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Seismic Analysis of RCC Building with Shear Wall at Different Locations

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Abstract—*Shear walls are commonly used as a vertical structural element for resisting the lateral loads that may be induced by the loads due to wind and earthquake. Besides they also carry gravity loads. A well designed system of shear wall in building frame improves seismic performance significantly. walls and slabs are used in high rise building. The study presents the results for different configurations of shear walls for 6 storey A box system structure that consists of reinforced concrete building. The results compared on the basis of effect observed due to height of structure having shear wall. In this paper The analysis is done for lateral loading. Loads used are equivalent static load as earthquake load. Results obtained from analysis plotted to compare and to have knowledge of behaviour of RCC framed structures with shear walls. The use of shear wall is efficient at corner of the structure. and less effective when used in low rise building.*

Keywords*: Shear wall, box system, equivalent static load, high and low rise structures, Lateral loading*

1. INTRODUCTION

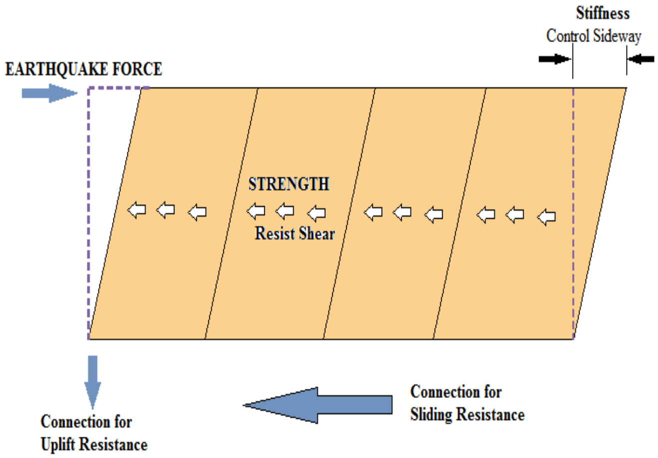
A shear wall structure is considered to be one whose resistance to horizontal loading is provided entirely by shear walls. They may act as a vertical cantilever in the form of separate planner walls and as non-planner assembles of connected walls around elevator, stair and service shaft. Shear walls have been the most common structural elements used for stabilizing the building structures against lateral forces. Their very high in-plane stiffness and strength makes them ideally suited for bracing tall buildings. The usefulness of shear walls in framing of buildings has long been recognized. Walls situated in advantageous positions in a building can form an efficient lateral-force-resisting system, simultaneously fulfilling other functional reqireme-nts. When a permanent and similar subdivision of floor areas in all stories is required as in the case of hotels or apartment buildings, numerous shear walls can be utilized not only for lateral force resistance but also to carry gravity loads. In such case, the floor by floor repetitive planning allows the walls to be vertically continuous which may serve simultaneously as excellent acoustic and fire insulators between the apartments. Shear walls may be planar but are often of L-, T-, I-, or U- shaped section (Figure 4) to better suit the planning and to increase their flexural stiffness.

The positions of shear walls within a building are usually dictated by functional requirements. These may or may not suit structural planning. The purpose of a building and consequent allocation of floor space may dictate required arrangements of walls that can often be readily utilized for lateral force resistance. Building sites, architectural interests or client's desire may lead the positions of walls that are undesirable from a structural point of view. However, structural designers are often in the position to advice as to the most desirable locations for shear walls in order to optimize seismic resistance. The major structural considerations for individual shear walls will be aspects of symmetry in stiffness, torsional stability and available overturning capacity of the foundations.

2. FUNCTION OF SHEAR WALL

Shear wall systems are one of the most commonly used lateral load resisting systems in high-rise buildings. Shear walls have very high in plane stiffness and strength, which can be used to simultaneously resist large horizontal loads and support gravity loads, making them quite advantageous in many structural engineering applications. 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 also provide lateral stiffness to prevent the roof or floor above from excessive sidesway. When shear walls are stiff enough, they will prevent floor and roof framing members from moving off their supports. Also, buildings that are sufficiently stiff will usually suffer less non-structural damage.

Use of shear wall gives a structurally efficient solution to stiffen a building. The main function of shear wall is to increase the rigidity for lateral load resistance in the tall buildings. Shear walls are commonly used as a vertical structural element for resisting the lateral loads that may be induced by the loads due to wind and earthquake. Besides they also carry gravity loads. A well designed system of shear wall in building frame improves seismic performance significantly. A box system structure that consists of reinforced concrete walls and slabs are used in high rise building.



