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BEHAVIOR OF RCC STRUCTURE WITH ALTERED SHEAR WALL LOCATIONBY USING STAAD.PRO V8I

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Abstract- The high seismic areas may be susceptible to the severe damage in structures. In the seismic design shear walls act as major earthquake resisting members. Now a day, shear wall in R.C. structure are most popular system to resist lateral load due to earthquake, wind, blast etc. Positioning of shear wall has influence on the overall behavior of the building. For effective and efficient performance of building it is essential to position shear wall in an ideal location. Story drift and lateral displacements are the critical issues in seismic design of buildings. This paper presents the response of building with different positioning of shear wall by Equivalent Static Method using IS 1893 (PART – I): 2002. Six different Model of G+8 RCC building, one with no shear wall and other five models with different position of shear wall which is subjected to earthquake load in zone V has been studied. Test results including story drift and story deflections are presented and get effective lateral load resisting system.

Keywords-Shear wall location, Equivalent static method, Story drift, Seismic analysis.

1. INTRODUCTION

India is a sub-continent which is having more than 60% area in tremor prone section as shown in figure 1.1. A most popular of buildings manufactured in India are designed based on consideration of permanent, semi-permanent, movable loads [1]. But earthquake is an infrequent load which leads to loss of human life but also trouble social conditions of India. The extent to which the structural response changes the features of earthquake motions observed at the base level depends on the relative mass and stiffness properties of the soil and the structure of building. Thus the physical property of the foundation medium is an important factor in the tremor response of structures supported on it [2-8**]**. In structural engineering, a shear wall is a structural system composed of braced or shear panels to counter the effects of lateral load acting on a structure. Wind and seismic loads are the most common loads that shear walls are designed to carry.Shear wall is a rigid vertical diaphragm capable of transferring lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes. The applied load is generally transferred to the wall by a diaphragm or collector. It must provide the required lateral strength to resist horizontal earthquake forces [9-13]. When shear walls are strong enough, they will transfer these horizontal forces to the next element in the load path below them.

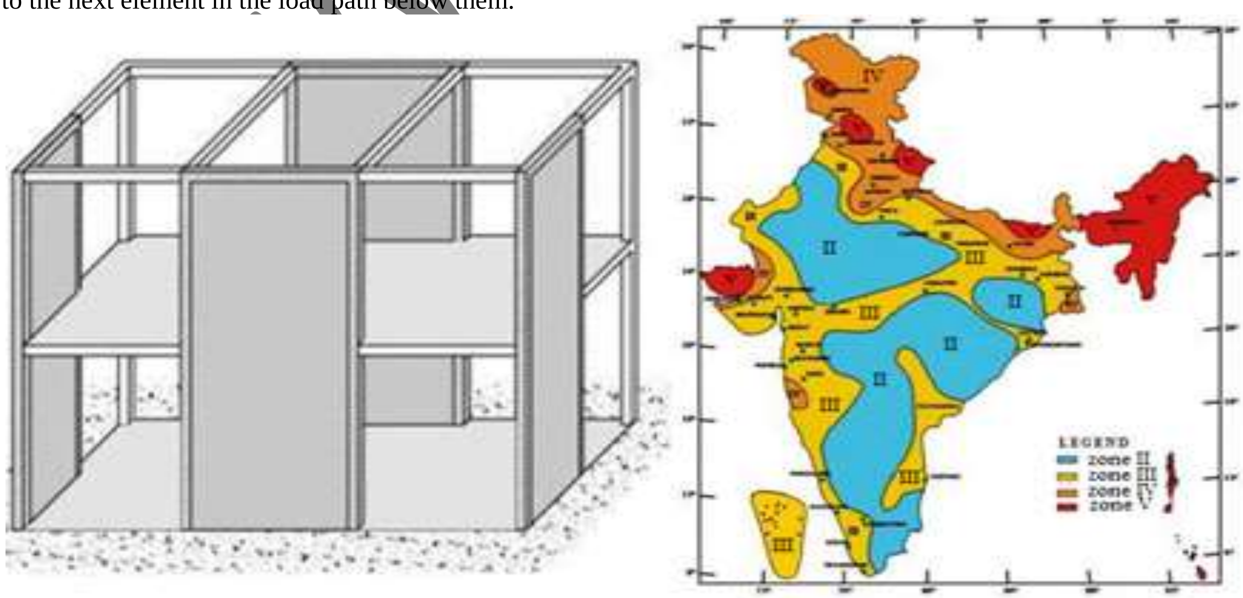

Fig. 1.1 Building with Shear Wall and Seismic Zone of India[5]

