Effectiveness of Changing Reinforced Concrete Shear Wall Location on Multi-storeyed Building

P. S. Kumbhare[1], A. C. Saoji[2]

1-Post Graduate Student in Structural Engineering, 2-Associate Professor, Civil Engineering Department,
Babasaheb Naik College of Engineering, Pusad- 445215, Maharashtra
Sant Gadge Baba Amravati University, Amravati, Maharashtra 444602

ABSTRACT

Shear wall is one of the most commonly used lateral load resisting in high rise building. Shear wall has high in plane stiffness and strength which can be used to simultaneously resist large horizontal load and support gravity load. The scope of present work is to study the effect of seismic loading on placement of shear wall in medium rise building at different alternative location. The residential medium rise building is analyzed for earthquake force by considering two type of structural system. i.e. Frame system and Dual system. Effectiveness of shear wall has been studied with the help of four different models. Model one is bare frame structural system and other four models are dual type structural system. Analysis is carried out by using standard package ETAB. The comparison of these models for different parameters like Shear force, Bending Moment, Displacement, Storey Drift and Story Shear has been presented by replacing column with shear wall.

Keywords: - Effectiveness, Frame Structure, Location, Shear Wall, Structural System, Muilt-storyed Building.

1. INTRODUCTION

Reinforced concrete shear walls are used in building to resist lateral force due to wind and earthquakes. They are usually provided between column lines, in stair wells, lift wells, in shafts that house other utilities. Shear wall provide lateral load resisting by transferring the wind or earthquake load to foundation. Besides, they impart lateral stiffness to the system and also carry gravity loads.

Reinforced concrete framed buildings are adequate for resisting both the vertical and horizontal load. However, when buildings are tall, beam and column sizes are quite heavy. So there is lot of congestion at these joint and it is difficult to place and vibrate concrete at these place and displacement is quite heavy which induces heavy forces in member. Shear wall behave like flexural members. They are usually used in tall building to avoid collapse of buildings. Shear wall may become imperative from the point of view of economy and control of lateral deflection. When shear wall are situated in advantageous positions in the building they can form an efficient lateral force resisting system. In this present paper one model for bar frame type residential building and four models for dual type structural system are generated with the help of ETAB and effectiveness has been checked.

2. BUILDING DISCRIBTION

A Building considered is the residential building having (G+11) stories. Height of each story is 3.1m. Other details are given below.

Zone	III
Response Reduction Factor	5
Importance Factor	1
Soil Condition	Medium
Height of Building	38.7 m
Depth Of foundation	1.5 m
Size of Column:-	
Interior column	500mm x 500mm
Side column	300mm x600mm
Corner column	500mm x500mm
Size of Beam	300mm x 450mm
Thickness of slab	150 mm
Thickness of Shear wall	230 mm
Live Load	3 KN / m^2
Floor Finish	1 KN / m^2
Material Properties	Concrete Grade M20
	Steel Grade Fe 415

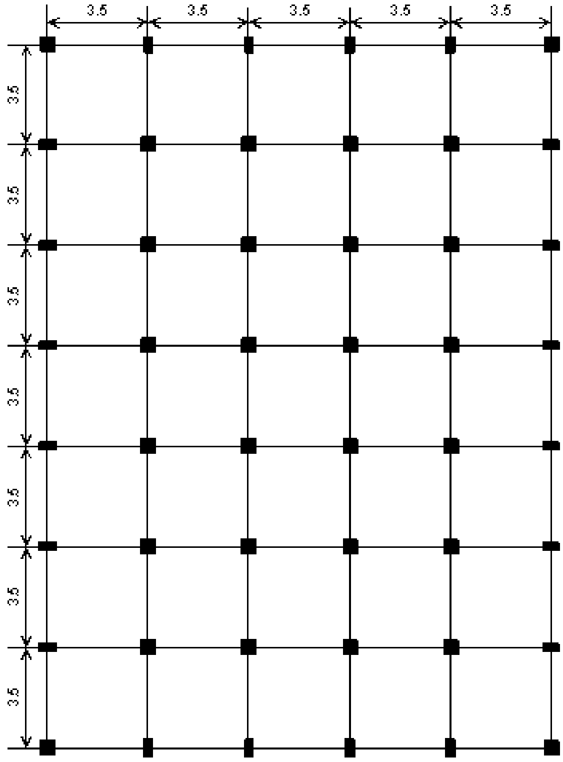

Figure.1 : Structural Plane

3. MODELLING AND ANALYSIS

Building is modeled using stander package ETAB. Beams and columns are modeled as two noded beam elements with six DOF at each node. Shear wall are modeled using shell element. Equivalent static analysis or linear static analysis is performed on models. Based on analysis result parameters such as bending moment, shear force in column, displacement, storey drift and storey shear are compared for each model. The following models have been considered.