The properties of seismic shear walls dominate the response of the buildings, and therefore it is important to evaluate the seismic response of the shear walls appropriately. Also it is necessary to find out the effective location of shear wall in the structure.

2.1 Advantages of Shear Walls in RC Buildings

Properly designed and detailed buildings with shear walls have shown very good performance in past earthquakes. Shear walls are easy to construct, because reinforcement detailing of walls is relatively straight-forward and therefore easily implemented at site. Shear walls are efficient, both in terms of construction cost and effectiveness in minimizing earthquake damage in structural and non-structural elements (like glass windows and building contents). Architectural Aspects of Shear Walls Most RC buildings with shear walls also have columns; these columns primarily carry gravity loads (i.e., those due to self-weight and contents of building).

3. PROBLEM

To check and compare effect of providing shear wall in low rise (6 storeys) at different locations of RCC framed building with following properties:

Plan dimension: 45m X 27m

Floor height: 3m

Thickness of shear wall: 0.23m

Thickness of slab: 0.15m

Beam and Column sizes:

1. For 6 storey:
All Beams= 0.23m X 0.60m

All Columns= 0.23m X 0.50m

Live load:

Top storey= 1.5 kN/m^2

Intermediate storey= 3.0 kN/m^2

Floor Finish= 1 kN/m^2

Earthquake data:

Type of strata: Medium

Seismic zone: IV

Importance factor, I: 1

Response reduction factor, R: 5

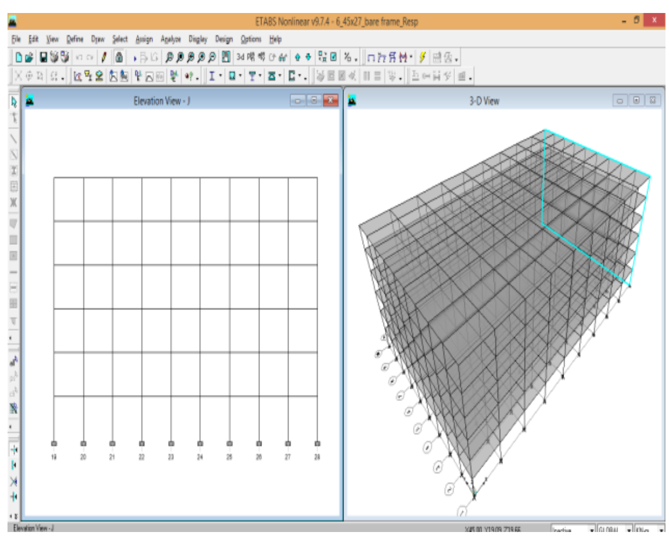
Concrete mix= M25 Steel= Fe415

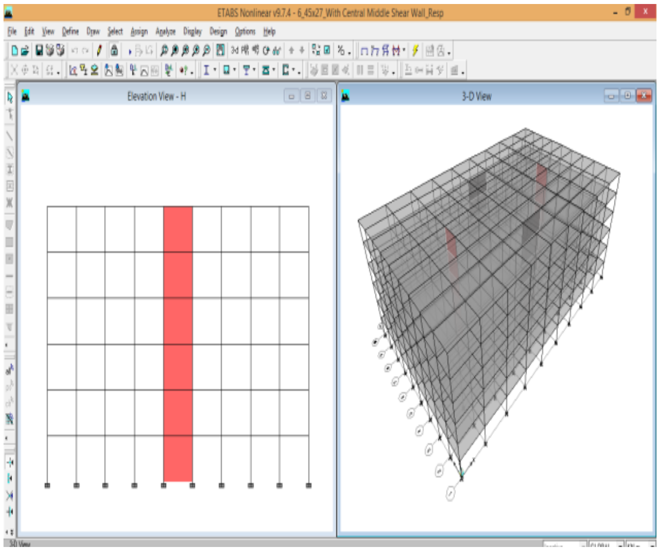
The modelling is done as considered above problem statement. The lateral loading considered is equivalent static load.