1.1 Type of Shear Wall [14-17]

- Simple rectangular
- Coupled shear walls
- Rigid frame shear walls
- Framed walls in filled frames
- Column supported shear wall
- Core type shear walls

1.2 Requirements of Shear Wall [18-20]

- The thickness of shear wall should not be less than 150 mm to avoid unusually thin sections.
- Effective flange width for the flanged wall sections from the face of web should be taken as least of half the distance to an adjacent shear wall web and one – tenth of total wall height.
- The minimum reinforcement in the longitudinal and transverse directions in the plan of the wall should be taken as 0.0025 times the gross area in each direction and distributed uniformly across the cross section of the wall.
- If the factored shear stress exceeds the 0.25√fck or if the wall thickness exceeds 200 mm.
- The maximum spacing of reinforcement in either direction should be lesser than, $\frac{l_w}{5}$, tw, or 150 mm.
- Diameter of bar should not exceed the one- tenth of the thickness of that part. This puts a check on the use of very large diameter bars in thin wall sections.

1.3 Advantages of Shear Wall [21-24]

- Sound-reducing qualities for Concrete homes built closer together and near noise sources like highways, railways and airports.
- It provides cost saving and fire resistant structure.
- Superb concrete finish with enhanced quality.
- Good appearance and Low water seepage problem.
- Better control of accuracy and workmanship.

2. METHODOLOGY

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

- Number of stores = G+8
- Soil Type: Medium soil
- Height of the each floor = 3 m
- Total height of the building = 27 m

Table-2.1 Load Combinations

S. No.	Load combinations
1	Dead load (DL)
2	Live load (LL)
3	Earthquake x+ (EQX)
4	Earthquake z+ (EQZ)
5	1.5(DL + LL)
6	1.2(DL + LL + EQX)
7	1.2(DL + LL – EQZ)
8	1.2(DL + LL + EQZ)
9	1.2(DL + LL – EQZ)
10	1.5(DL + EQX)
11	1.5(DL – EQX)
12	1.5(DL + EQZ)
13	1.5(DL – EQZ)
14	0.9DL + 1.5EQX
15	0.9DL – 1.5EQX
16	0.9DL + 1.5EQZ
17	0.9DL – 1.5EQZ

- Cross section of the beam = 450 mm x 450 mm
- Cross section of the column= 600 mm x 600 mm
- Shear wall thickness = 0.15 m
- Density of the concrete in the members =25 KN/m^3
- Dead Load = 12 KN/m^2up to 24 m and 10 kN/m^2 from 24m to roof
- Live Load = 4KN/m^2up to 24 m and 1.5kN/m^2 from 24m to roof
- Supports = All are fixed Supports

2.1 Seismic Parameters

- Zone value = 0.36
- Response reduction factor = 5
- Importance factor = 1
- Damping ratio = 0.05

