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COMPARATIVE STUDY ON RCC FRAMED STRUCTURES WITH AND WITHOUT SHEAR WALL AT SEISMIC ZONES II AND V

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Abstract - *Due to the increase in the world population and urbanization, the need for high rise buildings are increasing tremendously. Safety of these buildings should be given greater consideration. High rise buildings may actively get failed due to lateral forces like wind and earthquake. Safety against lateral forces can be achieved by implementing shear walls to the building. In this paper a 10 storeyed framed building at seismic zones II and V is analysed and studied with and without shear wall, where the shear wall is placed at two different location one at centers of sides and other at corners of sides. The modelling and comparative study on storey displacement, storey drift, storey stiffness and base shear of different models is done by using ETABS 17.0.1 version. The optimum location for placing shear wall is found out.*

***Key Words*: Base shear, ETABS, Framed building, Shear wall**

1. INTRODUCTION

Shear walls or structural walls are major lateral load resisting system placed on high rise buildings for the smooth functioning. They provide adequate rigidity and stiffness to the building thus reducing the easiness to failure. The placement of shear wall at advantageous position may act as an efficient and effective method to improve the seismic response of the building. In this paper 3 models of a 10 storeyed framed building at zones II and 3 models at zone V is analysed. Out of 3 first model will be a bare frame, second with shear wall at centers of sides and third with shear wall at corners of sides. The analysis results of base shear, storey drift, storey displacement and storey stiffness give the idea about the importance of having shear wall on RCC buildings and also the optimum position where it can be placed.

1.1 Objectives of study

- To understand the need of shear wall against seismic loading.
- To study the seismic behaviour of building at two different seismic zones.
- Comparison of base shear, storey drift, storey displacement and storey stiffness for buildings with different shear wall location.
- Finally, to find the optimum location for placing shear wall.

2. MODELLING

For this study, a 10-storey framed structure with regular plan is modeled. The buildings are assumed to be fixed at the base and the floors acts as rigid diaphragms. The floor area of the structure is 25x25m.

Model 1: Bare frame at zone II
Model 2: Shear wall placed at centers of sides at zone II
Model 3: Shear wall placed at corners of sides at zone II
Model 4: Bare frame at zone V
Model 5: Shear wall placed at centers of sides at zone V
Model 6: Shear wall placed at corners of sides at zone V

Table -1: Building data

Plan	25x25m
No. of storeys	10
Storey height	3m
Column size	0.6x0.6m
Beam size	0.3x0.35m
Grade of concrete	M30
Grade of steel	Fe 500
Wall thickness	0.23m
Slab thickness	0.15m
Live load	3 KN/m^2
Soil type	II
Damping ratio	5%
Importance factor	1.5
Soil condition	Medium