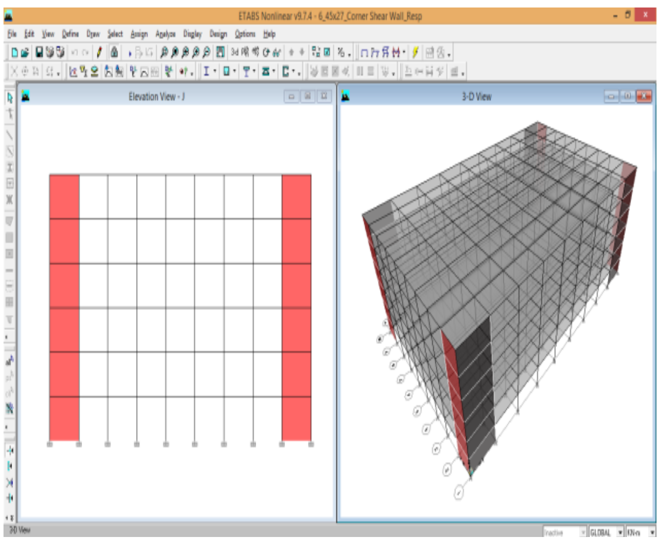
4. MODELS

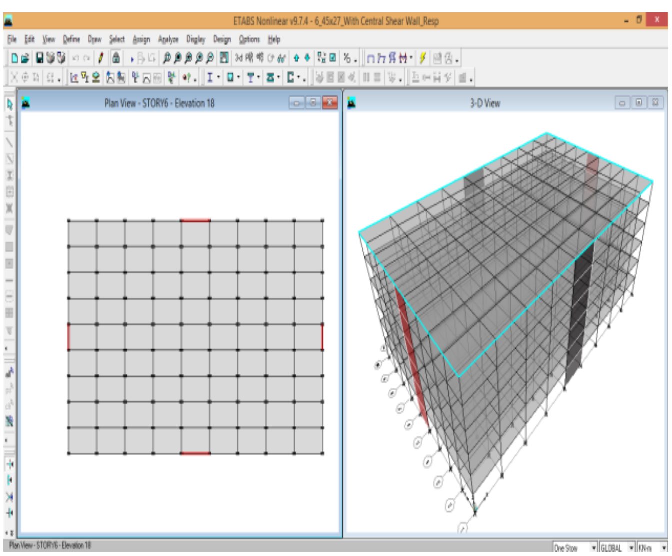
Model	Description
Model 1	6 storey- Bare frame structure without shear wall
Model 2	6 storey- Frame structure - shear wall placed at central middle of building
Model 3	6 storey- Frame structure - shear wall placed at centre of building

Model	Description
Model 4	6 storey- Frame structure - shear wall placed at core of building
Model 5	6 storey- Frame structure - shear wall placed at corner in L shape (4m) of building
Model 6	6 storey- Frame structure - shear wall placed at corner in L shape (8m) of building





