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A REVIEW ON ANALYSIS OF G+5 MULTI-STOREY BUILDING WITH AND WITHOUT SHEAR WALL FOR ZONE III

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ABSTRACT- Shear wall is a structural element which provides stability to structure from lateral loads like wind load and seismic loads. These walls are more important in seismically active zones when shear forces on the structure increases due to earthquakes. They have high plane stiffness and strength which can be used to simultaneously resist large horizontal loads while also supporting gravity loads. Shear walls are generally constructed from reinforced concrete, plywood/timber, unreinforced masonry. The shape and plan position of the shear wall influences the behavior of the structure considerably. Various research studies have been conducted on the design of shear wall and its performance to seismic forces. In this paper we have aimed to study the comparison between the effects of earthquake on G+5 storey building with and without shear wall at Zone III in medium soil conditions using STAAD.PRO v8i software.

Keywords- seismic zones, G+5, lateral loads

INTRODUCTION

Structures are subjected by gravity and lateral forces. Lateral forces such as wind loads, seismic loads, etc. leads to failure of structure by shear. Earthquakes are transitional ground vibrations caused by sudden release of strain energy stored in the earth's crust which spreads out in all directions from the fault region in the form of seismic waves. That causes both loss of life and property. Shear walls resist lateral forces such as seismic loads very well and are designed to counteract these forces. Shear walls are rigid vertical elements capable of transferring lateral forces from exterior walls, floors, and roofs to the foundation in a direction parallel to their planes. In residential construction, shear walls are straight external walls that typically form a box which provides all of the lateral support for the building. The structure is modeled and analyzed using STAAD.Pro v8i structural software. Indian Standard Code IS:456 is used for design of concrete structure.

LITERATURE REVIEW

P. Kalpana et al (2016) analyzed the structural building with and without shear wall at various heights for different models. The result in terms of axial forces, lateral displacement and bending moment in the structural shear walls with varying height are compared for different building models considered. Five-storied buildings were taken with shear-walls and without shear-walls. The model was prepared by using STAAD Pro analysis software.

She concluded that the displacements are reduced in building with shear wall compared to building without shear wall and also the node displacements are more for Zone V compared to Zone III for earthquake load.

A. Ravi Kumar et al (2017) designed and analyzed a G+9 floor earthquake resisting building with shear wall with the help of modeling ETABS software. In this study, the earthquake load was calculated and applied to a multi-storied building of plan 26mx26m and 10 no. of (G+9) floors with 40 meters height.

He concluded that shear walls are one of the most effective building elements in resisting lateral forces during earthquake and also provides larger stiffness to the buildings there by reducing the damage to structure and its contents.

Jay Kumar Sah et al (2018) designed and analyzed and seismic resistant multi-storey building with shear walls and raft foundation since earthquakes are the major problem in countries like India and Nepal. A multi-storey residential building is analyzed and designed, located in Zone III with B+G+13 storeys with a 3-meter height for each storey having a car parking facility provided at basement.

He concluded that the base shears, maximum storey displacement, storey drift, axial, shear, bending moment with their diagrams are known for the different load combinations.

Poornima D. et al (2017) performed seismic analysis in residential multi-storey building with different locations of shear wall. The building considered is a G+9 Residential Building for all types of models of same overall height of 30 m with each storey height of 3 m.

Conclusions were made for symmetric building on the basis of analysis was that there is drastic reduction in storey drifts in x and y very low in bottom stories, very high at the middle stories and finally decreases towards the upper stories.

Govardhan Bhatt et al (2017) made analysis for different models with Shear walls curtailed at different heights and compared those using ETABS, to understand the effect of curtailment of shear walls on the response of the structure.

They found that Storey Drifts increases tremendously at the level of curtailment for all the models. Also, the storey forces vary hugely in all the six models. Maximum forces were observed in SW10 while SW5 displayed the minimum forces because of the higher stiffness of SW10 model, enabling it to withstand higher lateral forces as compared to the others.

JaiminDodiya et al (2018) analyzed the multi-storey building with shear wall using ETABS modeling software. Equivalent static method, Response spectrum method and time history methods were adopted. The area of building was 376m^2 and height was 60m. Total number of floors was 20 and slab thickness was 150mm. Column size was 900x600mm.

He concluded that providing shear wall at opposite direction, performing better and more efficient than all other cases. Also, the provision of shear wall position in an appropriate location is advantageous and the structure performs better for an existing or a new structure.

Syed Ehtesham Ali et al (2014) determined the solution for shear wall location in multi-storey building. He considered a six storey building at Hyderabad in zone II. An earthquake load was calculated by seismic coefficient method using IS 1893 (PART–I):2002. The models were prepared in the ETABS software by using different cross sections of RC shear wall.

It has been observed that the top deflection was reduced after providing type 2 shear walls of the frame in X-direction as well as in Y-direction.

Syed Mohammad Umar et al (2017) investigated the effects of openings in shear wall on seismic response of structures. For parametric study 15 storied 4mx5m bays apartment buildings with typical floor plan of 25mx12m and floor height of 3m with different openings size and location in shear walls were modeled in ETABS-2015.

It was concluded that the response and stiffness of frame shear wall structure was more affected by the size of opening than their locations in shear wall. However the response of the building was better when the openings are provided in the center of the wall as compared to their eccentric positions.