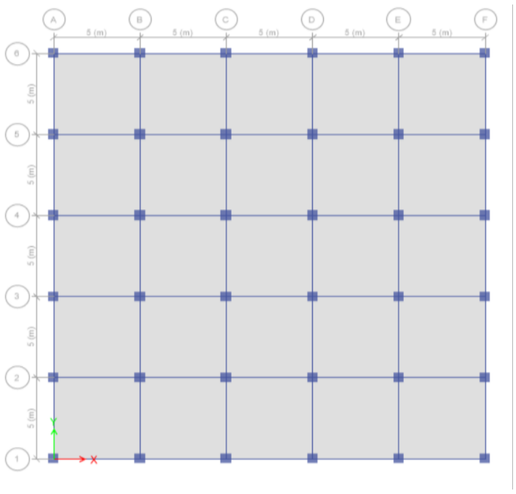

Fig – 1: Plan of model without shear wall

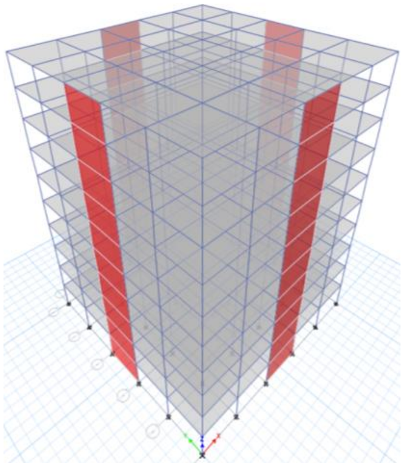

Fig - 4 : Elevation of model with shear wall at centers

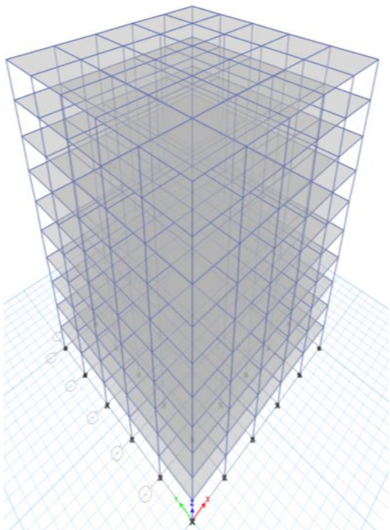

Fig - 2 : Elevation of model without shear wall

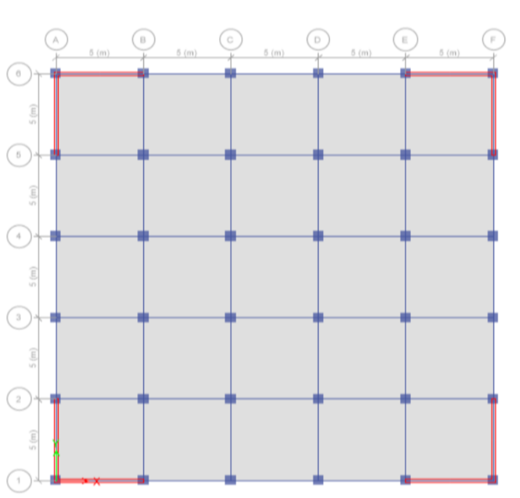

Fig – 5: Plan of model with shear wall at corners

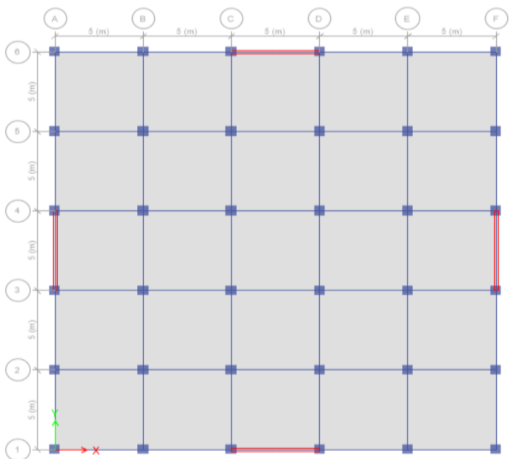

Fig – 3: Plan of model with shear wall at centers

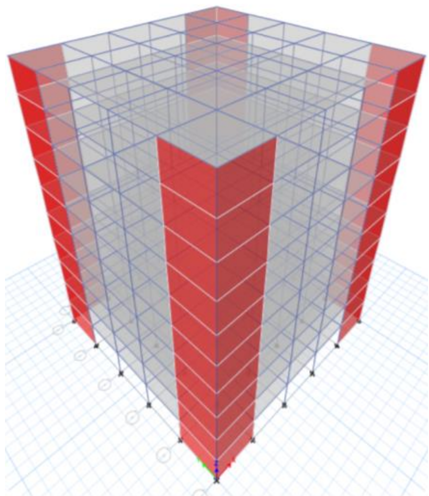

Fig – 5: Elevation of model with shear wall at corners

3. RESULTS AND DISCUSSIONS

The analysis results of all the six models from ETABS using response spectrum analysis method is obtained. The variation in the base shear, storey drift, storey stiffness and storey displacement for all the models in both tabular and graphical format is developed.

3.1 Base shear

The base shear is referred as the estimation of the maximum lateral force at the base of the building due to seismic activity. Table 2 shows the base shear results of the six models at zones II and V. From the table it is clear that in both the zones the model with shear wall at corners of exterior sides have higher base shear thus providing maximum resistance to induced inertia force.

Table -2: Base shear

MODEL	BASE SHEAR (KN)
1	807.17
2	1554.9
3	2418.02
4	2905.8
5	5680.25
6	8828.7

3.2 Storey displacement

Table 3 shows the maximum storey displacement values of each model and fig 6 represents the variation of storey displacement in graphical format. From the result the maximum storey displacement is seen higher for models without shear walls and less for models with shear walls in both the zones. Models with shear wall at corners gives minimum displacement.

Table -3: Maximum storey displacement

STOREY	MAX STOREY DISPLACEMENT (mm)					
	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6
10	8.327	5.737	4.092	29.976	20.654	14.73
9	7.8	5.07	3.604	28.079	18.252	12.974
8	7.189	4.349	3.063	25.879	15.656	11.026
7	6.522	3.753	2.603	23.479	13.512	9.37
6	5.995	3.14	2.146	21.582	11.304	7.725
5	5.228	2.486	1.683	18.82	8.948	6.06
4	4.282	1.85	1.229	15.417	6.659	4.424
3	3.175	1.237	0.803	11.432	4.452	2.891
2	1.922	0.68	0.432	6.921	2.447	1.556
1	0.68	0.229	0.15	2.448	0.825	0.541
BASE	0	0	0	0	0	0

