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Parametric Study of Buildings with and without Shear Walls for Seismic Performance

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Abstract - *Shear walls are structural systems which provide stability to structures from lateral loads like wind, seismic loads. As shear wall resist major portions of lateral loads in the lowest portions of the buildings and the frame supports the lateral loads in the upper portions of the building which is suited for soft storey high rise building. The properties of these seismic shear walls dominate the response of the building and therefore, it is important to evaluate the seismic response of the walls appropriately. In this present study, main focus is to determine the solution for shear walls behavior in multi-storey building. Effectiveness of shear walls has been studied with the help of six different models. Model one is bare frame structural system, model two is dual frame structural system and model three is a complete shear wall structural system with internal walls in y-direction and model four is a similar model having internal shear walls in x-direction, model five is again a dual frame having columns at exterior and shear walls in interior placed in y-direction and model six is also an dual frame structure having columns at exterior and shear walls at interior placed in x-direction. An earthquake load is applied to a building of G+15 stories located in zone III, type of soil II and various other factors are considered. Parameters like displacement and storey drift are calculated in all the cases replacing column with shear walls and their locations.*

***Key Words*: Static analysis, seismic coefficient method, shear wall, lateral loads, storey drift, displacement, ETAB-2013.**

1.INTRODUCTION

The natural occurrence of seismic activities which results in ground shaking or vibration creates disasters such as failure of structure and fatality. Saving lives is a major responsibility of the structural engineers which can be achieved by saving the structure getting affected from seismic events in a seismic zone. Since 60% of India lies in earthquake prone zone, hence it increases the need of understanding the behavior of earthquake, also constructing and developing earthquake resistant structures. Thus, shear walls are introduced to resist the lateral forces produced during earthquake. They are known as the vertical elements of the horizontal force resisting system. Shear walls in the structure counters the effect of lateral loads acting on structure. Especially, important for high rise buildings, shear walls thus act against lateral forces caused by wind, earthquake and uneven settlement loads. Deep straight walls or angular, U-shaped and box shaped shear walls are being generally used as per requirement in high rise buildings. Six different types of models are been designed in ETABS 2013 and its general graphical and tabular analysis is the henceforth part of this paper work.

2. BUILDING MODELLING

For this Study a G + 15 story building with 4 meters height for each storey, regular in plan is modeled. The models were analyzed in compliance to Indian Code of practice for Seismic Resistant Design of Building. The models are assumed to be fixed at the base and the floors act as rigid diaphragm. The sections of structural elements are rectangular and their dimensions are changed for different group of storeys. The structures are modeled using software ETABS 2013. Six different models were studied with different positioning of shear wall in building. Models are studied in type zone III comparing displacement, storey drift, Base shear etc. for all models. The dimensions of sections were calculated using plastic theories. The dimensions along the grade of concrete were decided according to the imposed loads or moments upon the section.

Table 1:- Preliminary data

No of storey	Sixteen (G+ 15)
Floor to Floor height	4m
Beam size	300x600 mm
Thickness of slab	200 mm
Column size Ground to 5th floor 6th to 10th floor 11th to 15th floor	 800 X 800 mm 700 X 700 mm 600 X 600 mm
Thickness of wall	300mm

Table 2:- Material properties

Storey no	Grade of concrete in column and wall	Grade of concrete in beam and slab	Grade of steel
Ground to 5th	M30	M25	Fe 500
5th to 10th	M25	M20	Fe500
11th to 15th	M20	M20	Fe500

The plans of building model are given below.

Model 1:- Bare frame structure

Model 2:- Dual frame system with shear wall at exterior.

Model3:- Frame having only shear walls with interior walls placed in y-direction

Model 4:- Frame having only shear walls with interior walls placed in x-direction.

