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Optimum Location of Shear Wall in RCC Building

Akash Kavani[1] , Arjun Butala[2] , Nirmal Mehta[3] , Siddharth Moteriya[4]
[1]*PG Student, Department of Civil Engineering U.V.P.C.E., Ganpat University at Kherva, India.*
[2]*Professor, Department of Civil Engineering U.V.P.C.E., Ganpat University at Kherva, India.*
[3]*Professor, Department of Civil Engineering U.V.P.C.E., Ganpat University at Kherva, India.*
[4]*Structure Engineer at SAM Structure Consultant-Rajkot, India.*

Abstract
In tall RCC buildings, lateral loads are critical in analysis and design. As the building height increases, stiffness becomes more important than strength for bearing these loads. Shear walls offer an effective solution with their high stiffness and strength, utilizing axial, shear, and bending actions to mitigate lateral loads. By doing so, shear walls decrease the moment and shear demands on other structural components. The proper positioning and location of shear walls within a building structure significantly influence its seismic performance against lateral loads. Inadequate placement of shear walls can introduce eccentricity, leading to torsional effects in the building system. This study focuses on determining the optimal location of shear walls in an RC building using software. The ETABS software is utilized to model RC buildings, and the analytical results are compared based on storey drift and story displacement.
Keywords: *Shear walls, location of shear walls, shape of shear walls, ETABS software.*

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I. INTRODUCTION

In structural engineering a shear wall is a vertical element of a system that is designed to resist in-plane lateral forces, typically wind and seismic loads. A shear wall resists loads parallel to the plane of the wall. Collectors, also known as drag members, transfer the diaphragm shear to shear walls and other vertical elements of the seismic force resisting system. Shear walls are typically light-framed or braced wooden walls with shear panels, reinforced concrete walls, reinforced masonry walls, or steel plates. The materials can be used to construct shear wall are wood, steel, masonry, concrete. And can be of different shapes like rectangular, C-shape, T-shape, L-shape, U-shape, W-shape etc.

II. LITERATURE REVIEW

2.1 Type of soil

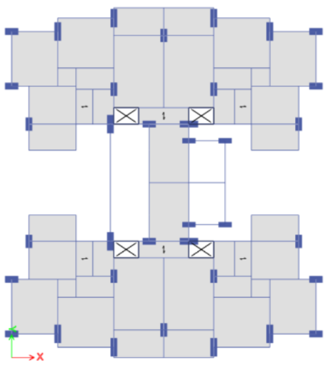
Anand, N., Mightraj, C., and Prince Arulraj, G. discovered that all three types of soil had identical base shear values. When the soil type shifts from hard to medium and then from medium to soft, the base shear values rise. For all construction frames, the lateral displacement value rises when the kind of soil shifts from hard to medium and then from medium to soft. When the kind of soil shifts from hard to medium to soft, the axial force and moment in the column increases. When constructing frames for seismic force, soil structure interaction must be appropriately taken into account since soil type variations affect the base shear, axial force, column moment, and lateral displacement.

2.2 Effect of wind in different direction

The pressure distribution on regularly used irregular-plan buildings was researched by M. Glória Gomes, A. Moret Rodrigues, and Pedro Mendes. Wind tunnel tests on L and U-shaped models were performed over a wide variety of wind directions. It was discovered that the shape of the building and the wind incidence angle can significantly alter the pressure distribution. Additionally, the measured pressure distributions and the mathematically determined flow patterns near the inner faces of these buildings with irregular plans are in agreement. When it comes to analysing flow patterns and velocity magnitude, it is important to consider both pedestrian comfort and the environment's air quality.

2.3 Different location of shear wall

In order to determine parameters like storey drift, base shear, maximum allowable displacement, and torsional irregularity, Shaik Akhil Ahamad and K.V. Pratap studied the dynamic analysis of a G+20 multi-story residential building provided with shear wall in various locations for different seismic zones. In this project, the dynamic analysis was carried out on type -III (soft soil) for an irregular structure in plan in all the zones as



specified, and it was found that the structure with shear wall, that is, the case where building with shear wall at four corner, was constructed in all the seismic zones of India as specified by IS 1893 (Part1) -2016.