Model I :- Bare frame without shear wall.

Model II :- Dual type structural system with channel shape of shear wall

Model III :- Dual type structural system with L shape of shear wall.

Model IV :- Dual type structural system with rectangular Shape of shear wall.

Model V :- Dual type structural system with Box shape of shear wall.

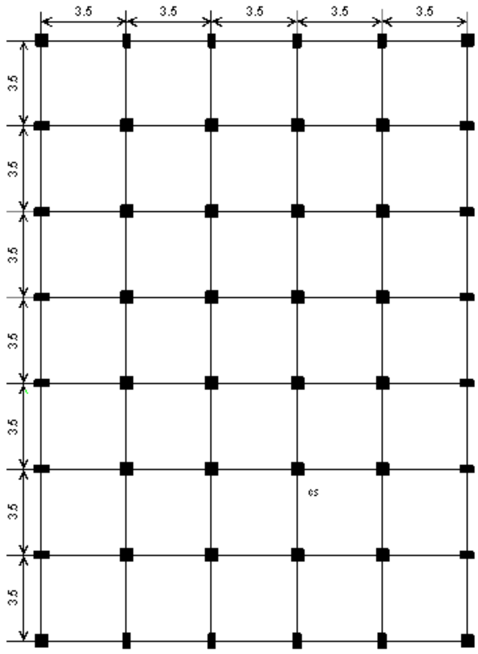

Figure. 2: Model I

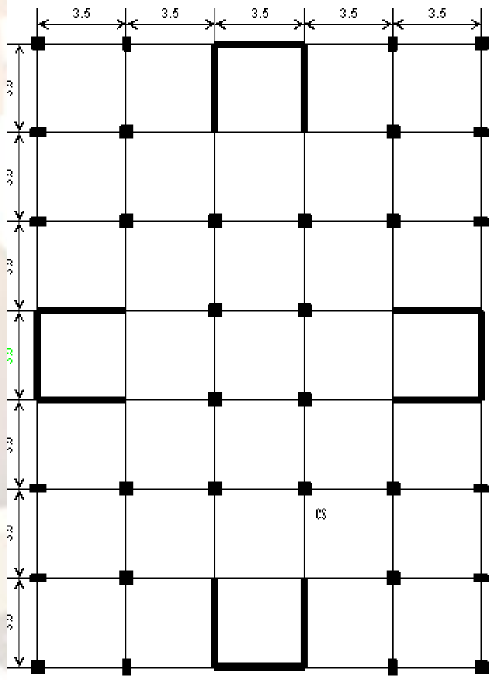

Figure.3 : Model II

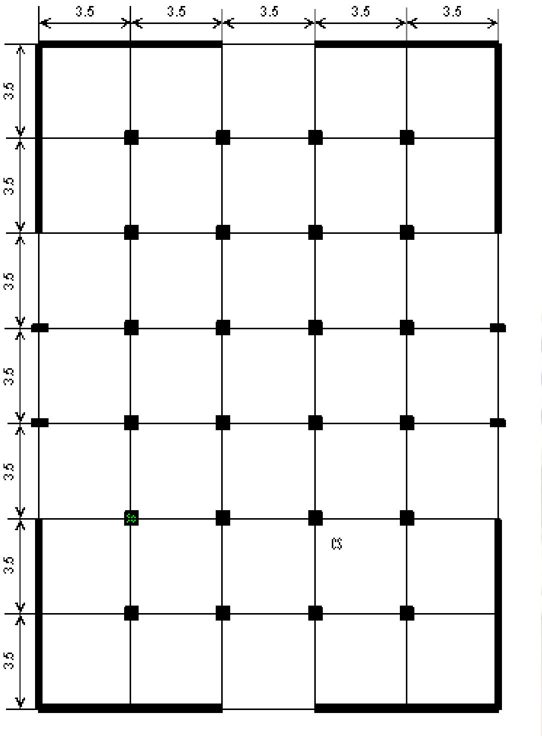

Figure.4 : Model III

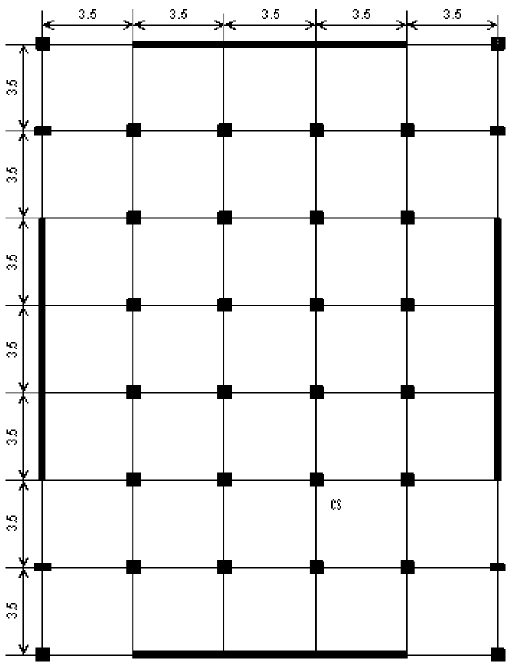