Model 5:- Dual frame having columns at exterior and walls placed in interior in y-direction

Model 6:- Dual frame having columns at exterior and walls placed in interior in x-direction

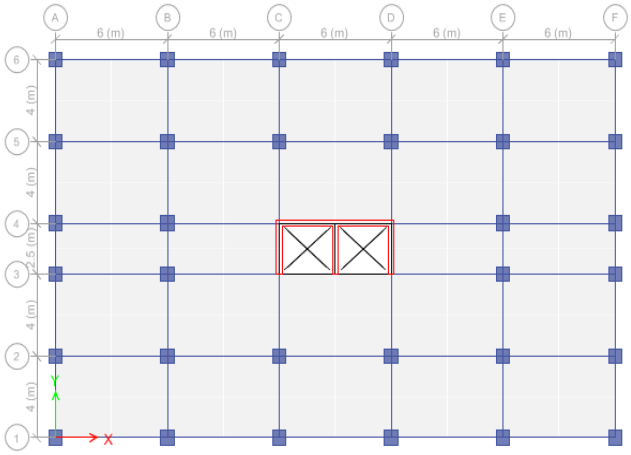

Figure 1:- Model 1

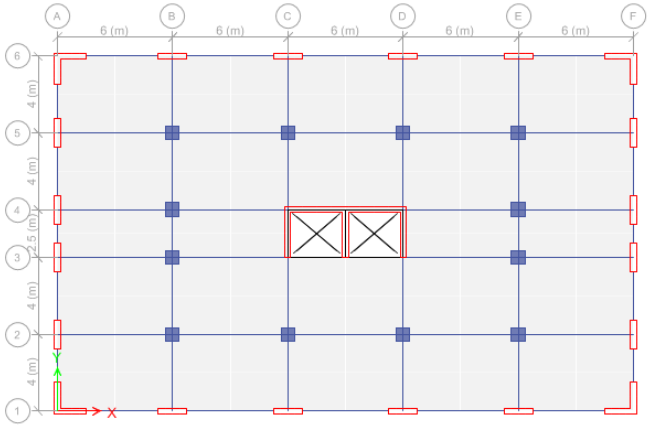

Figure 2:- Model 2

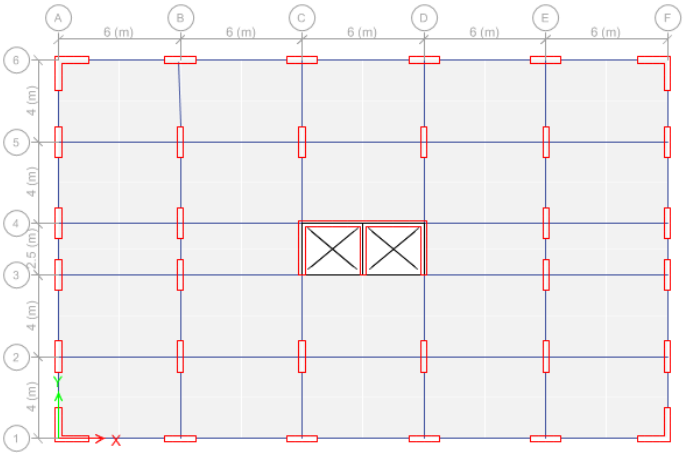

Figure 3 :- Model 3

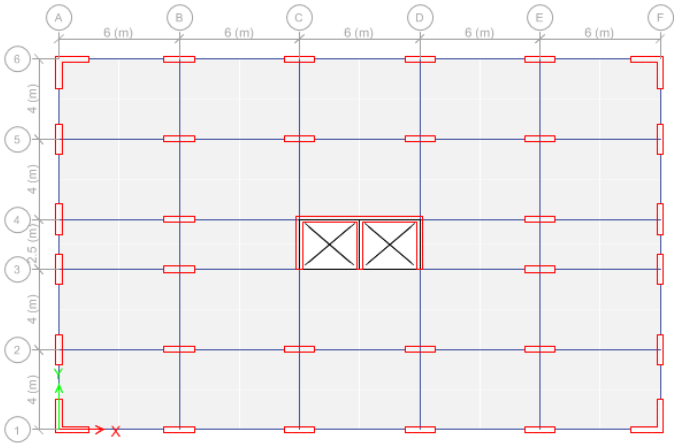

Figure 4:- Model 4

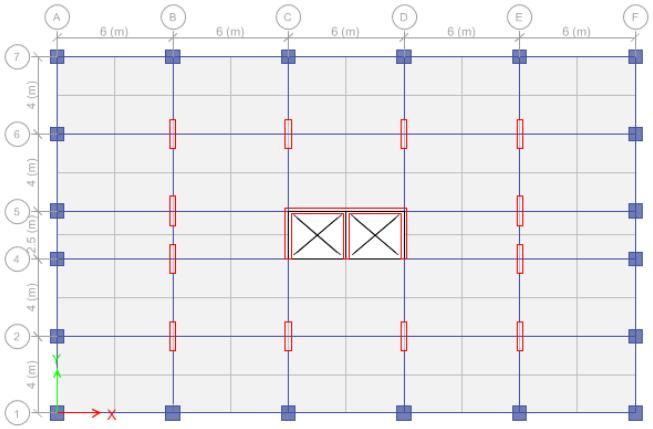

Figure 5:- Model 5

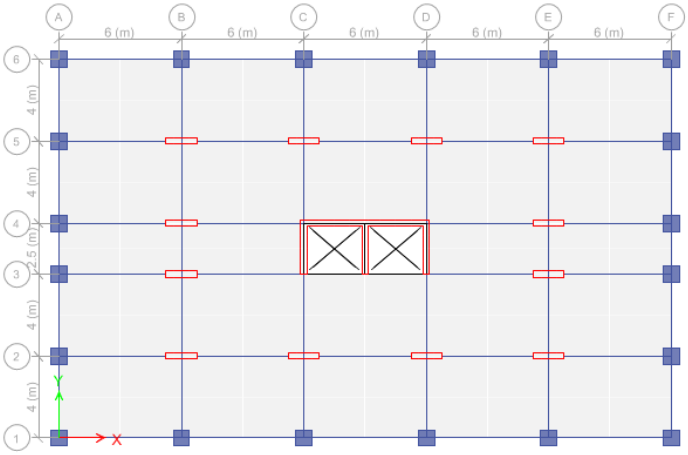

Figure 6:- Model 6

RESULTS AND DISCUSSION

