Analysis of a High-Rise Building (Symmetrical & Unsymmetrical) with Shear Walls under Dynamic Loads using STAAD.PRO

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Abstract— Now a day’s population of our country is increasing very rapidly, therefore to settle this vast increment in population we need to construct tall structures which can face high displacement and drift due to lateral forces. To counteract such situations in our country in this dissertation, I have considered a high-rise building with shear walls under effect of seismic forces as per Indian Standards code 1893-2002 part-1 and wind speed 39 m/s as per 875 part-III, considering shear wall effect to prepare a comparative study on a live project located at school of Planning & Architecture in Bhor Bhopal M.P. Shear walls are the most commonly used lateral load resisting systems in multi-story buildings. Shear walls have very high stiffness and lateral strength, which is used to resist very large lateral loads besides support gravity loads, making it quite advantageous in many structural engineering applications. In this study, I have mainly emphasized the structural behavior of High-rise building with shear walls (symmetric and unsymmetric) frame for the effect of 2-dimensional and 3-dimensional structure of G+6 tall structure under the effect of seismic zone II & medium type of soil condition. Modelling and analysis is done using STAAD.PRO software. Assuming material property is linear static. To compare the results modelled shear wall with 2-D AND 3-D models of various useful parameters such as lateral displacement, inter-storey drift, natural time period, base shear, torsion, resisting moment and obtained most effective position of RC shear wall on considered models. From the results it’s concluded that 2-D model shows least displacement and Storey drift values whereas resisting moment and base shear are maximum.

Key words: Linear Static Analysis, Structural Analysis, Shear Wall, Storey Drift, Base Shear, Resisting Moment, STAAD.PRO, Wind Speed

I. INTRODUCTION

In many regards concrete is a perfect building material, consolidating economy, flexibility of frame and work, and imperative imperviousness to flame and the assaults of time. The crude materials are accessible in every county, and assembling of concrete is moderately basic. It is little ponder that in this century it has turned into an inclusive building material. Tall structures are the most complex manufactured structures since there are clashing prerequisites and complex building frameworks to incorporate. The present tall structures are lean, influence in examination with prior elevated structures. Hence the effect of wind and seismic powers following them turns an essential part of the outline. Enhancing the auxiliary frameworks of tall structures can control their dynamic reaction. With more suitable basic structures, for example, shear dividers and tube structures, and enhanced material properties, the greatest stature of solid structures has taken off in late decades. Structures designed with auxiliary dividers are stiffer than encircled structures, decreasing the likelihood of extreme distortion and consequently harm.

In this study, I did comparative study on the effect of positioning of shear wall on a un-symmetric and symmetrical, 3-dimensional structure with 2-dimensional frame to determine its positive impact to enhance resistivity and comparing the variation in forces considering seismic zone II and wind basic speed 39 m/s.

Shear walls are vertical components of the even power opposing framework. At the point when the sheathing is appropriately secured to the stud divider surrounding, the shear divider can oppose powers coordinated along the length of the divider. At the point when shear dividers are outlined and developed legitimately, they will have the quality and firmness to oppose the flat powers. Shear dividers oppose two sorts of powers: shear powers and inspire powers. Associations with the structure above exchange flat powers to the shear divider. This exchange makes shear powers all through the tallness of the divider between the best and base shear divider associations. The quality of the wood, sheathing and latches must oppose these shear powers or the divider will tear or "shear" separated.

II. OBJECTIVES

Objective of this research is to study the effect of shear walls in irregular, Un-symmetrical and symmetrical building for seismic zone II and wind speed 39m/s. Modelling and analysis of G+6 storeys High-rise Building frame has been done using STAAD.Pro V8i software.

Specific Objectives of the Present Study are-
1) To Determine the effect of dynamic loadings (seismic and wind) as per Indian Standard in a high-rise building.
2) To prepare comparative study between 2-dimensional and 3-dimensional building with regular and irregular shape high-rise building.
3) To determine the effect of shear walls, under dynamic loading on high-rise building.

