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Comparison of A G+4 Building With and Without Shear Wall

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ABSTRACT: The intention of this study is to find the best suitable structural system to resist the earthquake and then explore the effectiveness of shear wall in order to minimize the impact of the structural damage due to the earthquake. Due to limited availability of the land, there is increased incidence of high-rise buildings and thus lateral loads come into the picture. Therefore, now more often, we need to take lateral loads into consideration while designing buildings, especially skyscrapers. Same concept also holds good for earthquake loads. A building, which is designed for lateral loads like that of wind load, can also resist the earthquake forces up to some extent. The structure is analyzed for earthquake load in both the types of structural system i.e. shear wall and then it is compared with reinforced concrete frame system. The system help in controlling the deflection by increasing the stiffness of the structure. In this project, study of 5-storey building is presented with some investigations which are analyzed in zone- In this paper complete analysis and design used with STAAD Pro V8i. Comparison of these models for different parameters like amount of concrete used, amount of steel used and cost of the structure carried out. Deflection and bending moments are calculated on different structural systems in order to figure out the better structural system in resisting the earthquake loads.

KEYWORDS: Lateral load, shear wall, Stiffness, High-rise building, Deflection, Cost

I. INTRODUCTION

Reinforced concrete constructing is most commonplace sort of production in India. While tall buildings are constructed those building have problems to undergo lateral deflection due to lateral load and moment at base. Shear partitions are furnished as a structural member to face up to lateral masses due to earthquake and wind with the aid of growing the stiffness of high upward push building in region of infill partitions. A shear wall is a structural member composed of braced panels to counter the consequences of lateral load appearing on a shape. Wind and seismic loads are the most well known hundreds that shear partitions are designed to carry. The shear wall accepts a shear of proportional to lateral playback for its pressure. Behaviors of RC frames with shear wall have been studied by quantity of researchers experimentally and analytically. End is made by using them that shear wall have an impact on the seismic response substantially. Use of shear wall or improves the overall performance of RC body shape. A shear wall decreases lateral deflections, storey's flow and bending moments inside the body and for this reason reduces the probability of crumble. In distinctive earthquake zones, behavior of members is special. Earthquake zones in keeping with IS CODE: 1893.1.2016 is considered. Throughout the earthquake, it's far the destruction of homes and systems that on the whole purpose lifestyles-loss. The large quantity of harm associated with earthquake and the ensuing lack of life displays terrible manufacturing practice in India.

(A) Lateral Loads

Most of the lateral loads are live loads they act as a horizontal load on structure and cause structure to drift and sliding. Some important lateral loads are seismic load, wind load, and earth pressure against a basement of wall. Study of this type of lateral load has become one of the most important issues for a structural engineer. These lateral loads depend on the type of structure. They are important because if they are neglected they can cause a catastrophic failure.

(B) Shear Walls

Reinforce concrete building have vertical plate like RC walls called shear wall, in addition to slab beam and columns. These are like wide beams which are vertically placed. These wall start at base level and are continuous throughout the structure height. Their thickness can be as low as 150 mm or high as 400mm in tall buildings. Shear walls have high stiffness and strength, so shear walls can resist lateral loads as well as support gravity loads and this make these walls very useful in reinforced concrete structures. Lateral sway of high rise buildings can be controlled up to a great extent by using shear walls in construction. Shear walls can be located as exterior wall and also can be

interior. Shear walls are more effective when these are located along exterior perimeter of building. Shear wall is stiffer in its plane as compare to other planes. It is considered to be a primary structure that offers relatively rigid resistance to the vertical and horizontal forces operating in its plane. Under the condition of this joint loading, a shear wall develops shear, axial, tensional and flexural strain, resulting in a complex internal stress distribution. In this way, the load has been shifted vertically to the foundation of the building. Therefore, there are four important failure mechanisms. Factors that determine the failure mechanism include geometry, loading, physical properties, restraint and construction. There are provided in multi-storeyed buildings. Properly design and detailed RC building with shear wall have shown verity good performance in past earthquake. The design shear wall is given in IS-code 13920:2016.

