Structural Action of Monolithic Shear Wall on Various Structural Members of Building in Zone IV and V

Manisha Jadhav[1]

[1] *Manisha Jadhav , PG student, Department of Applied Mechanics, Government College of Engineering, Karad*
[2] *Prof.U.L. Deshpande, Associate Professor, Dept of Applied Mechanics, Government College of Engineering, Karad., Maharashtra, India.*

Abstract – *Constructions made of shear walls are high in strength, they majorly resist the seismic force, wind forces and even can be built on soils of weak bases by adopting various ground improvement techniques. In the present thesis, a there is analysis of G+10 building without shear wall and other four G + 10 building models with different position of shear wall. The building is modeled in ETABs 2018 software, and analysis is carried out with additional live loads on slab under linear static analysis method. This project study the review of shear wall by dynamic analysis method i.e. response spectrum method in zone IV and V. A comparison is made between RCC building without shear wall and building with different position of shear wall. The design is performed in accordance with the specifications and standards set out by the IS code and national building regulation.*

By studying different position of shear wall it was concluded that Corner Shear wall with 50% opening enhances the strength of normal RCC building with increasing the maximum storey displacement, reducing in storey drift as well as storey shear.

***Key Words*: Shear wall, storey displacement, storey shear, storey drift, storey stiffness, overturning moments etc**

1.INTRODUCTION

Because an earthquake causes the ground to shake, a building resting on it will suffer movement at its foundation. One of the current research areas is structural control, which tries to reduce structural vibration during loading such as earthquakes and severe winds. The purpose of the shear wall is to examine the various methods for securing tall constructions against the impact of heavy winds loading and seismic loading.The walls are structurally interwoven with the roofs and floors, as well as additional lateral walls that run across at right angles, giving the building structures three-dimensional solidity. The structural systems with shear walls are more stable. Because, in comparison to RCC framed buildings, their supporting area is significantly larger in relation to the entire plan area of the building. Shear walls are quick to build, and in a country like India, where shelter is critical in a short period of time, shear walls can be constructed swiftly. Shear walls have great in-plane stiffness and strength, allowing them to resist huge horizontal loads while also supporting gravity loads. In comparison to traditionally constructed brick constructions, the precision with which they are constructed is likewise very great. As a result, the primary goal of a shear wall is to construct a safe, tall, and attractive structure. This research aids in the investigation of wall strength and ductility.

1.1 Objective

1. To Study of different types of shear wall.
2. To Decide the position of shear wall.
3. To find out the response of structural members of building without shear wall in high seismic zone.
4. To find out the response of structural members of building with shear wall.
5. To compare the performance of both building
6. To find out the seismic characteristics of structure like storey drift, storey shear, base shear.

1.2 Methodology

1. Prepare software model on Etabs of G+10 RCC Symmetrical building.
2. Analysis conventional building model by using response spectrum method.
3. Decide appropriate location of shear wall in building.
4. Analysis and design building models with and without shear wall for seismic zones IV and V.
5. Compare results analytically by using Etabs.

1.3 Modelling

Model 1: G + 10 RCC building without Shear Wall.

Model 2: G +10 RCC building with corner shear wall and 50% opening.

Model 3: G+ 10 RCC building with full periphery shear wall and 30% opening for door and windows.
Model 4: G+10 RCC building with full periphery shear wall and 25% alternate opening for door and windows at two side of building.

Model 5: G+10 RCC building with full periphery shear wall and 38% alternate opening for door and windows at all side of building.