TYPES OF LOADS ACTING ON STRUCTURES

Types of loads acting on structures are:
1. Dead Loads
2. Live Loads
3. Wind Loads
4. Earthquake Loads

***Dead Loads*:** The first vertical load that is considered is dead load. Dead loads are permanent or stationary loads which are transferred to structure throughout the life span. Dead load is primarily due to self-weight of structural members, permanent partition walls, fixed permanent equipment and weight of different materials. It majorly consists of the weight of roofs, beams, walls and column etc. which are otherwise the permanent parts of the building. The calculation of dead loads of each structure are calculated by the volume of each section and multiplied with the unit weight. Unit weights of some of the common materials are presented in table below.

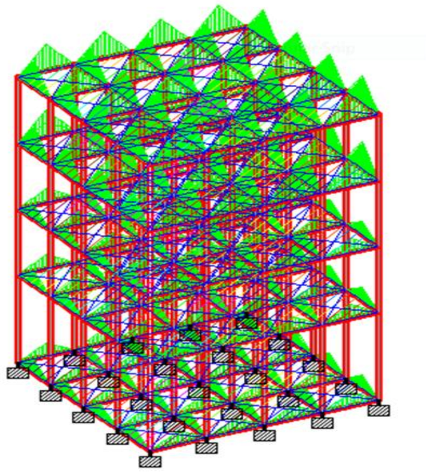
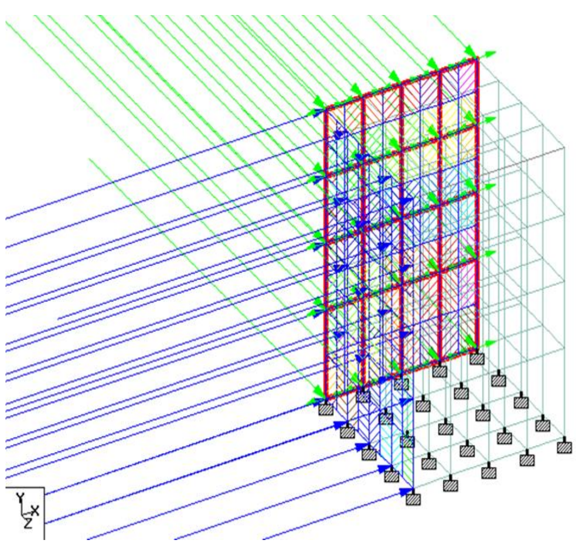


Fig 1.1: STAAD model showing self-weight of the building

Live Loads (LL): The second vertical load that is considered in design of a structure is imposed loads or live loads. Live loads are either movable or moving loads without any acceleration or impact. These loads are assumed to be produced by the intended use or occupancy of the building including weights of movable partitions or furniture etc. Live loads keep on changing from time to time. These loads are to be suitably assumed by the designer.

Wind Loads: Wind load is primarily horizontal load caused by the movement of air relative to earth. Wind load is required to be considered in structural design especially when the heath of the building exceeds two times the dimensions transverse to the exposed wind surface. For low rise building say up to four to five stories, the wind load is not critical because the moment of resistance provided by the continuity of floor system to column connection and walls provided between columns are sufficient to accommodate the effect of these forces.



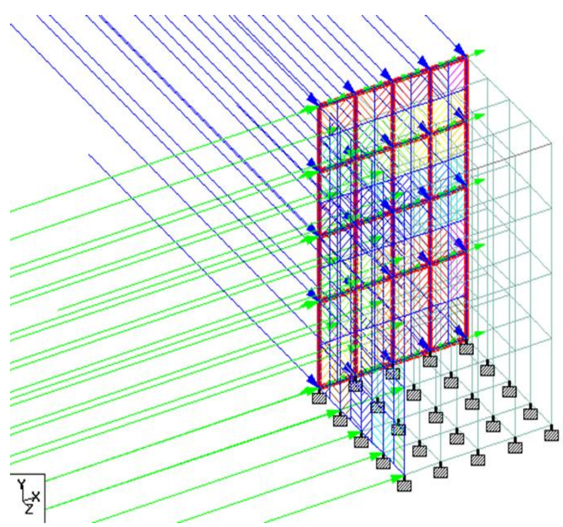


Fig 1.2: Wind load from front view **Fig 1.3:** Wind load from Side view

Earthquake loads: Earthquake forces constitute to both vertical and horizontal forces on the building. The total vibration caused by earthquake may be resolved into three mutually perpendicular directions, usually taken as vertical and two horizontal directions.

The movement in vertical direction does not cause forces in superstructure to any significant extent. But the horizontal movement of the building at the time of earthquake is to be considered while designing.

The seismic accelerations for the design may be arrived at from seismic coefficient, which is defined as the ratio of acceleration due to earthquake and acceleration due to gravity. For monolithic reinforced concrete structures located in the seismic zone 2, and 3 without more than 3 stories high and importance factor less than 1, the seismic forces are not critical.

CONCLUSION

From the study of literature presented in this paper, conclusions are drawn out for analysis and design of RCC framed structure as:

1. Shear wall should be located away from the centroid of the building and should be placed symmetrically in plan to avoid torsional effects.
2. Diagonal shear wall was found to be effective for structures located in earthquake prone areas.
3. By constructing shear walls damages due to effect of lateral forces due to earthquake and high winds can be optimized.
4. Shear walls construction will provide larger stiffness to the buildings there by reducing the damage to structure and its contents.
5. The base shears, maximum storey displacement, storey drift, axial, shear, bending moment with their diagrams are known for the different load combinations.
6. Corner shear walls and the shear walls provided centrally at the outer edge have shown better performance.

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