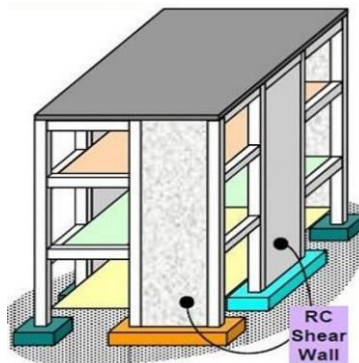


Fig. 1 Shear Wall

II. RELATED WORK

A considerable amount of research have been done in this field. Some of them are below –

Priyosmita Das (2017), this paper focuses on a new concept of arresting the lateral deflection of a residential building by stiffening the top or intermediate storey at an optimized level. Here an effort has been made to find out the appropriate level at which stiffening will prevent the lateral sway of the Structure to the greatest extent. This paper portrays an efficiency of the concept of stiffening with the help of response spectrum analysis of a five storey residential building in STAAD Pro which has been provided with shear wall at different levels. Altogether seven different cases have been considered and analyzed to determine the effectiveness of shear wall to determine the optimum level of stiffening to arrest maximum deflection. Within the limited scope of this paper a comparative analysis of the seismic response of the building has been done to obtain an optimum combination of stiffness and strength keeping economy in mind.

MD. Samdhani Azad (2016), this study plays attention on the seismic behavior of structure with steel braced as well as with shear walls. Analysis has done in ETABS software to conclude the different type of behavior. In their results they have shown comparison of Different models for maximum displacement and storey drift. They concluded that model, having shear wall in the middle among all the model is the safest.

Varsha R. Harne (2014), by using structural analysis software STAAD-Pro V8i analysis of a building has done by using different type of models. Different type of cross sections of RC shear walls are used such as Boxed type, L-type and cross type shear wall and these walls are located at different positions of building such as along periphery, at corner and at middle position. All types of load combinations have studied and as results have found that the load combination 1.5DL +1.5EQX is the most critical among all for all models.

O. Esmaili, S. Epackachi, M. Samadzad, S.R. Mirghaderi (2008), In this paper, firstly he quoted, that few unique trouble of the tower and evaluation of its seismic load bearing system with considering about some essential factor have been discussed. Finally, having some technical information about the structural behavior of the case would be very fascinating and useful for designers.

III. METHODOLOGY

In this research, the target of the analysis is a building with a normal floor plan as shown in the figure. All floors are considered for analysis, including his 1st floor with a floor height of 3.5 m. The floor area of the building is 480 square meters. The structure has 5 fields in the X direction, each field length 6 m, and 3 fields in the Z direction with different lengths, 2 fields length 6 m, the middle field length The height is 4 m. This study considers column type. Depending on the structural requirements, some columns are rectangular while others are square. We will use two types of beams with different cross sections. Bar sizes are 230mm x 450mm and 300mm x 450mm. A plate with a thickness of 200 mm is used. The thickness of the floor material is 50 mm. The struts of the structure are fixed below. Three types of walls are used: main walls, partition walls and parapet walls. The thickness of the main wall is 230 mm, the wall thickness of the partition walls and parapets is half the thickness of the main wall, so the wall thickness is different. The height of the main walls and bulkheads corresponds to the height of the floor. A height of 1 m is considered for the attic. Some models have shear walls and the thickness of the shear walls is 230 mm. Soil conditions are considered to be of medium hardness, with a damping ratio of 5% and an important factor taken into account¹. Dead and live loads are applied accordingly. Seismic loads are applied according to IS 1893 (Part -1) 2016.

