Comparative Study on Lateral Load Resisting System in High-Rise Building using ETABS

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Abstract: *— Nowadays, the building height is observed more and more slender, and more susceptible to sway and hence dangerous in the earthquake. Such type of the building can be strengthening by providing an appropriate lateral load resisting system. In the seismic design of the buildings, reinforced concrete structural walls or shear-wall, act as major earthquake resisting members. Structural walls provide an efficient bracing system and offer great potential for lateral load resistance. The properties of these seismic shear-walls dominate the response of the buildings and therefore, it was important to evaluate the seismic response of the walls appropriately. In this study the (G+17) storey building was analyze with different shear-wall configuration. The modeling is done to examine the effect of different cases on seismic parameters like base shear, lateral displacements, lateral drifts and model time period for the zone-V in medium soil as specified in IS: 1893-2002.*

Keywords — *Structural wall, Shear wall, Lateral load resisting system, base shear, Lateral displacement, Storey drift, Time period, ETABS*

I. INTRODUCTION

Buildings are experienced various types of loads during its service life. The loads are mainly gravity loads and lateral loads. Ali and patil (2013) said that the primarily purpose of all kind of structural system in building is to support gravity loads. The common loads resulting from the effect of gravity load are dead load, live load and snow load. Other side buildings are also subjected to lateral loads caused by earthquake force and wind pressure.

The structural system of the building has to resist both the gravity load and lateral load.

The structural system of the building may consisting of two component (i) horizontal framing system, it is consisting of slab and beams, which is transfer the vertical loads to the vertical framing system and (ii) vertical framing system, it is consisting of beams and columns, which is transfer the lateral load to foundation. Titiksh and Gupta (2015) said that the selection of a particular type of structural system depends upon two important parameters i.e. seismic risk of zone and the budget. The lateral forces acting on any structure are distributed according to the flexural rigidity of individual components.

Concrete walls made to resist lateral forces acting on the building is known as shear walls. These are vertical elements of the horizontal force resisting systems. These walls are like vertically-oriented wide beams that carry earthquake loads transfer to the foundation. These wall systems are often used for resisting the lateral forces caused by seismic excitation, because of the height of shear walls which would be just sufficient in resisting the lateral loads as good as the shear walls having full height equal to the height of the structure itself.

II. PROBLEM STATEMENT

(G+17) storey residential building along with terrace and different shear wall configuration were analyzed in medium soil in zone-V using ETABS. Below table-1 shows building data.

Table: 1 Building data

Plan Area	25m X 25m
No of storey	18
Typical Storey Height	3.5m
Wall Load	12 kN/m^2 (on external Beam)
	6 kN/m^2 (on Internal Beam)
Floor Finish	1 kN/m^2
Parapet Load	2.3 kN/m^2
Live Load	3 kN/m^2
Beam Size	300mm X 900mm
Column Size	600mm X 600mm
Slab Thickness	150mm
Shear wall thickness	230mm

Grade of Concrete	M30
Grade of Steel	Fe500
Seismic Zone	Zone-V
Soil type	Medium Soil

Model considered for analysis :

Model – 1: Bare frame
Model – 2: Shear wall along periphery
Model – 3: Shear wall at core and periphery
Model – 4: Shear wall at core

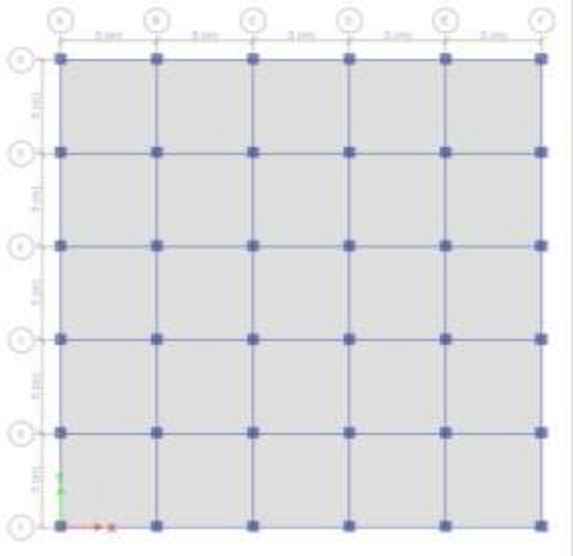

Figure: 1 Bare frame (Plan)

