Dynamic Response of High-Rise Structures under the Influence of SHEAR WALLS

Details for Structure Report and Analysis

Ardra Baiju
Department of Structural & Construction Management
Mangalam College of Engineering
Kottayam, Kerala

Gokul P V
Assistant Professor
Department of Structural & Construction Management
Mangalam College of Engineering
Kottayam, Kerala

***Abstract*— The primary purpose of all kinds of structural systems used in the building type of structures is to support gravity loads. The most common loads resulting from the effect of gravity are dead load, live load and snow load. Besides these vertical loads, buildings are also subjected to earthquake loads. Earthquake loads can develop high stresses, produce sway movement or cause vibration. Therefore, it is very important for the structure to have sufficient strength against vertical loads together with adequate stiffness to resist lateral forces. Therefore, it is very important for the structure to have sufficient strength against vertical loads together with adequate stiffness to resist lateral forces. Shear walls are popular structural systems to resist lateral forces acting on buildings such as wind and earthquake loading. Structural engineers are interested in the accuracy of computational models for shear walls because for dynamic loading, the absolute stiffness of shear wall systems is the prime determinant for the design base shear of the building.**

Keyword—Gravity load, Shear Wall

I. INTRODUCTION

Nowadays population is a major problem and is increasing day by day thus resulting in construction of more vertical housing due to shortage of land. Structural are design to resist earthquake, wind load and stable the structure and the damage in the structure causes loss of peoples and the high raise buildings and to check the strength stiffness and resists the displacement of the building by proper designs and detail ductile of the building and can design the proper gravity loads and depends the design of the building, the paper deals the analysis, design is done by using the software package called as E-TABS. E-TABS is 3D structural software. E-TABS is the abbreviation of “Extended 3D Analysis of Building System. Hence revisions are done depend upon the codal provisions and the result given by the analysis. Now a day, Shear Walls are the most common structures built inside the structures in order to counteract severe earthquake forces.

Earthquake is a major concern for the engineers to give stability to the buildings. Properly designed and detailed buildings with shear walls have shown very good performance in past earthquakes. Shear walls must provide the necessary lateral strength to resist horizontal earthquake forces. When shear walls are strong enough, they will transfer these horizontal forces to the next element in the load path below them. These other components in the load path may be other shear walls, floors, foundation walls, slabs or footings. Shear walls are vertical elements of horizontal resisting system. Shear walls are constructed to counter the effects of lateral load acting on a structure. In residential construction, shear walls are straight external walls that typically form a box which provides all of the lateral support for the building. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of structure and occupants; create powerful twisting (torsion) forces. These forces can literally tear (shear) a building apart. Reinforcing a frame by attaching or placing a rigid wall inside it maintains the shape of the frame and prevents rotation at the joints. Shear walls are especially important in high-rise buildings subjected to lateral wind and seismic forces. Shear wall buildings are usually regular in plan and in elevation. Shear wall is a structural member used to resist lateral forces i.e. parallel to the plane of the wall. For slender walls where the bending deformation is more, Shear wall resists the loads due to Cantilever Action. In other words, Shear walls are vertical elements of the horizontal force resisting system. ETABS is a sophisticated, yet easy to use, special purpose analysis and design program developed specifically for building systems. ETABS Version 9 features an intuitive and powerful graphical interface coupled with unmatched modelling, analytical, and design procedures, all integrated using a common database.

Although quick and easy for simple structures, ETABS can also handle the largest and most complex building models, including a wide range of nonlinear behaviour, making it the tool of choice for structural engineers in the building industry.

II. LITERATURE GAP

Shear walls are especially important in high-rise buildings subject to lateral wind and seismic forces. Generally, shear walls are either plane or flanged in section, while core walls consist of channel sections. They also provide adequate strength and stiffness to control lateral displacements. Opening in shear wall is the important for efficient use of space in high rise building. Varying percent of opening are analysed.