Models Considered for Analysis:

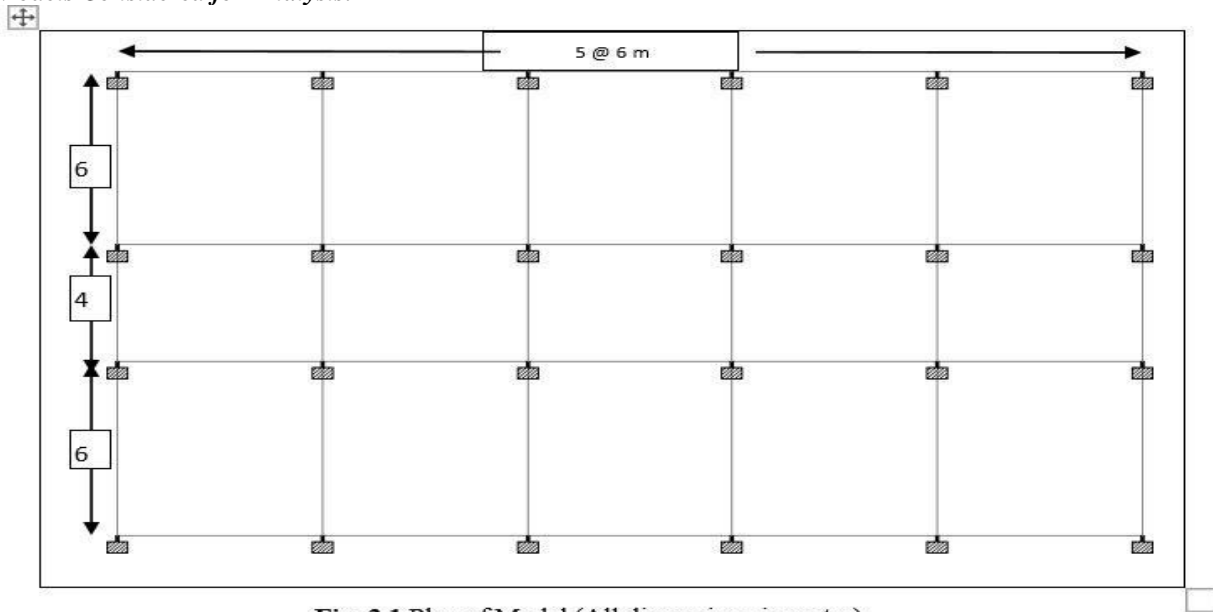


Fig. 3.1 Plan of Model (All dimensions in meter)