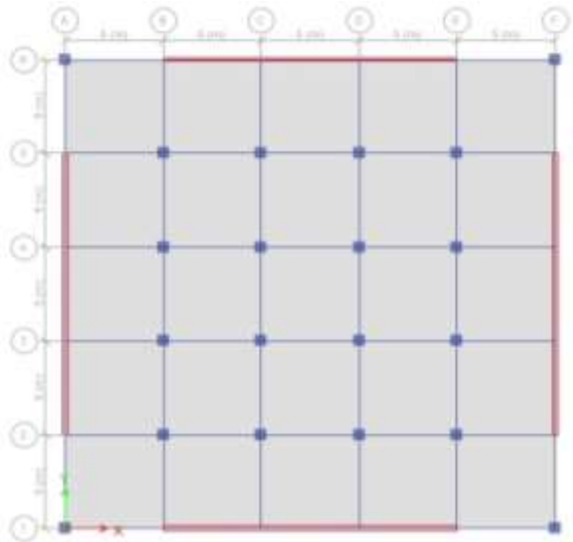

Figure: 2 Shear wall at periphery (Plan)

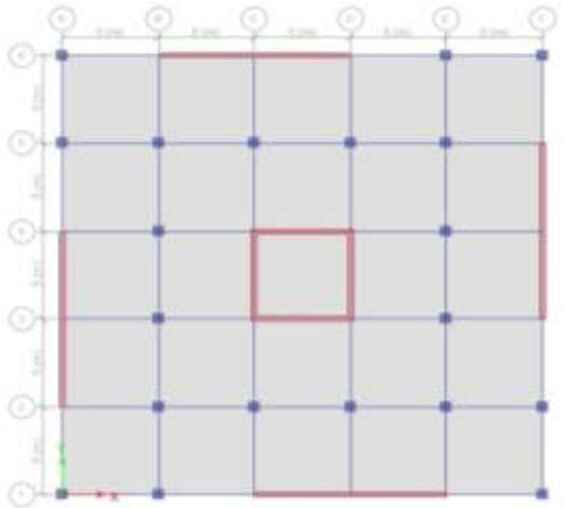

Figure: 3 Shear wall at center and periphery (Plan)

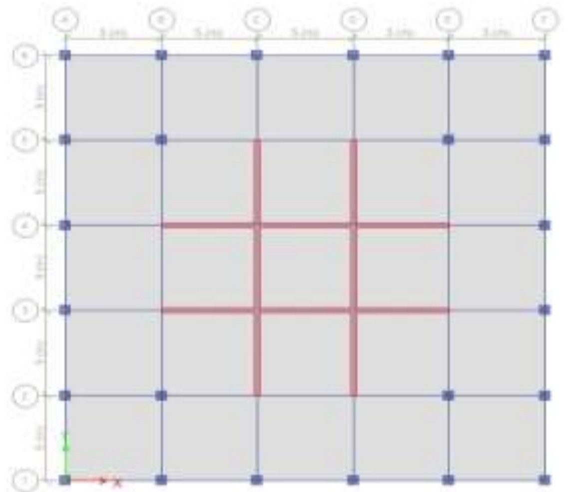

Figure 4 Shear wall at centre

III. RESULT AND DISCUSSION

From the results of analysis, it is observed that the value of base shear, lateral displacement and storey drift in X and Y directions are same.

1. BASE SHEAR

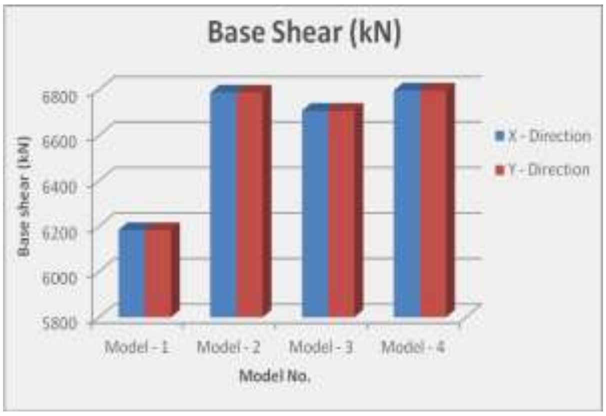

Chart 1 Base shear of models

As the result shows that the shear wall models gives more result than the bare frame model. The base shear in model-2, model-3 and model-4 are increased by 9.7%, 8.5% and 10% compare to model -1. Model-3 shows less base shear compare to other shear wall models.