Figure.5 : Model IV

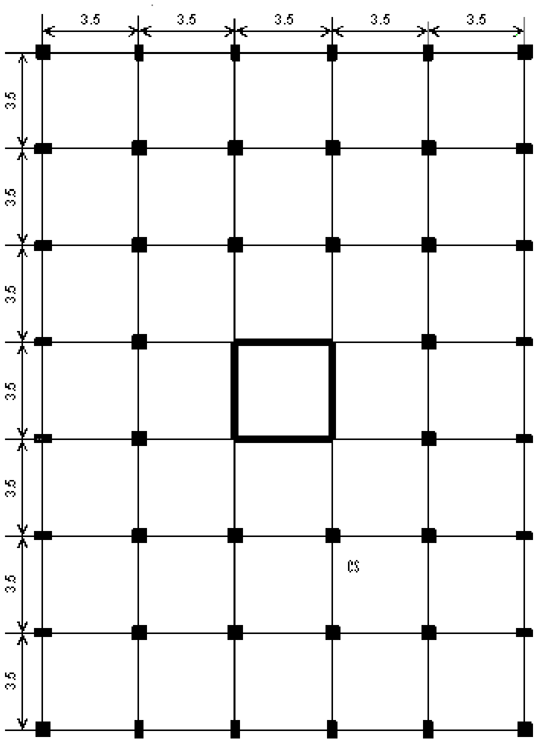

Figure. 6 : Model V

4. RESULT AND DISCUSSION

4.1 Lateral Displacement

Lateral Displacement of models at each floor level is shown in Fig. 7

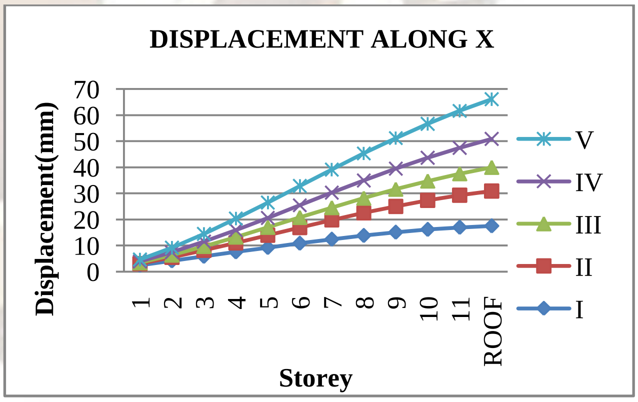

Figure 7: Lateral Displacement

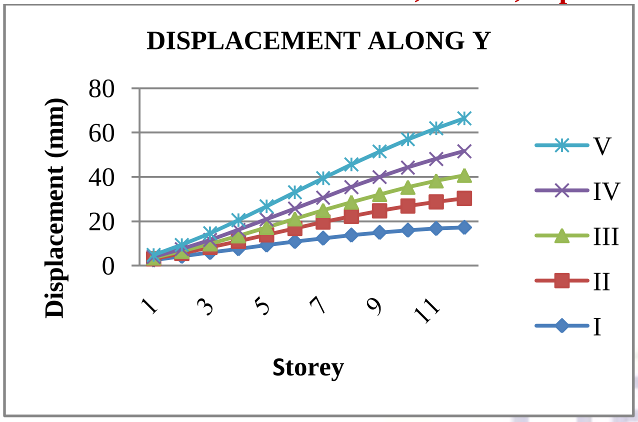

Figure 8: Lateral Displacement

From result observed that the displacement of Model II, Model V reduced up to 20-30 % as compared with bare frame model. Where as in model III and IV maximum displacement also reduced up to 30-50 % as compared with bare frame.