The details of proposed building are as follows

No. of storey – G+10

Plan area– 400 sq. meter

Plan dimensions – 20 m X 20 m

Height of building – 30 m

Beam – 0.230 m x 0.450 m

Column– 0.450 m x 0.450 m

Zone factor – zone 4 and 5

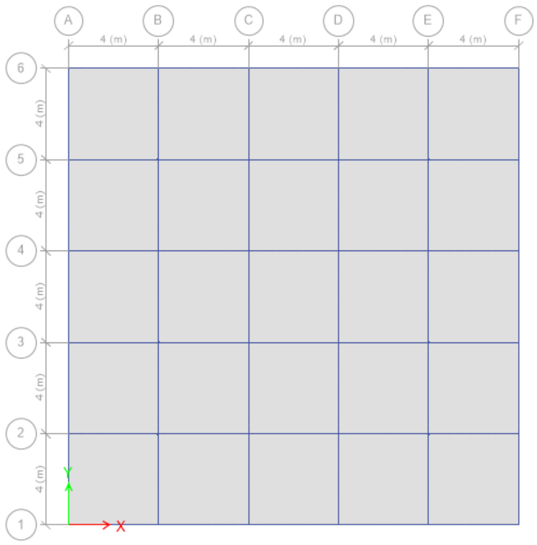

Fig 1: Plan of RCC building Without shear wall

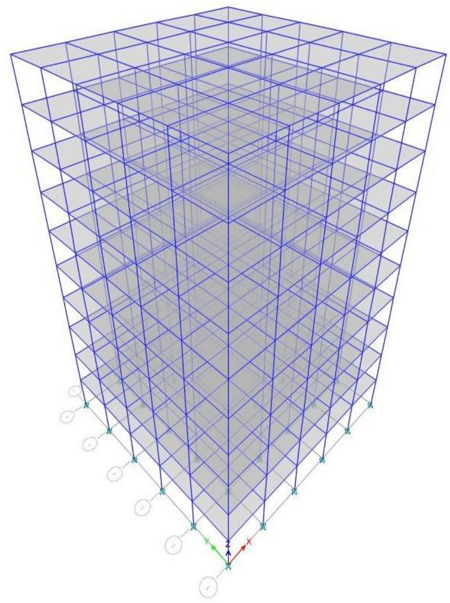

Fig 1: Plan of RCC building Without shear wall

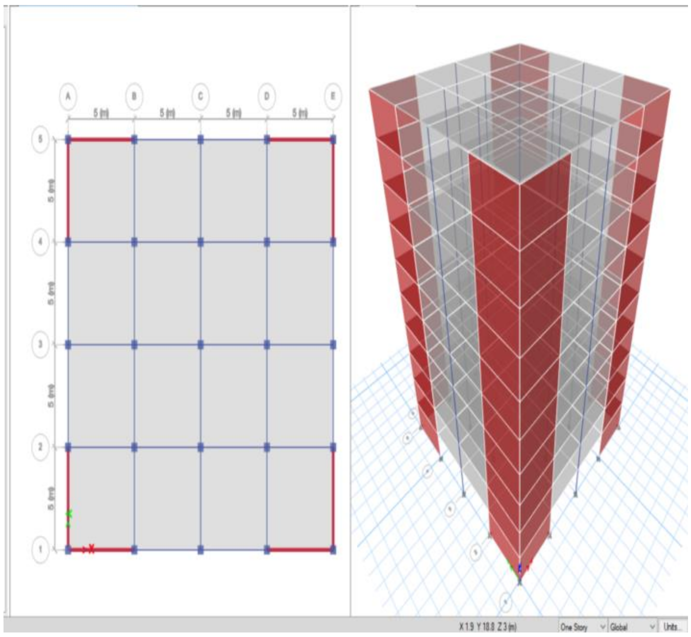

Fig 3: shear wall at corner with 50% opening

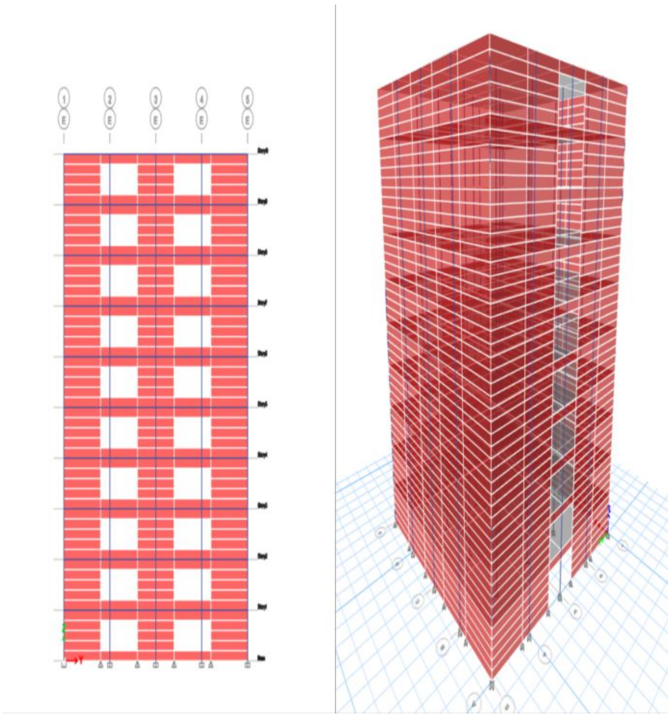

Fig 4: full shear wall with 30 % opening of door and window

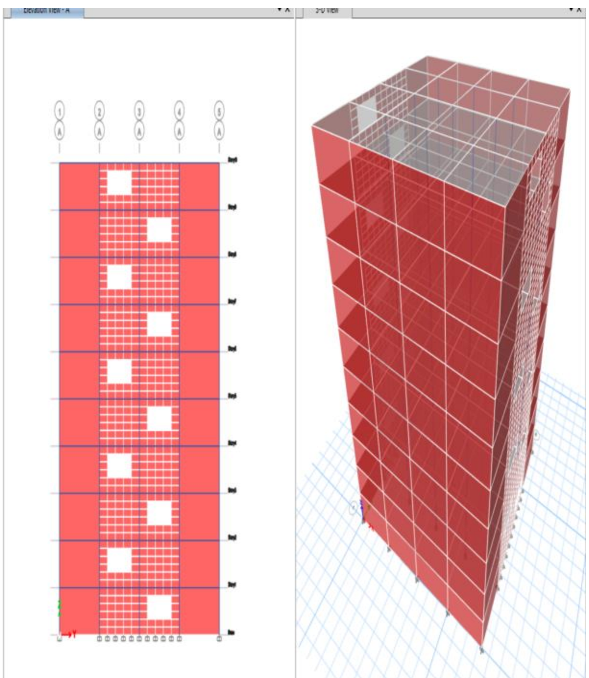

Fig 5: Full shear wall with 25% opening of door and window

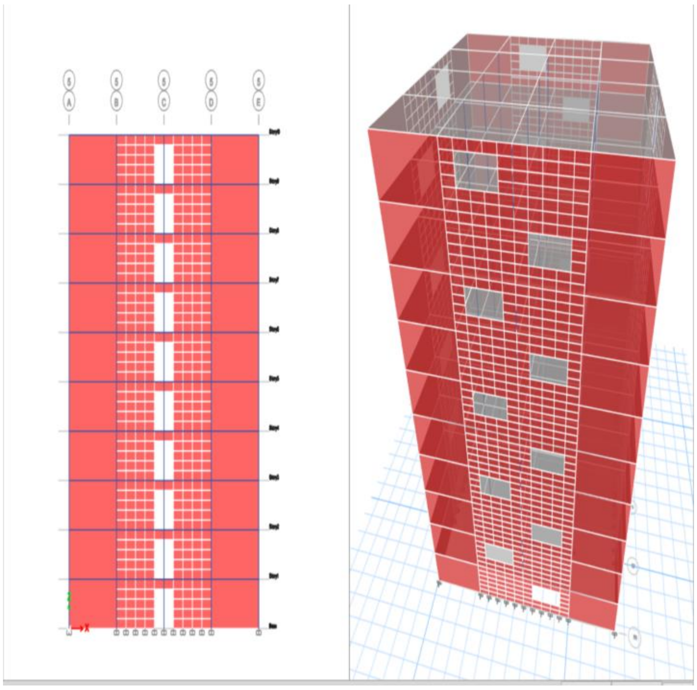

Fig 6: Full Shear wall with 38% of all side alternate opening of window and door

1.4 Load Calculations

Dead Load: 10 KN/ m^2

Live load: 2 KN/m^2(As per the IS 875 Part 1)

Floor Finish Load: 1KN/m^2

Seismic Loads (IS 1893:2016)

Seismic Zones Z= 0.24 and 0.36

Response reduction Factor R=5

Importance Factor I= 1

Silt Type=2

1.5 LITERATURE SURVEY

Surana and Singh [1] Investigated that both the wide column model and shell element model predict the strength capacities of the wall in close agreement with the experimental results. it can be concluded that shear-wall building has performed slightly better in comparison to the shear-wall core building. Nevertheless, performance of both the buildings designed for Indian code, is satisfactory.