III. SCOPE AD OBJECTIVE

The scope of the present study is to design and analysis of G+29 building with Shear walls with various percentages of openings on the building using ETABS. The objectives of this study are the modal analysis of structure with shear wall and comparison of shear wall with various percentages of opening on the building.

IV. DETAILS AND DIMENSIONS

Table 1 Dimension details

NO OF STORY	30
Floor height	3m
Grade of concrete	25Mpa
Grade of steel	Fe415
Beam dimension	350mmX350mm
Column dimension	450mmx450mm
Slab thickness	150mm
Plan dimension	25mx12m

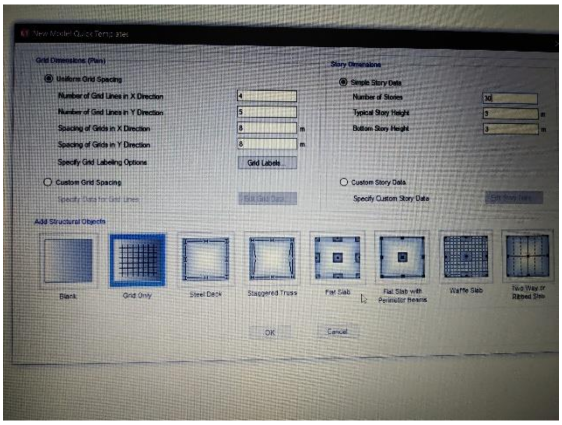

Figure: 2 Grid dimension

V. MODELLING

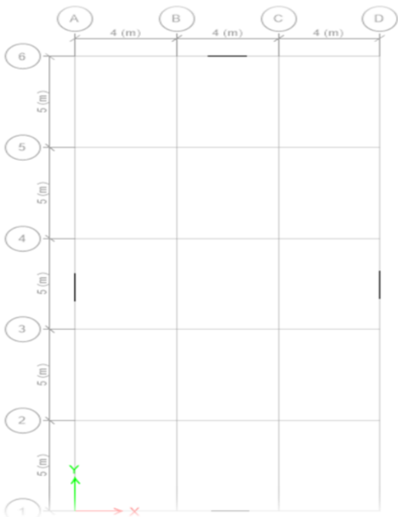

Figure: 3 Model plan

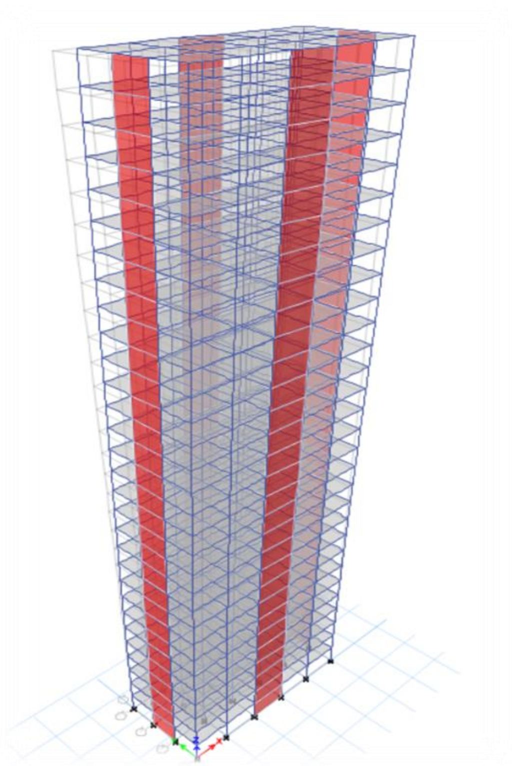

Figure: 1 3D view of structure with shear wall

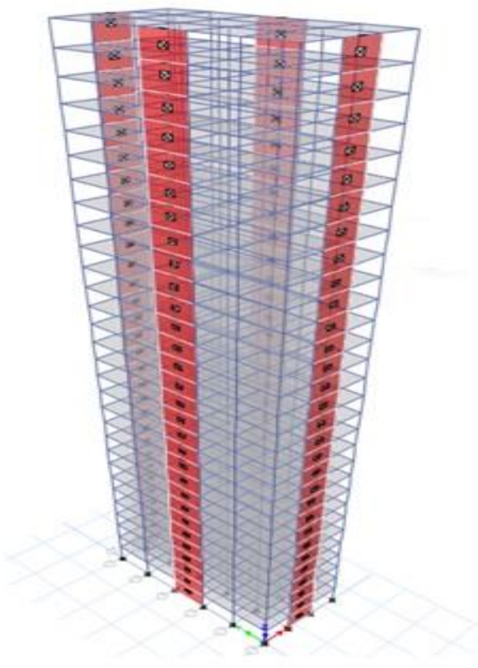

Figure: 4 Structure having shear wall with 5% opening

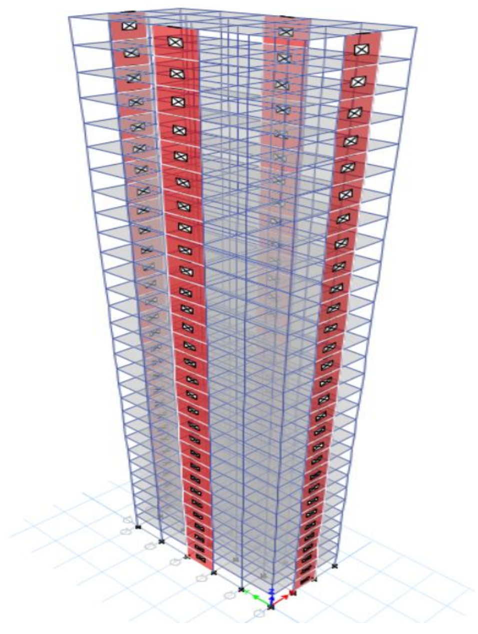