III. LITERATURE RELATED TO OUR STUDY

Varsha R. Harne (2015) concentrated to decide the best area of shear divider in multi-story building. In this investigation of six stories RCC building put in NAGPUR subjected to seismic quake zone-II. Quake stack is ascertained by seismic coefficient strategy utilizing IS 1893 (PART– I):2002. The examinations were performed utilizing STAAD Pro. In this investigation has been completed to assess the quality of RC shear mass of a multi-storeyed working to change the shear divider area. In this taken here diverse instances of shear...
divider position for a 6 story building have been dissected. Position of shear divider has turned out to be unavoidable in multi-story working to oppose level powers.

Chithambar Ganesh.A (2016) studied to determine the best location of the shear wall in multi-story building using Etabs by nonlinear analysis method for a reinforced concrete building. A RCC frame by attaching or placing inside a rigid wall, it maintains the shape of the frame and prevents rotation at the joints. Shear walls are most important in multi-storey buildings subject to lateral forces. In this study to compare the parameters like lateral displacement, storey drifts, and forces etc.

S. Natarajan (2016) studied the seismic response of the RCC buildings and analysis was performed by Finite element based software-ETABS using response spectrum method. A residential RCC building of G+15 irregular shapes is considered for the analysis. The properties of these seismic shear walls determine the response of the buildings, and therefore, it is also important to evaluate the seismic response of the shear walls appropriately. In this study an irregular multi-storey building with and without shear wall was studied to compare the parameters of lateral loads, storey drifts and torsion effects. From the results, it is inferred that shear walls are more resistant to lateral loads in an irregular structure. When walls are situated in best positions in a building, they can be resisting efficiently lateral loads like wind or earthquakes.

Raad Dheyab Khalaf (2016) studied presence of irregularities like plan irregularities or vertical irregularities are considered as a major deficiency in the seismic behaviour of buildings. Dynamic Analysis is carried out using FEM software ETAB v 15 by response spectrum method. Shear walls are one of the very effective solutions to sustain the lateral forces and they provide required stiffness and strength, good for drift control and also simple to construct. In this study is made to investigate the plan irregularities by varying location of shear wall on different asymmetrical models. Analysis have been done to estimate the performance of multi-storey buildings and the effects of structural irregularities in stiffness, strength, mass and combination of these factors are to be going to be considered. The parameters considered to compare are displacement, inter storey drift, and storey stiffness.

### IV. BUILDING GEOMETRY

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Building Description</th>
<th>Plan Area</th>
<th>X-Y Direction Grid Spacing</th>
<th>Storey Height</th>
<th>Number of storey</th>
<th>Beam Dimension</th>
<th>Column Dimension</th>
<th>Slab Thickness</th>
<th>Thickness of shear wall</th>
<th>Thickness of wall</th>
<th>Bottom Support Condition</th>
<th>Seismic Zone</th>
<th>Zone Factor</th>
<th>Soil Type</th>
<th>Importance Factor</th>
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### VI. RESULTS

#### A. Storey Displacement

#### B. Maximum Bending moment
C. Axial Force

![Axial Force Graph]

D. Shear force

![Shear force Graph]

VII. CONCLUSION

- Here results shows that 3-dimensional symmetric is comparatively more economical as compared to 2-dimensional, whereas in un-symmetrical case 3-dimensional shows more bending moments.
- Symmetric frame 2-dimensional shows more force than 3-dimensional, whereas in unsymmetrical structure result is opposite showing least in 2-dimensional and more in 3-dimensional.

A. Storey displacement

- Axial force in 2-dimensional symmetric structure is more than 3-dimensional. Whereas 2-dimensional in unsymmetric is less than 3-dimensional.
- It is clearly observed that minimum story displacement is in two dimensional unsymmetrical
- In unsymmetrical three dimensional frame have comparatively more displacement than 2-dimensional un-symmetric.
- Is is observed that 2-dimensional symmetric frame shows much more displacement than 3 dimensional frame symmetric.

REFERENCES