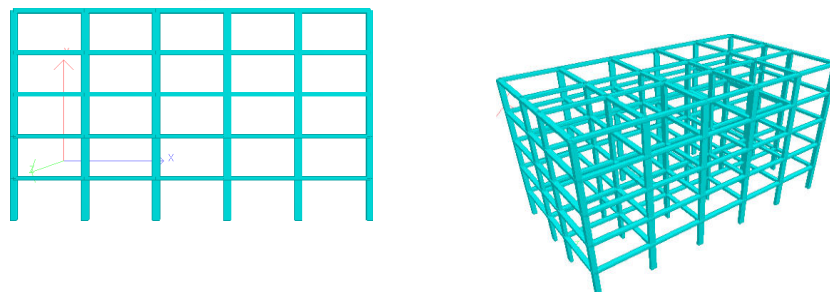


Fig. 3.2 Elevation and Isometric view of M-1

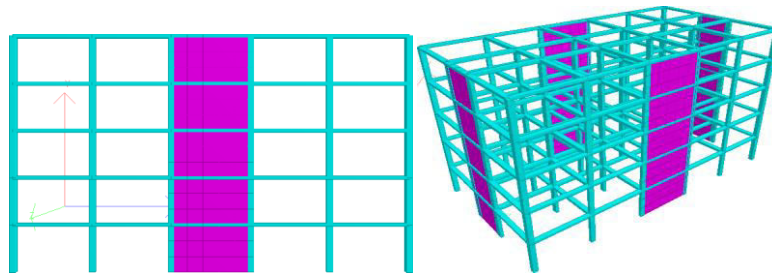


Fig 3.3 M-2 RCC Framed Structure with shear walls, 5 Storey in Earthquake Zone-V

A. Load Case Details:

- 1) *Dead load*:- Dead loads are calculated with the help of the unit weight of the materials assigned to the framing members. Indian code IS 875 (part I) -1987 is used for the design loads other than earthquake loads for building & structures.
- 2) *Live load*:- A live load of 4KN/m² is applied on the structure.
- 3) *Earthquake load*:- The earthquake load based on the Indian Standard IS 1893 (Part 1): 2002, Criteria for Earthquake Resistant design of Structure, Part 1: General Provisions and Buildings (fifth revision) is used.

IV. RESULT & DISCUSSION

In this paper, the analysis is performed on different models with different deployment types. The focus of this research is the control of construction costs and the safety against lateral forces of high-rise buildings. Costs are controlled by reducing the size of the columns and providing shear walls at the column locations.

(A) Comparison between Materials which are used:

If you use a shear wall instead of a simple frame structure, it will look like the table below.

After that, the amount of material is reduced. It can be said that shear forces are more effective in high-rise buildings in important seismic areas.

Storeys	Material used	RC-Frames	Shear Wall
5	Concrete(m ³)	292	372
	Steel(Kg)	59564	29103

Fig 4.1 Quantity of Material used in Zone-5

(B) Material Cost Comparison among Different Models:

The following table has been found that when shear walls used in place of simple frame construction, material costs are reduced in most cases. However, material costs may increase. due to column failure. From this result, it can be said that the shear wall system has the greatest cost savings. From an economic point of view, the shear wall system is most important in high-rise buildings.

Storey's	Material used	Material Cost (INR)	
		RC-Frame	Shear Wall
5	Concrete	1460000	1860000
	Steel	2978200	1455150
	Total Material Cost	4438200	3315150

Fig 4.2 Material Cost

(C) Deflection Analysis in Different Frame structure:

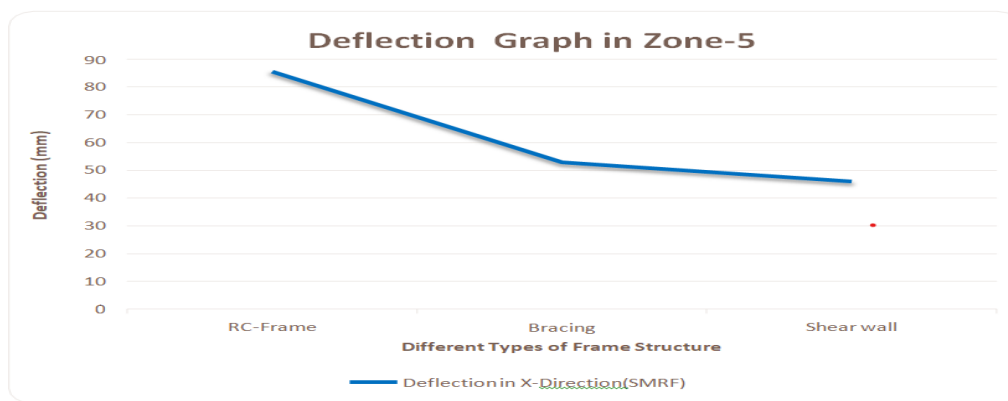


Fig 4.3 Comparison of Deflection for 5-storeys in Zone-5



Fig 4.4 Storey Displacement Comparisons with RC-Frame for 5 Storeys Building in Zone-5

V. CONCLUSION

Shear wall structure uses more concrete than an RC structure. A high-rise building in Zone 5 was found to have a lesser amount of steel in its shear walls compared with RC frame. Therefore, it can be concluded that the total cost of shear wall construction is less compared with RC frame. Bending moments in shear walls are less than RC frames. Storey drift increases from top to bottom on all models. From this it can be concluded that drift in tall buildings are controlled by increasing the overall stiffness using shear walls. Deflection and bending moment in case of shear wall are very less as compared to its counterpart.



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