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DRIFT Reduction in High Rised Building using Shear Wall With and Without Openings

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Abstract: In modern tall buildings, shear walls are commonly used as a vertical structural element for resisting the lateral loads that may be induced by the effect of wind and earthquakes. Shear walls (SW) are proven to be efficient in resisting and transferring the lateral/seismic loads in earthquake prone areas. The reinforced concrete shear wall building is high in plane stiffness and strength which can be used to simultaneously resist large horizontal load. The use of shear wall-buildings is quite common in high rise building. During seismic excitation, they contribute in absorbing moments and shear forces and reduce torsional response. In high rise buildings it is customary to provide doors and windows which leads to the provision of openings at the shear walls architectural design leads to the existence of doors and windows within shear walls. The scope of the present work was to analyze the twenty story building and RC shear wall building with and without opening. Developed modeling and analyzed the reinforced concrete shear wall building by using ETABS program to analyze the three structure. The comparison of these models for different parameters like displacement, story drift and base shear has been presented by RC shear wall building with and without opening.

Keywords: High Rise Building, RC Shear Walls With Openings, Lateral Loads, ETABS.

I. INTRODUCTION

A. Definition of High Rise Building

The tallness of a building is relative and cannot be defined in absolute terms either in relation to height or the number of stories. But, from a structural engineer's point of view the high rise building can be defined as one that, by virtue of its height, is affected by lateral forces due to wind or earthquake or both to an extent that they play an important role in the structural design.

II. LATERAL LOAD -RESISTING SYSTEMS

It can be said that there are as many types of lateral systems as there are engineers. However, most of the systems can be grouped into three basic types:

- Shear wall system.
- Frame system.
- Combination of the two, the shear wall–frame system (dual system).

A. Shear Walls

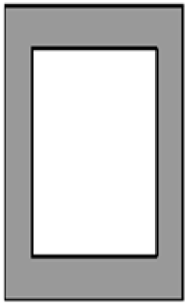
This section provides an introduction to shear walls and how they resist earthquake and wind forces. This section also shows how to properly construct the shear walls and the parts that make them up. With this knowledge, contractors can build proper shear walls and inspectors can recognize the errors untrained contractors make. Shear walls are vertical elements of the horizontal force resisting system. The shear wall can resist forces directed along the length of the wall. When shear walls are designed and constructed properly, they will have the strength and stiffness to resist the horizontal forces. Buildings engineered with structural walls are almost stiffer than framed structures, reducing the possibility of excessive deformations and hence damage. The necessary strength to avoid structural damage under earthquakes can be achieved by providing a properly detailed longitudinal and transverse reinforcement. By adopting special detailing measures, dependable ductile response can be achieved under major earthquakes. Lateral forces, that is the forces applied horizontally to a structure derived from winds or earthquakes cause shear and overturning moments in walls.

Type Of Shear Wall: Shear wall is a concrete wall made to resist lateral forces acting on high rise buildings as shown in fig.1. The Shear Wall sections are classified as six types:

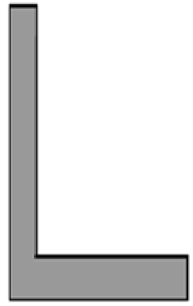
- Box Section
- L – Section
- U - Section
- W – Section
- H – Section

B. Coupled Shear Walls

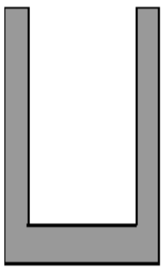
In many shear wall buildings, a regular pattern of openings will be required to accommodate windows or doors or both. Highly efficient structural systems, particularly suited for ductile response with good energy dissipation characteristics, can be conceived when openings are arranged in a regular pattern. Examples are shown in Fig.2 where a number of walls are interconnected or coupled to each other by beams. These walls are generally referred to as coupled shear walls.



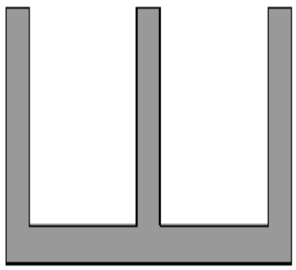
(a) Box Section



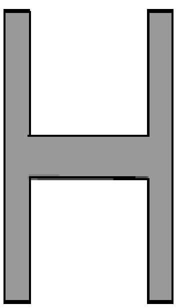
(b) L - Section



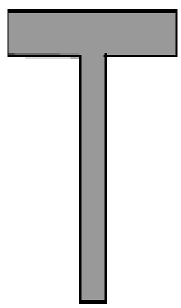
(c) U – Section



(d) W - Section



(e) H - Section



(f) T - Section

Fig.1. Type of Shear Wall.