Figure: 5 Structure having shear wall with 10% openings

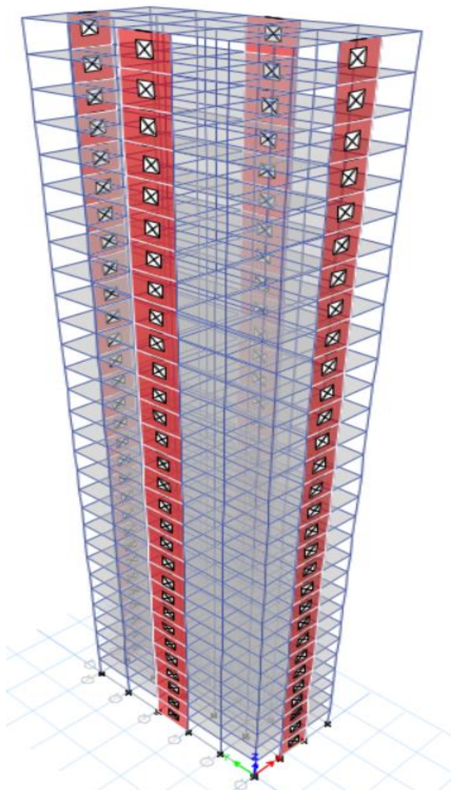

Figure: 6 Structure having shear wall with 15% openings

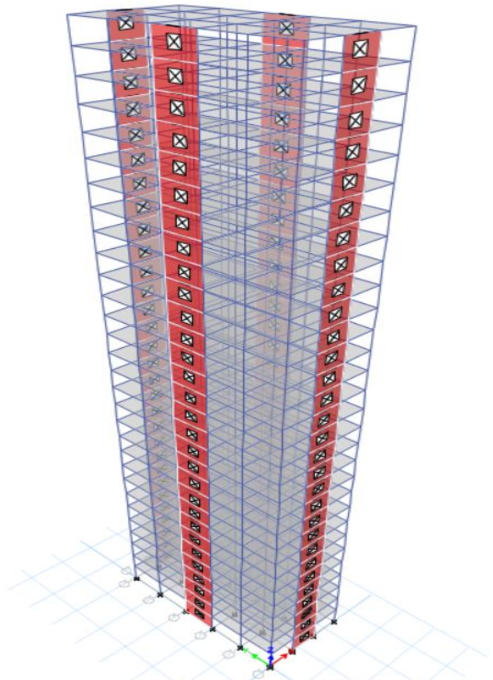

Figure: 7 Structure having shear wall with 20% openings

VI. LOAD FORMATION

The 30 storey high rised building with shear walls of various opening percentage in various models considered for analysis for determining the behaviour of the building during earthquake load on the building. The modelling of building is done using, IS 1893:2002. For given structure, loading with applied loads includes live load, and dead load respectively. The loads considered for the present study is given in Table below

Table 2 Load details

Dead load	12 KN
Live load	3 KN
Masonry load	1 KN

VII. RESULT

After analysis, various results are obtained and these results are evaluated by comparing the stiffness of structure for various opening percentages in shear walls.