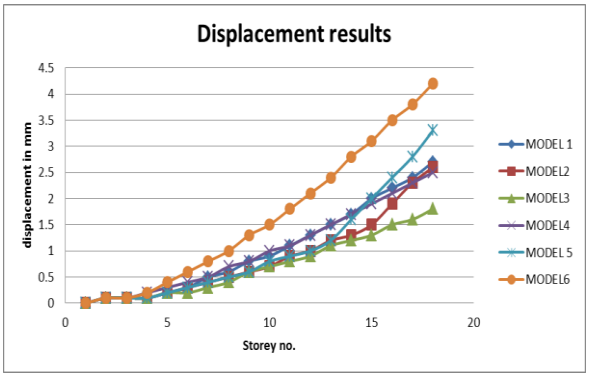

Chart 1:- Displacement of all models

From results it is observed that the displacement of model III is less compared to other models

Storey Drift

Storey drift of all models are as shown are

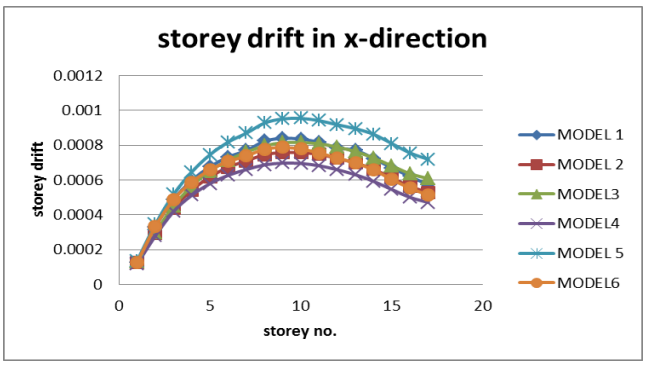

Chart 2:- Storey drift in x- direction for all models

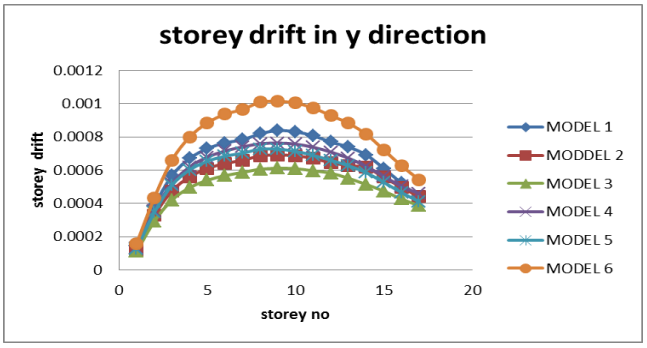

Chart 3:- Storey drift in y- direction for all models

Model 1, Model 2, Model 3 and Model 5 are further compared to find out the stable structure (considering the direction of shear walls)