4.2 Storey Drift

Storey Drift for different models as shown in figure. 8.

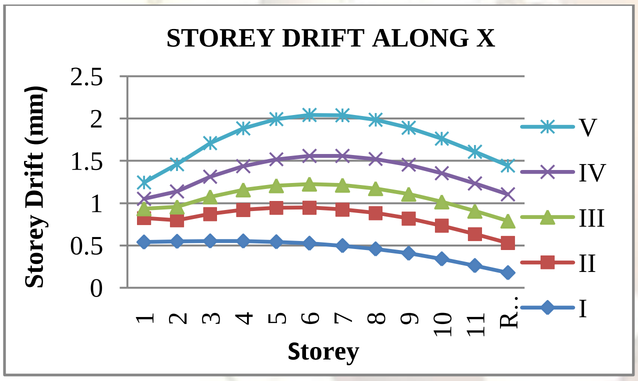

Figure 9: Storey Drift

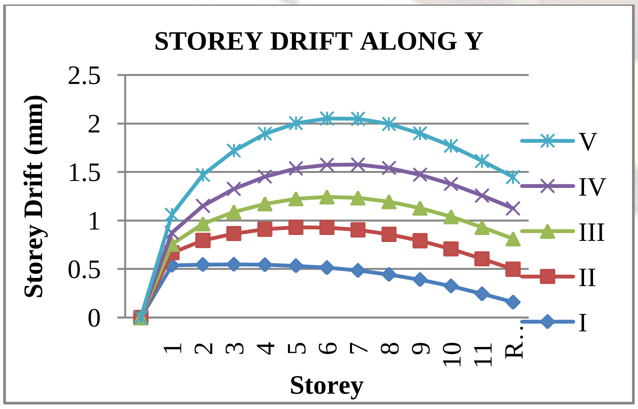

Figure 10: Storey Drift

From result observed that drift is increased as height of building increased and reduced at top floor.

4.3 Storey Shear

Storey Shear for different models are as shown in figure.9

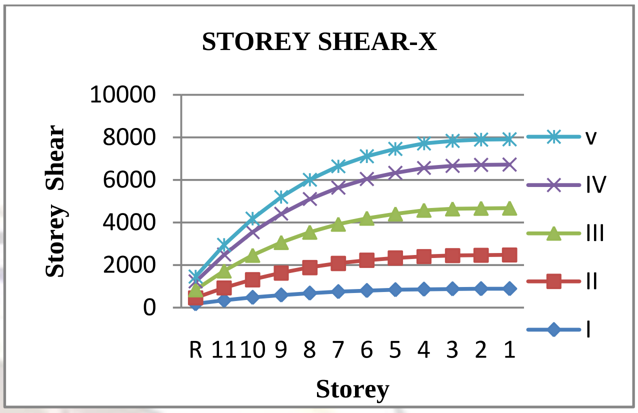

Figure 11: Storey Shear

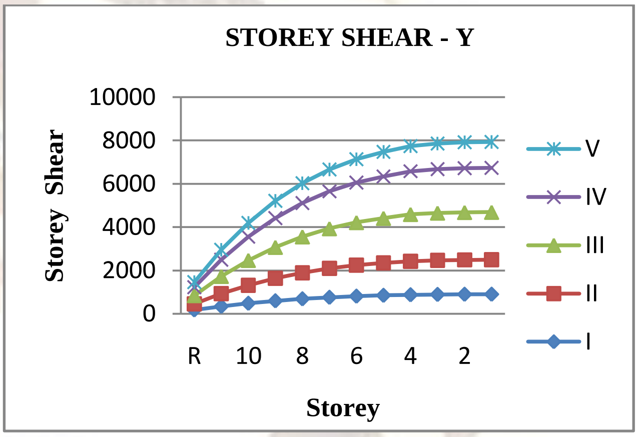

Figure 12: Storey Shear

4.4 Bending Moment And Shear Force in column

Maximum Bending Moment and shear force in column as shown in Fig. It is observed that shear force decreases up to 75-85 % in model II, model III, model V as compared to the bare frame and bending moment up to 75-90 % decreases is observed.