2.2 Different Load Combinations

The different load combinations are shown in table 2.1

3. MODELLING AND ANALYSIS IN STAAD.PRO

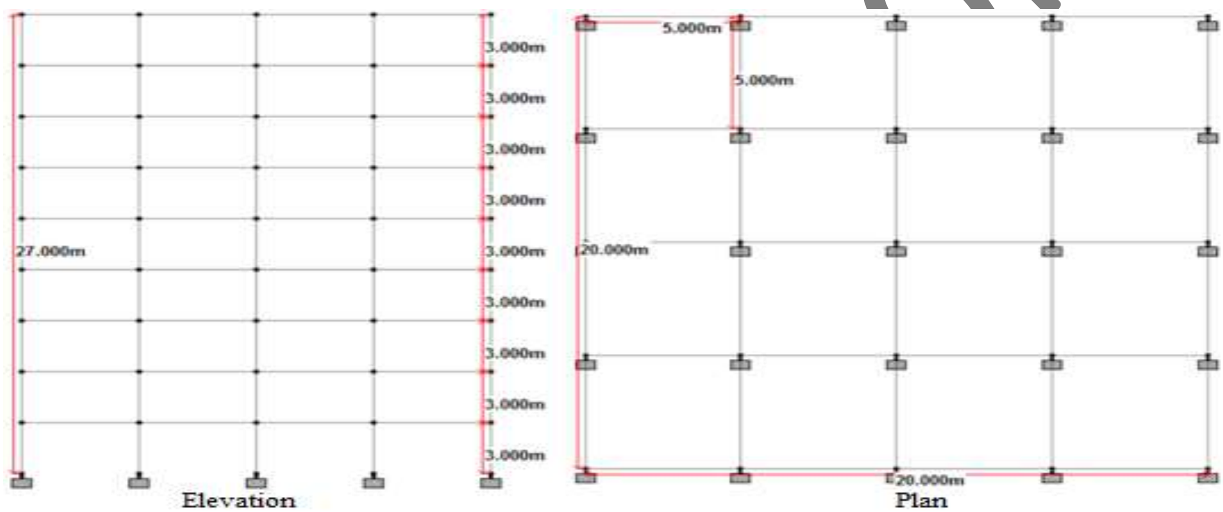

Fig. 3.1 Model Considered in the Study

Six models are considered for analysis. These models are shown below:

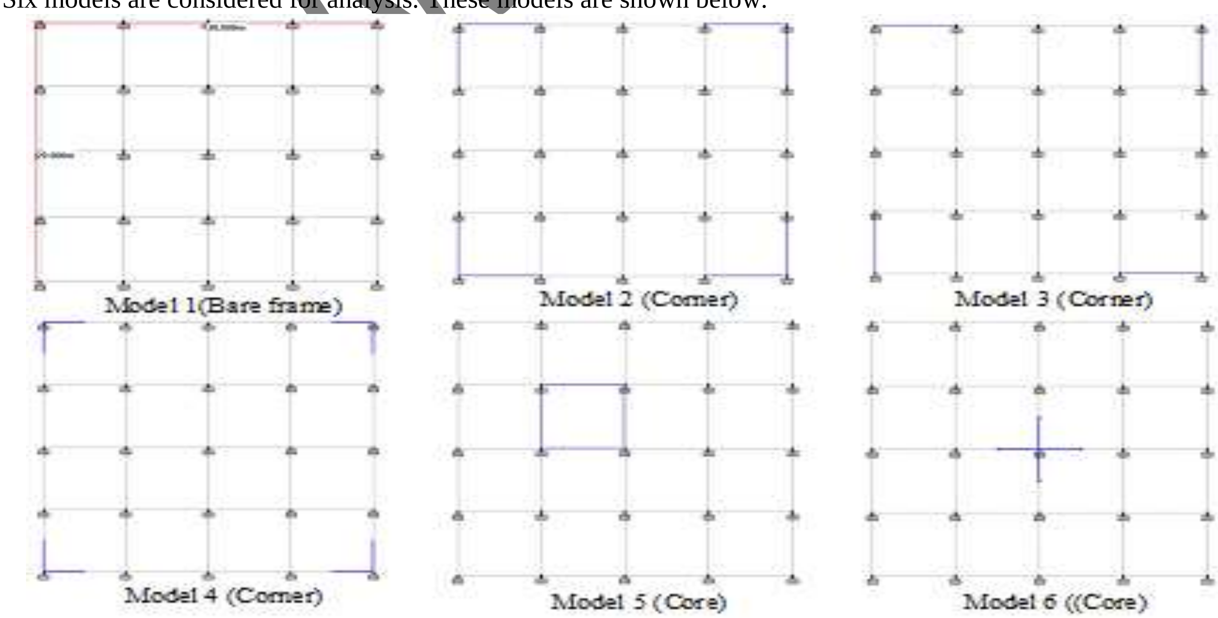

Fig. 3.2 Plan of Six Models With Different Configurations

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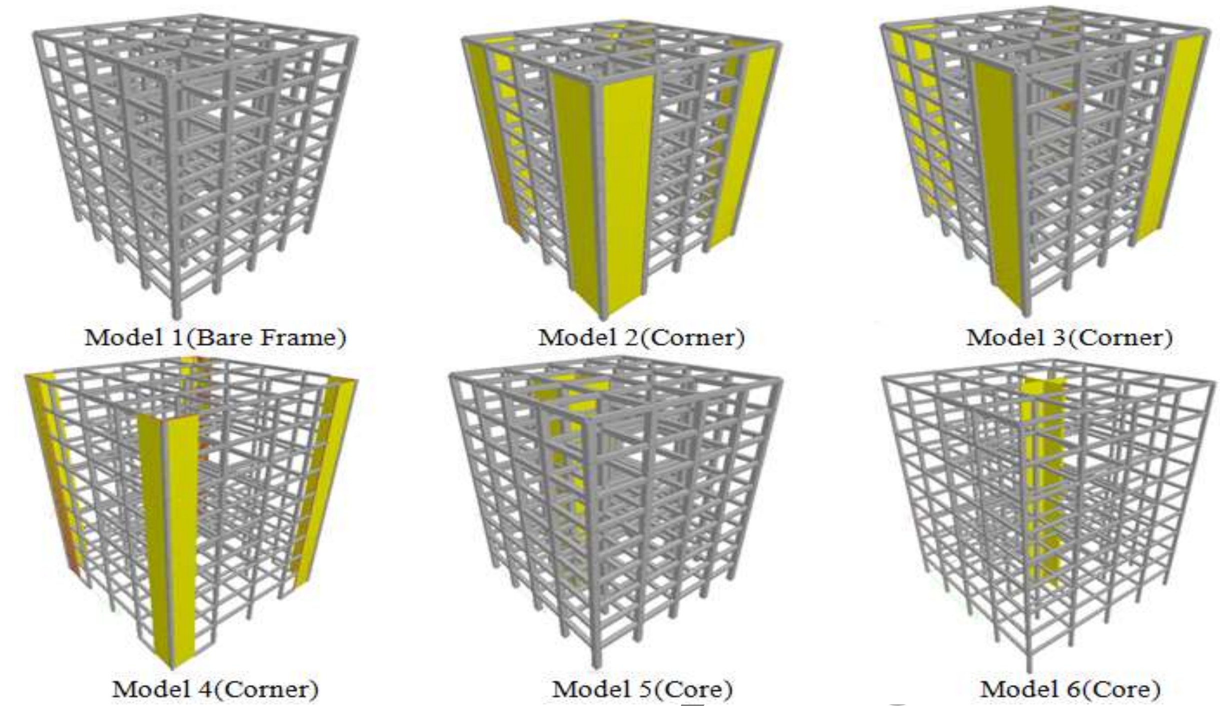

Fig. 3.3 Three Dimnsional View of Structure With Different Shear Wall Location

The above figure 3.3 show that multi-storey building structure frame G+8 have been modeled in STAAD.PRO design and analysis software with given material properties and specifications.

4. RESULTS

The structure analysis of all the frames models that includes different location of shear walls has been done by using software STAAD.PRO and the results are shown below. The parameters which are to be studied are inter-storey drift and average displacements.

4.1 Average Displacements

Fig. 4.1 shows the comparison of displacement curves for different storey height wise distributions for all the models. It is also observed that the displacement of model 2, 3, 4, 5 is reduced when compared to the values of model 1. Average displacement variation of for all the models shown in Table 4.1 and 4.2.

4.2 Storey Drift

Storey drift is the displacement of one level relative to the other level above or below.Figure 4.2 shows the comparison of curves for number of storey and storey drift. . It is also observed that storey drift increases when the height of storey increased up to a limit and then decreases. Storey drift for all the models are shown in Table 4.3 and 4.4.