The load-resisting mechanisms in a coupled shear wall are shown qualitatively in Fig.3 b and c. It is seen that the total overturning moment, M, in the wall without openings shown in Fig.3a, is resisted at the base entirely by flexural stresses. On the other hand, in the coupled walls shown in Fig.3b and c, axial forces as well as moments occur at the base to resist the overturning moment, M, resulting in the following equilibrium statement:

$$M = M_1 + M_2 + T_d \quad (1)$$

The magnitude of the axial force, T = C, is given by the sum of the shear forces occurring in the coupling beams above the level under consideration. When the coupling is relatively weak, as is often the case in apartment buildings because of limited beam depth, the major portion of moment resistance is due to moment components. On the other hand, if coupling beams are stiff, major moment resistance is by the couple generated by the equal and opposite axial focus in the wall piers. The resistance of a coupling beam, also referred to as link beam, is shown schematically in Fig.4. Unless adequately designed for flexural ductility and shear force expected under strong ground shaking, flexural or shear failures may develop in structural walls.

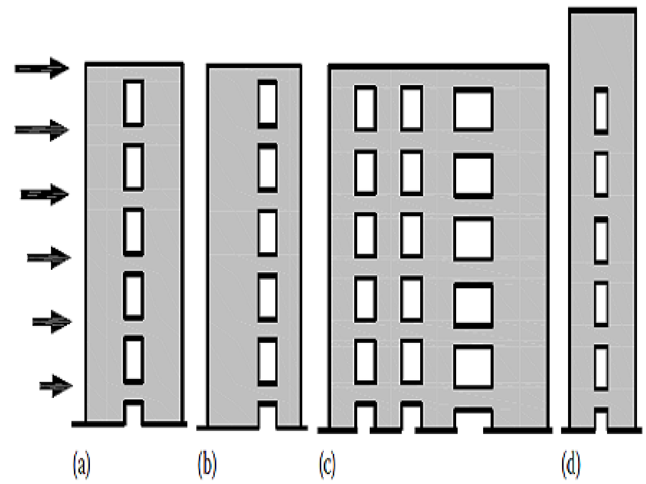


Fig.2. Shear walls with openings.

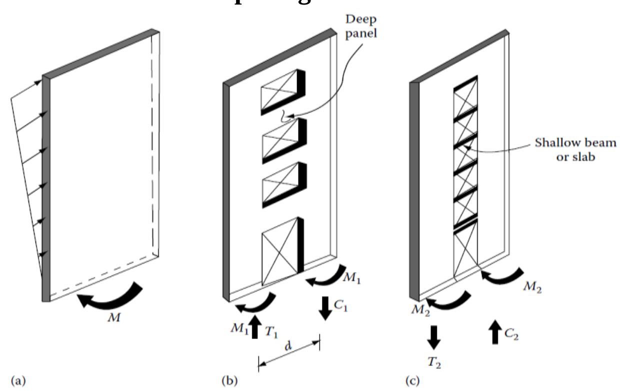


Fig.3. Lateral load-resistance of single and coupled shear walls.

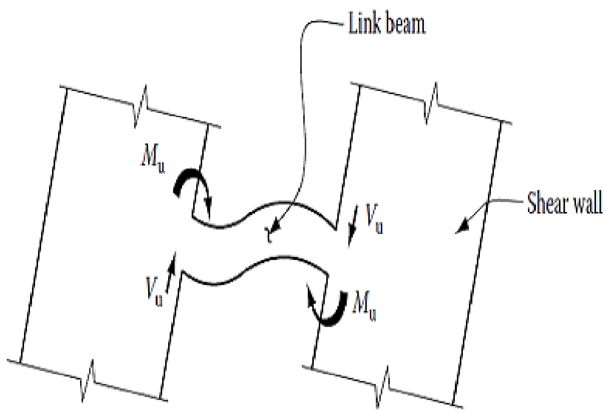


Fig.4. Coupling beam resistance.

III. CONCLUSION

The analysis is carried out using the ETABS software tool and the lateral load analysis is done for structure without shear wall, structure with shear wall and structure with shear wall with openings. Results are compared for the frame lateral forces and story drifts of all the cases and after comparison the results, the following conclusions can be drawn on the basis of the numerical results obtained by software :-

- Shear wall is very effective to resist horizontal forces coming from earthquake and wind forces. In high rise structure if it is properly oriented it will reduce torsional effect and story deflection.
- The maximum lateral displacement at the top story due to lateral loads was in control and in limitations. The check calculated is safe.
- Shear wall is very effective to reduce the maximum drift of the structure.
- No significant difference in drift and displacement provision of 20 % opening in the shear wall.
- The shear force in the columns is decreased in the structures with shear walls.
- No significant difference in shear force and moment provision of 20 % opening in the shear wall.

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