2. LATERAL DISPLACEMENT

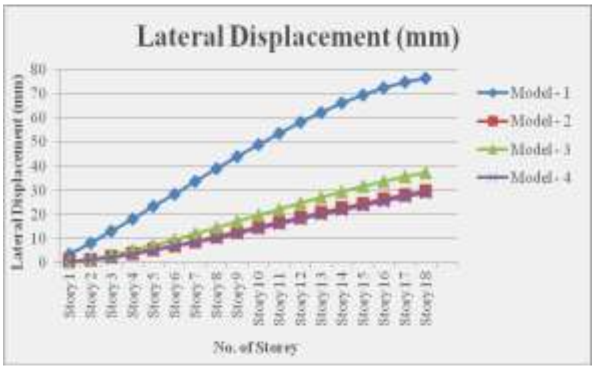

Chart 2 Lateral displacement of models

From above chart 2 it observed that the model-2 and model-4 gives less displacement compare to other models. Model-1 gives more displacement compare to other models. The displacement in model-2, model-3 and model-4 are reduced by 61.74%, 51% and 62% compare to model-1.

3. STOREY DRIFT

Chart 3 Storey drift of models

From above chart 3, it observed that the model-2 and model-4 gives less drift compare to other models. Model-1 gives more drift compare to other model. The drift in model-2, model-3 and model-4 are reduced by 61%, 52% and 62% compare to model-1.

4. TIME PERIOD

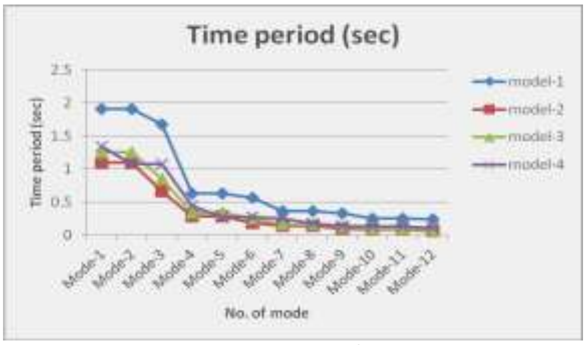

Chart 4 Time period of models

From above chart 4, it observed that the model-2 gives less time period and more in bare frame. It observed that the as the lump mass is increases the time period is decreases respectively.

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IV. CONCLUSION

- From the above equivalent static analysis, The results shows that shear wall model shows more base shear compare to bare frame.
- The bare frame model shows more lateral displacement and drift compare to shear wall models.
- It observed that lateral displacements and drift is significantly lower after inserting shear wall in the bare frame.
- Storey drift of model is within the limit as clause no 7.11.1 of IS**:** 1893(Part-1):2002.
- From the comparison of storey drift values it can be observed that maximum reduction in drift values is obtained when the shear walls are provided at centre (core).
- It observed that shear wall at centre (Model-4) shows maximum reduction in displacement and drift up to 62% compare to bare frame.
- It observed that the shear wall at periphery (model-2) shows less time period than other model.
- It observed that as the lump mass of building is increased the time period is decrease.

REFERENCES

[1] M. Ali and V. Patil, "Studies on Behaviour of Wall-Frame Structure Subjected to Lateral Load," International Journal of Innovation and Research, vol. 2, no. 11, pp. 438–443, 2013.

[2] E. N. Rana, "Structural Forms Systems for Tall Building Structures," vol. 1, pp. 33–35.

[3] A. Titiksh and M. K. Gupta, "A Study of the Various Structural Framing Systems Subjected to Seismic Loads," SSRG International Journal of. Civil Engineering, vol. 2, no. 4, pp. 23–30, 2015.

[4] S. Praveen and G. A. M. Pandian, "ANALYSIS AND EVALUATION OF STRUCTURAL SYSTEMS WITH BRACING AND SHEAR WALL," pp. 1592–1596, 2016.

[5] P. K. S. Sable, E. V. A. Ghodechor, and P. S. B. Kandekar, "Comparative Study of Seismic Behavior of Multistory Flat Slab and Conventional Reinforced Concrete Framed Structures," vol. 2, no. 3, pp. 17–26, 2012.

[6] Bryan staffford smith, alex coull,"Tall Building structures analysis and design" (John Willey and Sons, Inc).

[7] Y. Singh, "Lateral Load Resisting Systems for Multi-Storey Building" pp. 1–21.

[8] IS 1893(part-1):2002, "Criteria for Earthquake resistant design of structures", Bureau of Indian Standards, New Delhi.