2.4 Seismic behavior changes design

D. K. Kulkarni and Punashri Prakash Phadnis explored five different models of G+3 and G+10-story RCC frames with various shear wall configurations. The analysis was performed using ETABS and is based on the equivalent static and response spectrum methods carried out in accordance with IS 1839-2002 (Part-I). Their seismic performance was evaluated by performing elastic time history analysis for the analysis recorded of the El Centro, California, earthquake. Different parameters, including the fundamental natural period and lateral displacement, are calculated in this study.

2.5 Earthquake loads in different seismic zone

Sylviya B,P. Eswaramoorthi studied G+4 storey RCC frame which is subjected to Earthquake loading in different seismic zone and different model is there by changing the location of shear wall by using ETABS Seismic analysis performed by linear dynamic response spectrum method which is used to calculate the earthquake load as per IS 1893-2002 (Part I). Four different model like Structure without shear wall, structure with Shear wall at periphery, structure with shear wall at intermediate shear wall, structure with shear wall at core were model for analysis. The result has been calculated on the basis of parameter like storey displacement, storey shear and maximum storey displacement for each model It is studied the structural wall are most effective when placed at the periphery of the building.

III. MODELING AND METHEDOLOGY

There are various types of shapes in Shear walls, including Rectangular, L-shape, C-shape, T-shape are most commonly adopted. Location of shear wall is also very important. All types of shape and location have their own importance. In this study 4 models are design with different numbers of shear walls having different grade of concrete as follow:-

From Plinth lvl to 3rd floor slab lvl = M40

From 3rd to 8th floor slab lvl = M35

From 8th to top lvl = M30

3.1 Design Parameters

To compare with or without shear wall following data are selected for modelling work in software. The dimension of residential building (21.02 × 19.72)m with (P+14) plan is taken.

Table 1: Design Data

Types of building	Residential
Height of building	46.95 m
No. of storeys	P+14
Slab thickness	150mm
Shear wall thickness	300mm
Loads considering	As per IS-875-2015(part-1 to 5), IS-1893-2016
Software	ETABS
Grade of concrete	M40, M35, M30
Grade of Reinforcement	HYSD Fe-500
Seismic Zone	III
Column Size	(450×1250)mm, (450×900)mm
Beam Size	(300×600)mm