Chart 4:- Storey drift in x- direction for Model 1, Model 2, Model 3, Model 5.

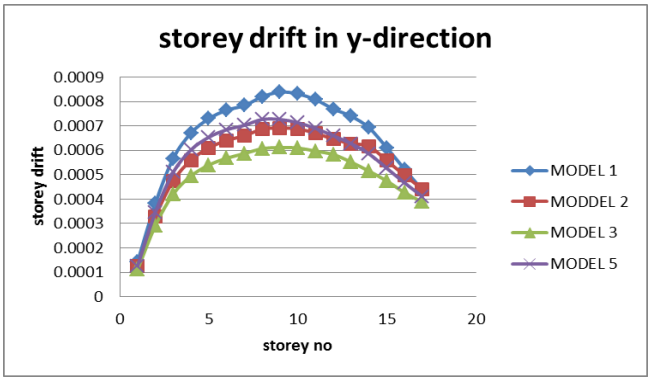

Chart 5:- Storey drift in y- direction for Model 1, Model 2, Model 3, Model 5.

Model 1, Model 2, Model 4 and Model 6 are further compared to find out the stable structure (considering the direction of shear walls)

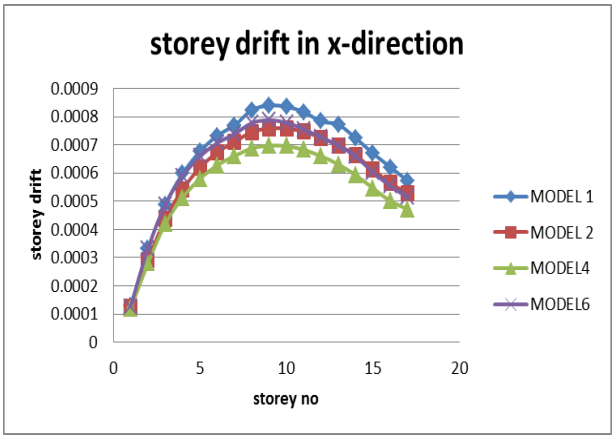

Chart 6:- Storey drift in x- direction for Model 1, Model 2, Model 4, Model 6.

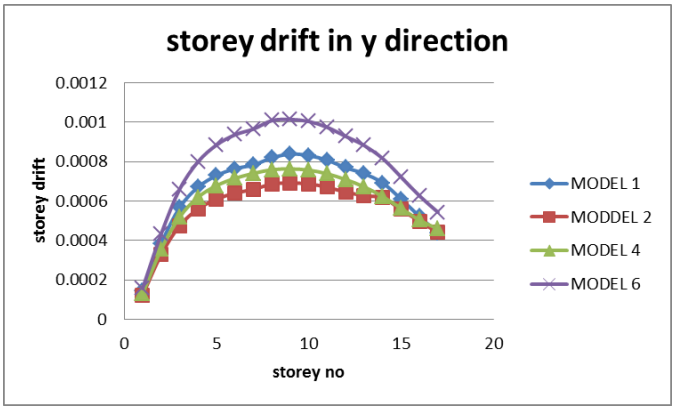

Chart 3:- Storey drift in y- direction for Model 1, Model 2, Model 4, Model 6.

CONCLUSION

It can be summmarized from the above graphs that implementation of shear walls adds stability to structure. The above graphs shows that a bare frame structure and the structure having walls column at exterior and shear walls at interior are unstable than the model having only and the models having shear walls at corner and interior filled with columns. However by displacement graphs it can be seen that the models having only shear wall is effective than Model no. 2. Hence it can be concluded that the Structure with shear wall only is more stable during seismic activities.

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