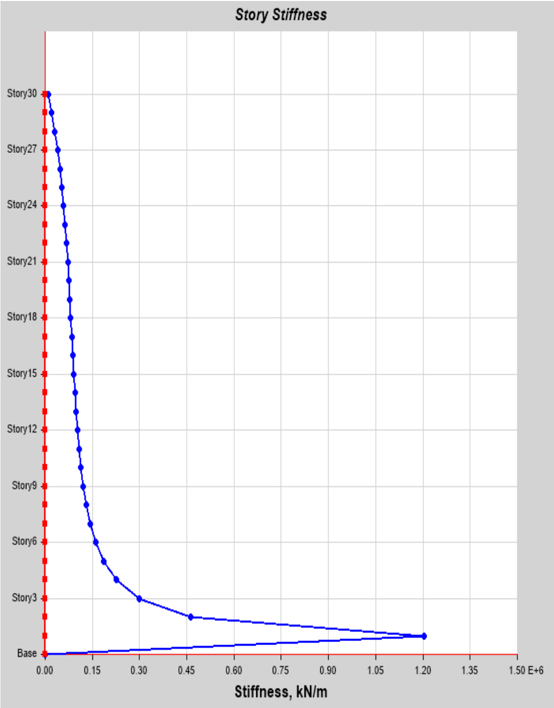

Figure: 8 Stiffness without opening

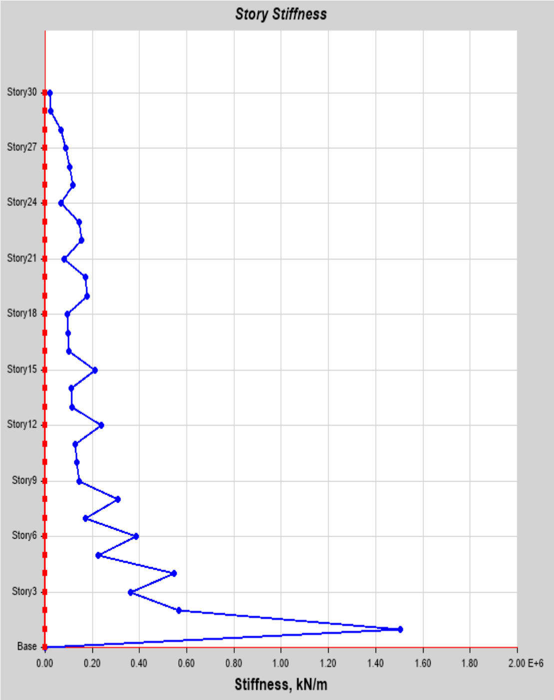

Figure: 10 stiffness with 10% openings

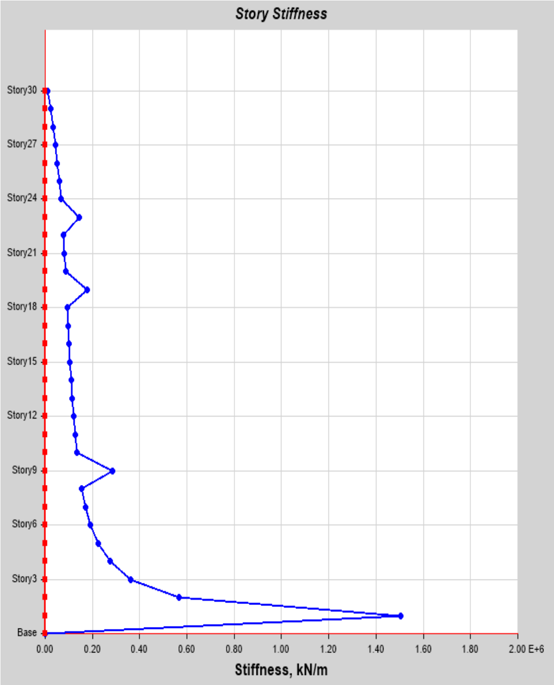

Figure: 9 stiffness with 5% openings

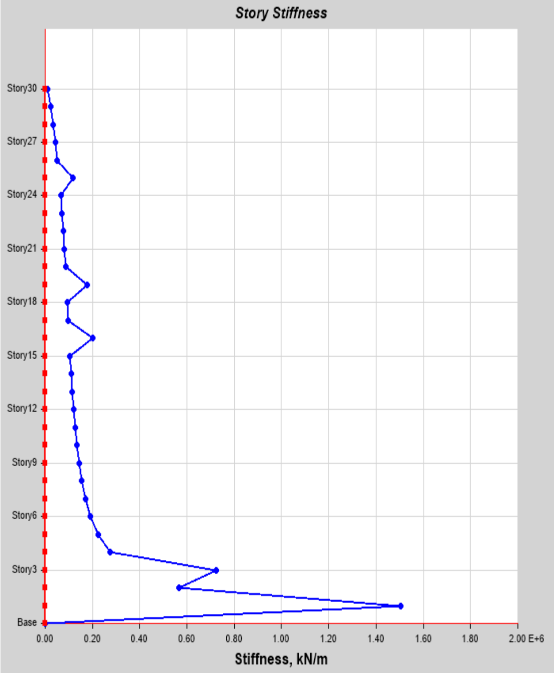

Figure: 11 Stiffness with 15% openings