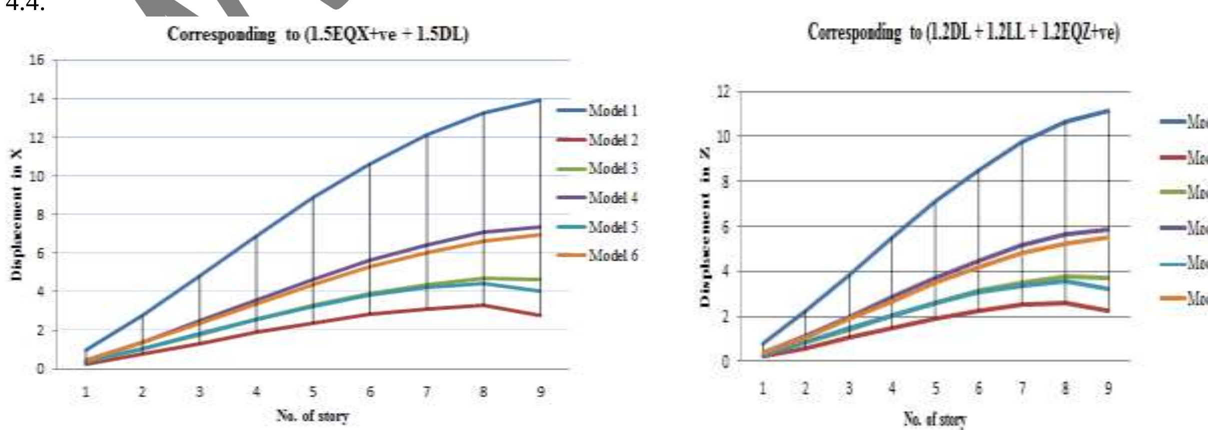

Fig. 4.1 Comparison Curves for Different Displacements (in cm).Vs no. of Storey

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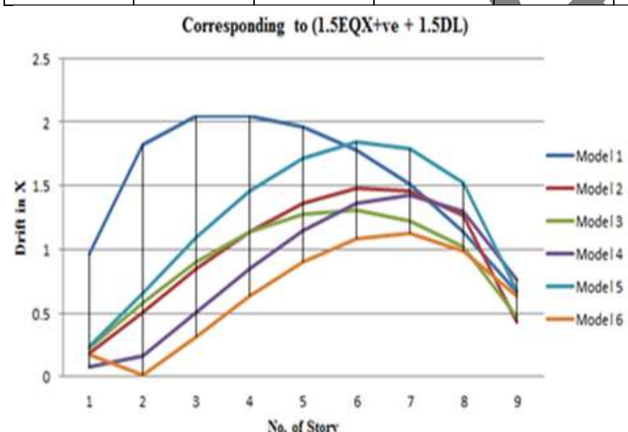
Table-4.1Average Displacement in X Corresponding to (1.5EQX+ve + 1.5DL)

Storey	1	2	3	4	5	6	7	8	9
Model 1	0.9713	2.7961	4.8413	6.8938	8.8511	10.6315	12.1462	13.2823	13.948
Model 2	0.2633	0.7647	1.3279	1.8849	2.3954	2.8228	3.1291	3.2768	2.7825
Model 3	0.3574	1.0398	1.8089	2.5746	3.2876	3.9079	4.3957	4.7104	4.6062
Model 4	0.4806	1.4102	2.4775	3.5703	4.6298	5.6075	6.4505	7.0912	7.3191
Model 5	0.368	1.0562	1.8186	2.5661	3.2486	3.8212	4.2359	4.4414	4.0517
Model 6	0.4629	1.3504	2.3597	3.3827	4.3653	5.2644	6.0328	6.6098	6.9746

Table-4.2Average Displacement in Z Corresponding to (1.2DL + 1.2LL + 1.2EQZ+ve)

