureau of Indian Standards.

5. IS: 456-2000 Indian standard Code of practice for Plain and Reinforced Concrete (Fourth revision), Bureau of Indian Standards.

6. IS: 875(Part 1, Part 2, Part 3)-2015, Indian standard code of practice for design loads (Other than earthquake) for buildings and structures.

7. Nagarjuna and Shiva Kumar B. Patel - "Lateral stability of high rise building with floating column", International Research Journal of Engineering and Technology (IRJET), Volume 2, Issue 4 , July-2015.

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