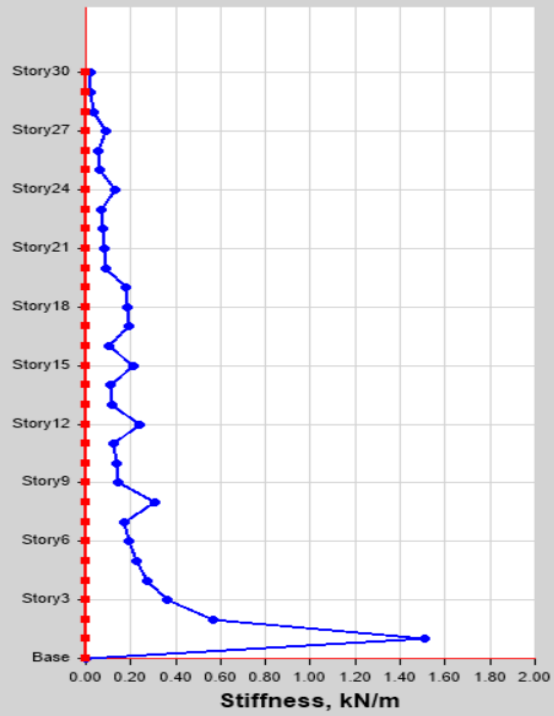

Figure: 12 Stiffness with 20% openings

Stiffness of different storeys under different percentage of openings in shear walls and in shear wall without opening is compared. Neither the storey displacement nor story drifts had shown much variation for different percentages of openings in shear walls.