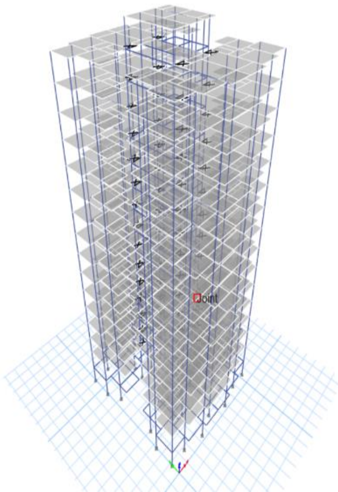


Figure 1: Having column only

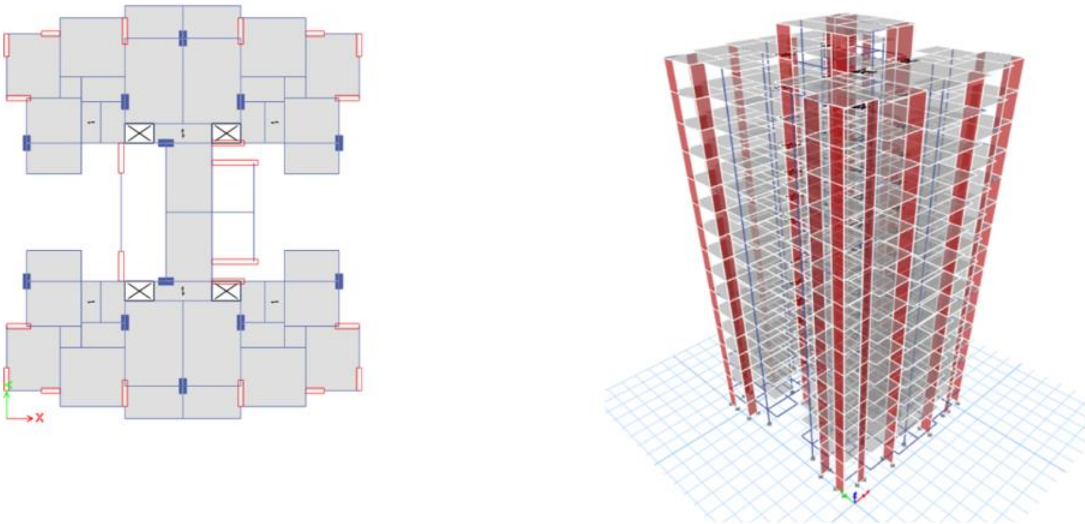


Figure 2: Having column with Straight Shear Wall

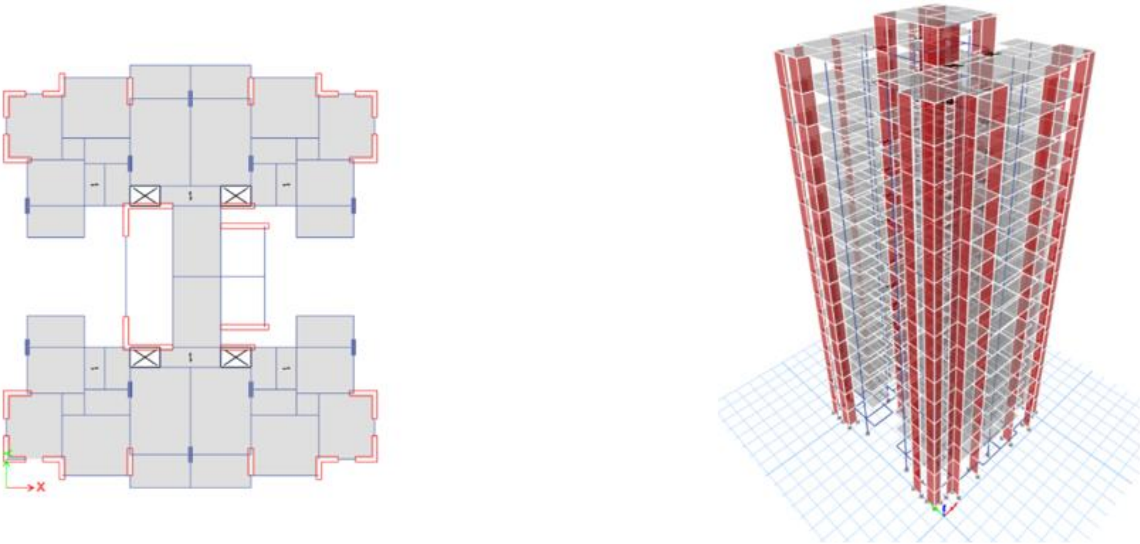


Figure 3: Having column with Shear Wall (L-shape)

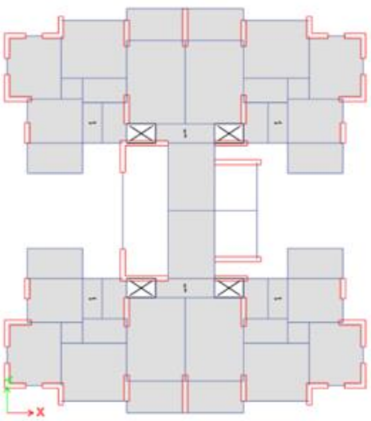
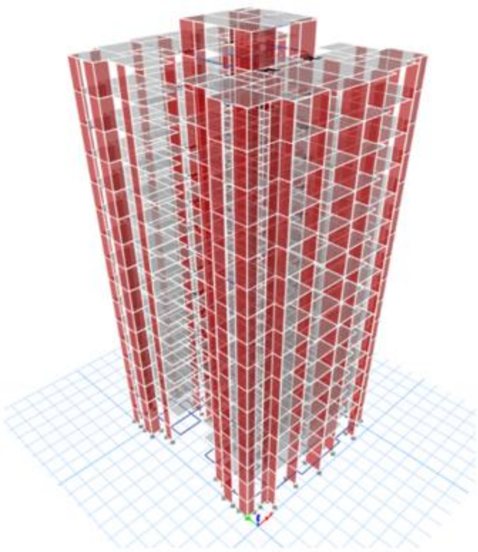