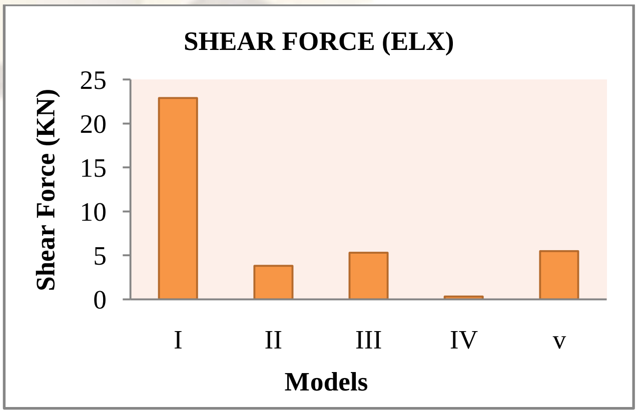

Figure 13: Shear Force (ELX)

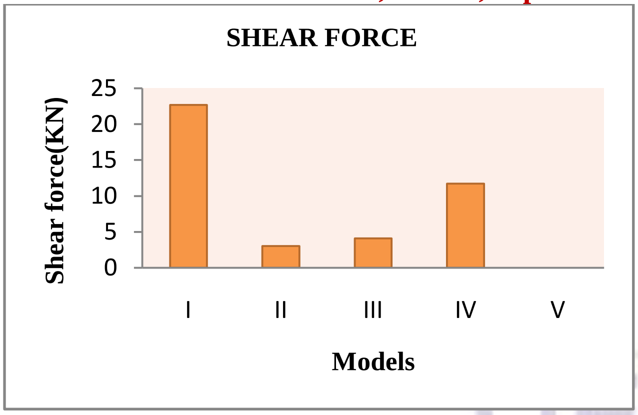

Figure 14: Shear Force (ELY)

Bending Moment

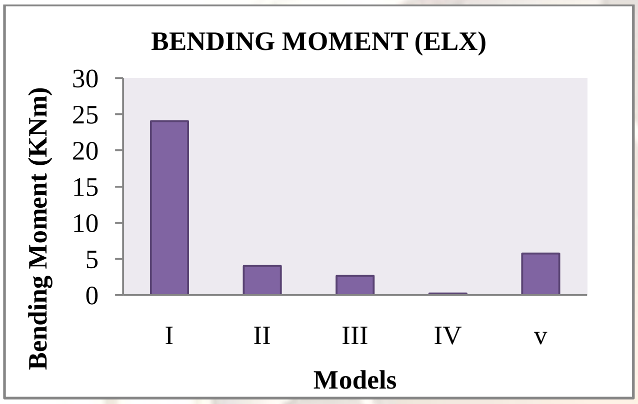

Figure 15: Bending Moment (ELX)

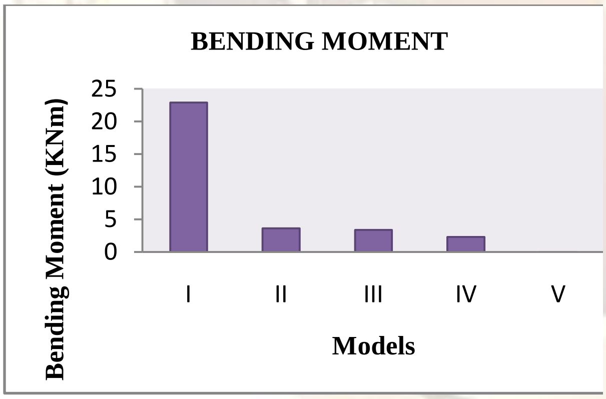

Figure 16: Bending Moment (ELY)

5. CONCLUSION

From above results it is clear that shear wall frame interaction systems are very effective in resisting lateral forces induced by earthquake. The study indicates the significant effect on shear force and bending moment of column at different levels of the building by shifting the shear wall location. Placing shear wall away from center of gravity resulted in increase in the most of the members forces. It follows that shear walls should be coinciding with the centroid of the building. For residential building shear walls can be used as a primary vertical load carrying element, thus serving the load and dividing space. The frame type structural system become economical as compared to the dual type structural system can be used for medium rise residential building situated in high seismic zone.

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