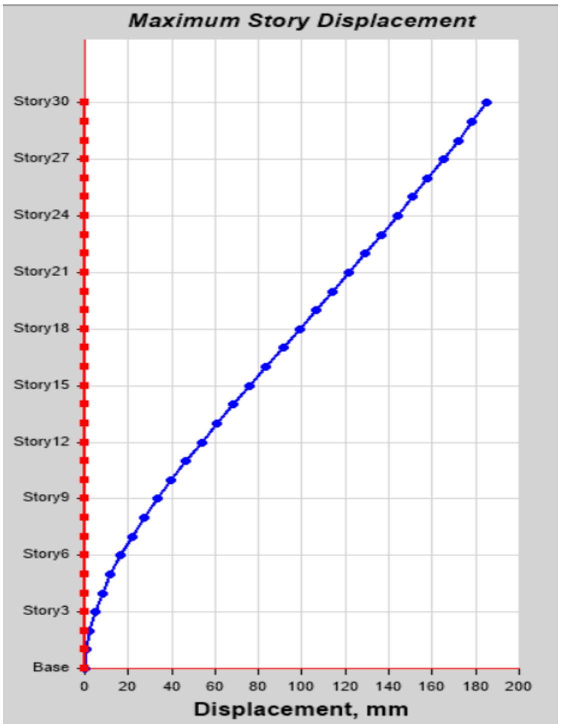

Figure: 13 Storey Displacement

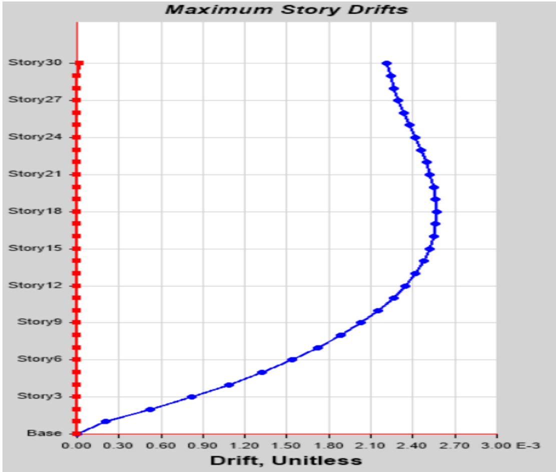

Figure: 14 Storey Drift

The figure 13 shows the displacement of the structure in each storey due to earthquake load in Y direction. As the storey increases the displacement also increases. Thus the maximum displacement is seen in the top storey. The maximum displacement obtained is 182.434 mm. Stiffness of storeys with 5%,10% & 15% were nearly same as that of storeys having shear wall with no openings. Stiffness of storeys with 20 % has shown variation compared to storeys having shear wall with no openings. Storey displacements of storeys with 5%,10%, 15% & 20% were nearly same as that of storeys having shear wall with no openings. Storey drifts of storeys with 5%,10%, 15% & 20% were nearly same as that of storeys having shear wall with no openings.

VIII. CONCLUSION

The major conclusions drawn from the present study are as follows :-

- It has been observed that by increasing the size of opening has much dominant effect only when the percentage of opening has increase above 15%.
- The behaviour of frame shear wall structure remains almost similar for an opening up to 15% of shear wall area as that of shear wall with no opening.
- The storey displacement and storey drifts of frame shear wall structure remains almost similar for openings of shear wall area as that of shear wall with no openings
- Openings in shear walls were effective up to 15%.

IX. REFERENCES

[1] Syed Mohammad Umar, "Seismic Analysis of RC Shear Wall Frame Buildings with and Without Openings in Shear Wall", International Research Journal of Engineering and Technology, 2017

[2] A. Ravi Kumar," Analysis and Design of Shear Wall for an Earthquake Resistant Building Using ETABS", International Journal for Innovative Research in Science & Technology, Volume 4, Issue 5, 2107

[3] S. Natarajan, "A Review on Analysis and Design of Shear Walls in High Rise Irregular Building", International Journal of Scientific Engineering and Technology Research, Volume 5, Issue 5,2016

[4] Sanjay Sengupta, "Study of shear walls in multistoried buildings with different thickness and reinforcement percentage for all seismic zones in India", International Journal of Research in Engineering and Technology, Volume 3, Issue 11,2014