Storey	1	2	3	4	5	6	7	8	9
Model 1	0.777	2.2369	3.873	5.515	7.0809	8.5052	9.7169	10.6259	11.1584
Model 2	0.2107	0.6118	1.0623	1.5079	1.9163	2.2583	2.5033	2.6215	2.226
Model 3	0.2859	0.8318	1.4471	2.0597	2.6301	3.1263	3.5166	3.7683	3.685
Model 4	0.3845	1.1281	1.982	2.8562	3.7038	4.486	5.1604	5.673	5.8553
Model 5	0.2947	0.8456	1.4561	2.0547	2.6013	3.0601	3.3925	3.5574	3.2465
Model 6	0.3684	1.0746	1.8777	2.6914	3.4724	4.1862	4.7948	5.2496	5.5279



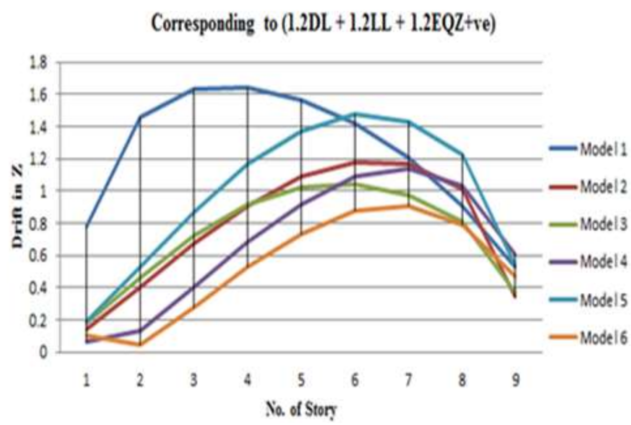


Fig. 4.2 Comparison Curves for Storey Drift (in cm).Vs no. of Storey

Table-4.3Storey Drift in X Corresponding to (1.5EQX+ve + 1.5DL)

Storey	1	2	3	4	5	6	7	8	9
Model 1	0.9713	1.8248	2.0452	2.0525	1.9573	1.7804	1.5146	1.1362	0.6657
Model 2	0.183	0.5084	0.8465	1.1399	1.3603	1.4783	1.4593	1.2678	0.4323
Model 3	0.2235	0.5765	0.9023	1.1414	1.2789	1.308	1.2226	1.016	0.4743
Model 4	0.0811	0.1626	0.5045	0.8506	1.1497	1.359	1.4294	1.296	0.7622
Model 5	0.2406	0.6567	1.0905	1.4555	1.7171	1.8407	1.7895	1.526	0.6772
Model 6	0.1711	0.0147	0.3175	0.6308	0.8987	1.0806	1.1316	0.9899	0.6376

Table-4.4 Storey Drift in Z Corresponding to (1.2DL + 1.2LL + 1.2EQZ+ve)

Storey	1	2	3	4	5	6	7	8	9
Model 1	0.777	1.4599	1.6361	1.642	1.5658	1.4243	1.2117	0.9089	0.5326
Model 2	0.1464	0.4067	0.6772	0.9119	1.0883	1.1826	1.1674	1.0142	0.3458
Model 3	0.1788	0.4612	0.7219	0.9131	1.0231	1.0464	0.978	0.8128	0.3795
Model 4	0.0649	0.1301	0.4036	0.6805	0.9197	1.0872	1.1435	1.0368	0.6097
Model 5	0.1927	0.5259	0.8732	1.1655	1.375	1.474	1.433	1.222	0.5428
Model 6	0.106	0.0424	0.2795	0.5264	0.7373	0.8783	0.9115	0.7867	0.4671

CONCLUSION

Decreasing order for average displacement is **{Model 1>Model 4>Model 6> Model 3> Model 5> Model 2}.**Deflection of the multi-story building structure of model 2 is very less as compare to other models for G+8. Overall conclusions are thatdisplacement at different level in multi-storiedbuilding with shear wall is comparatively lesser as compared to R.C.C. building Without Shear Wall.Models 2 and 5 having shear wall are preferable for construction.Story drift drastically reduced in the bare frame when shear wall is provided in the multi-storey building. After analysis of above results it is clear that shear wall frame interaction systems are very effective in resisting lateral forces induced by earthquake.

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