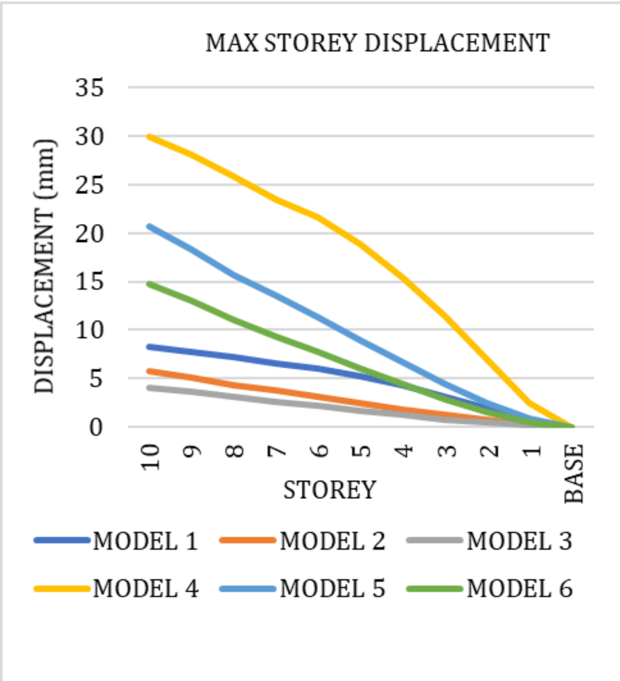

Fig -6: Maximum storey displacement

3.3 Storey drift

Storey drift is defined as the relative movement of each storey with respect to other. Table 4 shows the maximum storey drift values of each model and fig 7 represents the variation of storey drift in graphical format. From the result the maximum storey drift is seen greater for models without shear walls and lesser for models with shear walls in both the zones. Models with shear wall at corners gives minimum drift.

Table -4: Maximum storey drift

STOREY	MAX STOREY DRIFT (10^{-3})					
	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6
10	0.18	0. 233	0. 171	0.65	0.84	0.616
9	0.251	0. 25	0. 18	0.904	0.9	0.65
8	0.304	0. 253	0. 182	1.094	0.912	0.655
7	0.345	0. 25	0.178	1.242	0.899	0.641
6	0.383	0. 243	0.168	1.378	0.874	0.606
5	0.388	0. 223	0.152	1.397	0.804	0.549
4	0.412	0. 212	0.142	1.482	0.762	0.511
3	0.43	0. 186	0.124	1.547	0.668	0.445
2	0.415	0. 15	0.096	1.493	0.542	0.347
1	0.227	0.076	0.05	0.816	0.275	0.18
BASE	0	0	0	0	0	0

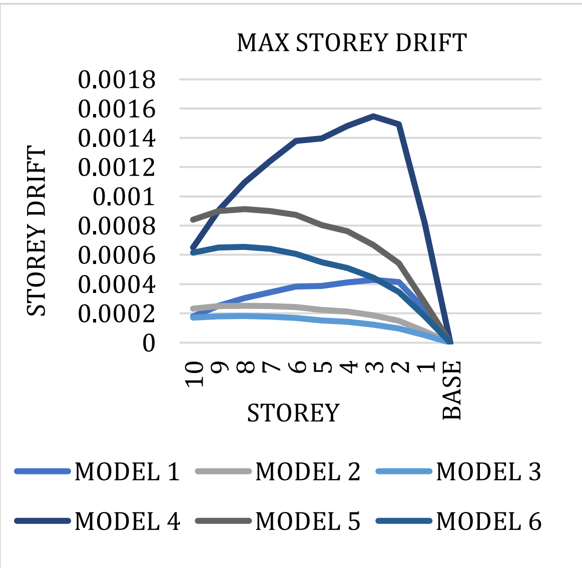

Fig -7: Maximum storey drift

3.4 Storey stiffness

Table 5 shows the storey stiffness results of the six models at zones II and V. From the table it is clear that in both the zones the model with shear wall at corners of exterior sides have higher stiffness compared to others thus providing maximum resistance to lateral forces. The storey stiffness of the bare frame model for both the zones are same and by the addition of shear wall it increases to greater extend.

Table -5: Storey stiffness

MODEL	MAX STOREY STIFFNESS (10^4 KN/m)
1	121.9
2	576.2
3	1070
4	121.9
5	556.8
6	1100

4. CONCLUSIONS

Based on the analysis of the six different building models the following conclusions are drawn:

1. Implementation of shear wall reduces the chance for seismic failure of buildings by imparting greater strength and stiffness.

2. Base shear and storey stiffness of models with shear wall at corners is maximum compared to shear walls placed at centers. This helps to reduce the impact of applied lateral forces.

3. The maximum displacement and maximum storey drift is minimum for corner shear walled models. Thus shows the reduction in the deflection and movement of the building during seismic activity.

4. The optimum position to place shear walls on a multi storeyed building is at the corners of exterior sides since it shows better seismic performance.

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