Figure 2: Having only Shear Wall

3.2 Result Comparison

The comparison of all models for different criteria like story displacement and story drift is done.

Story Displacement:-

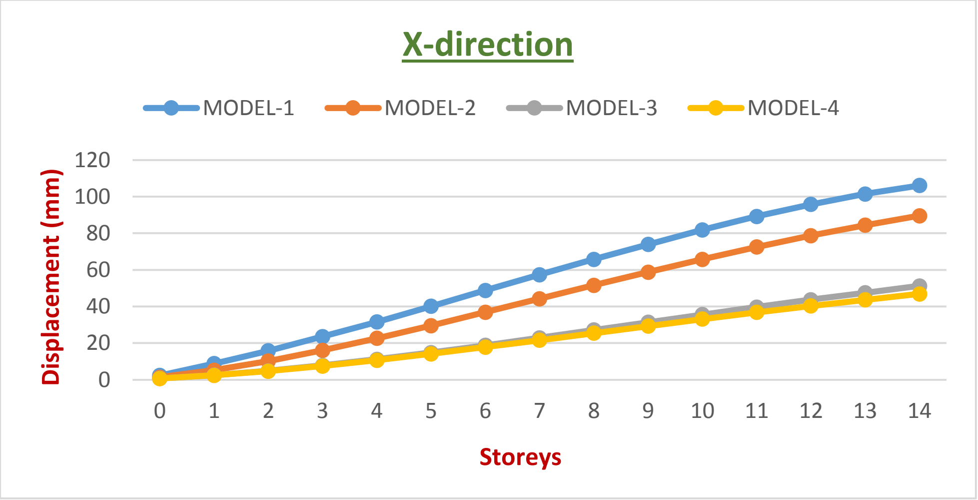


Figure 5: Storey Displacement in X-direction

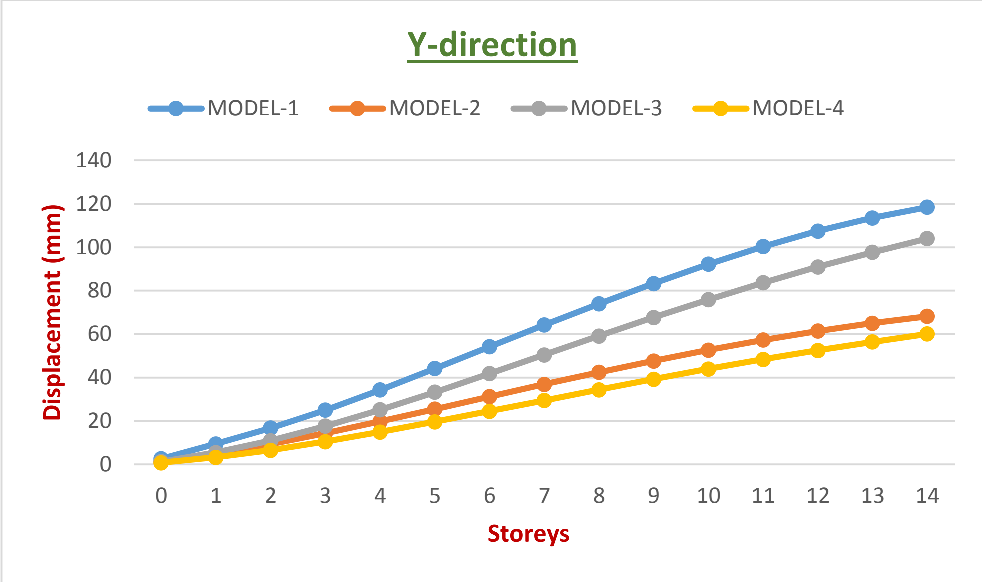


Figure 6: Storey Displacement in Y-direction

Story Drift:-

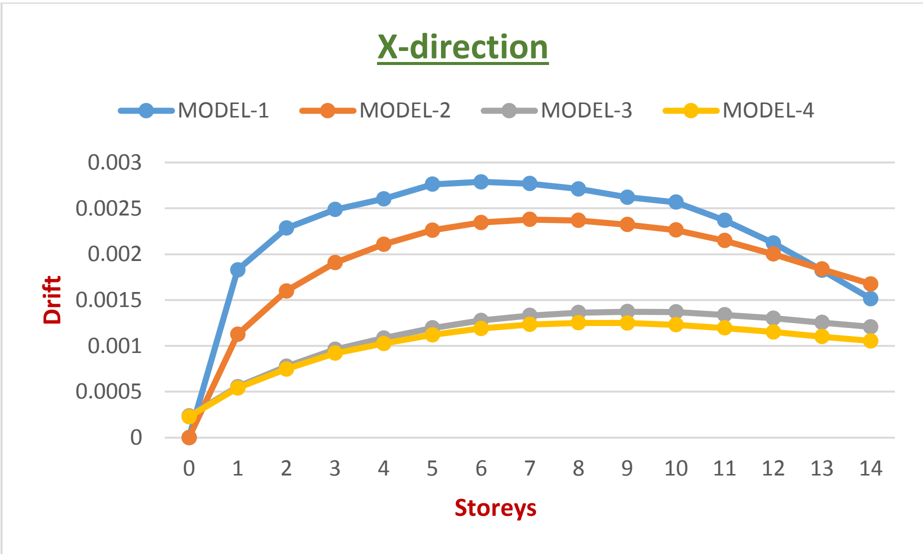


Figure 7: Storey Drift in X-direction

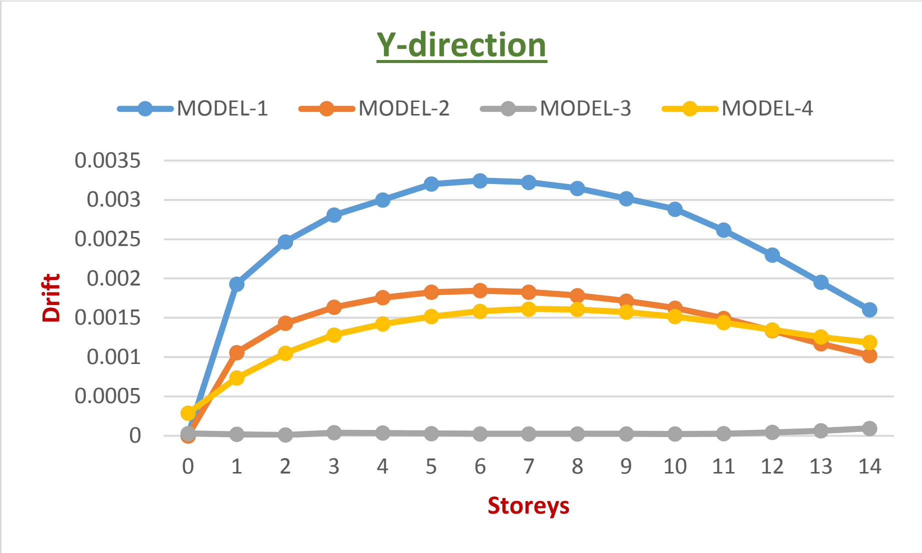


Figure 8: Storey Drift in Y-direction

IV. CONCLUSION

By using ETABS software the important parameters of shear wall can be extracted. After analyzing the all data, it is concluded that,

- Storey displacement of building decreases.
- Story drift of the building decreases.
- Axial load on column decreases.
- Story stiffness increases.
- Optimum location of shear walls are at, combination of outer periphery and internal also.

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