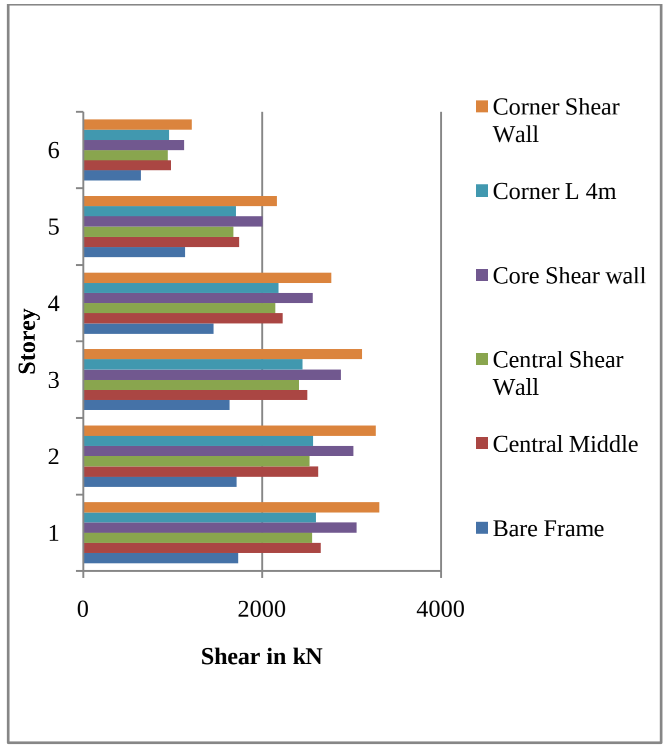




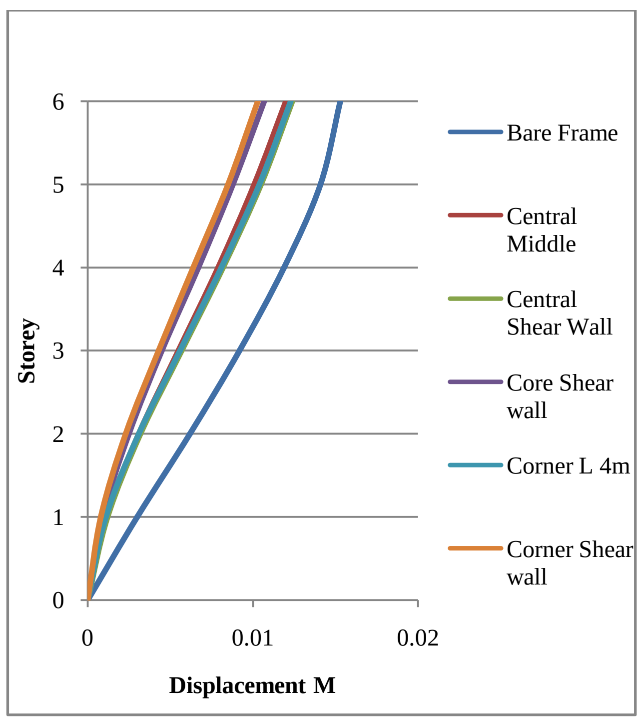
5. RESULTS

5.1 6 storey building

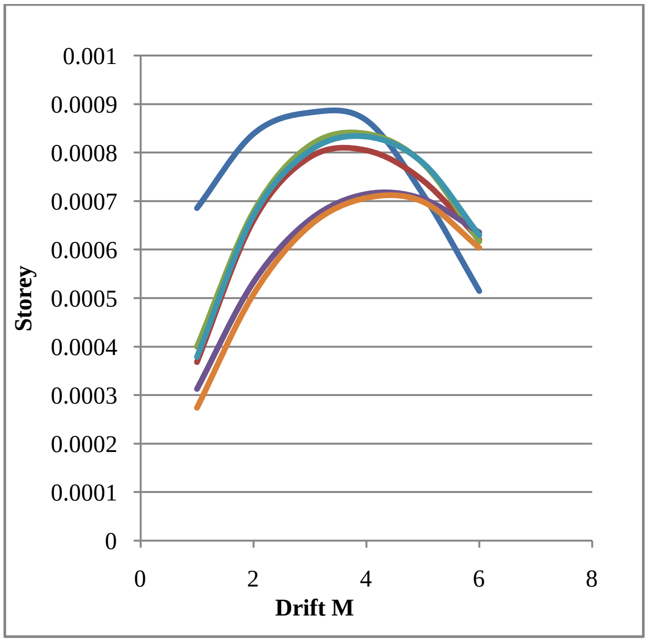
1) Base shear



2) Deflection



3) Drift



6. RESULTS

The results found plotted to get actual behaviour of structure and to judge the objectives of study. The results and their significance discussed here briefly.

From the graph of base shear for 6 storeys it clears that the base shear is maximum for model having shear wall at core of the structure. Base shear is least for structure without shear wall. When we increase the size of shear wall the seismic weight of structure increases and also the natural time period reduced so ultimately base shear increases.

The graph of displacement reflects that for structure having core shear wall the displacement is least. The maximum structural displacement for 6 storey building is 0.0281m for bare frame structure and least value is 0.0107m for structure with shear wall at core location. The displacement observed is within the limits specified in IS 1893:2002 (Part I).

The graph of drift reflects that for structure having core shear wall drift values are less than that of other structures. The nature of graph for bare frame is erratic. So it is very difficult to compare drift behaviour for different heighted structure.

7. CONCLUSION

- The shear wall located at core of building gives deflection in permissible limit but maximum base shear so it is more vulnerable to earthquake.
- The shear wall located at corner of building gives deflection in permissible limit also minimum base shear so it is less vulnerable to earthquake.
- The time period of frame with shear wall is less hence attract more base shear compared to bare frame.
- The location of shear wall affects various structural parameters.
- For Shear wall at corner L shape is effective location.
- In low rise (6 storey) building, even providing shear wall at different locations the structural parameters not much affected.

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