Cao and Hang [2] they had done experimental studies on mid-rise shear wall with concealed truss was proposed. The experimental results show that The failure mode of the mid-rise shear wall with concealed truss is quite different with that of the ordinary mid-rise shear wall. The effect of the concealed truss lies in that it slows the development of the cracking, expands the distribution area of the cracking, extends the dissipation area of the bottom plastic hinge, and improves the post stiffness and integrated seismic capacity of the shear wall.

Tuken and Siddiquiper [3] In the present study, an easy to apply analytical method has been proposed to determine the amount of shear walls necessary to make reinforced concrete buildings seismic-resistant against moderate to severe earthquakes by using Turkish code.

Sen and Singh [4] They carried out investigation on performance of flat slab buildings of various heights, designed for gravity load alone according to code. In the proposed method, flat slabs are designed for gravity load alone, and number and sizes of shear walls are obtained to control the inter-storey drift within allowable limits. Once the sizes of the shear walls are obtained, the design can be performed according to the relevant codes.

2. RESULTS

2.1 Storey Displacement

Maximum storey displacement is the lateral displacement of the storey relative to the base. the lateral force resisting system can limit the excessive lateral displacement of the building. normally the storey drift ratio around the intermediate level of the building is more critical than that of top.

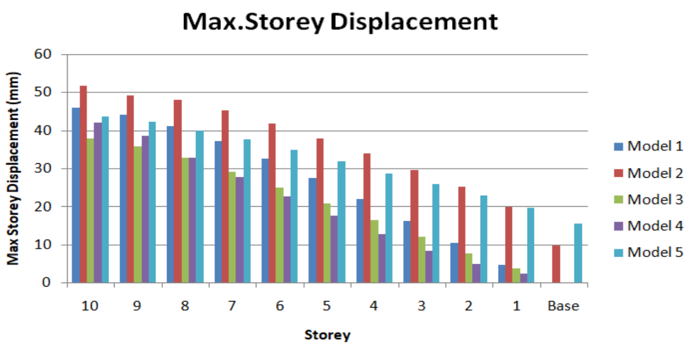

Chart 1: Max storey displacement for zone -IV

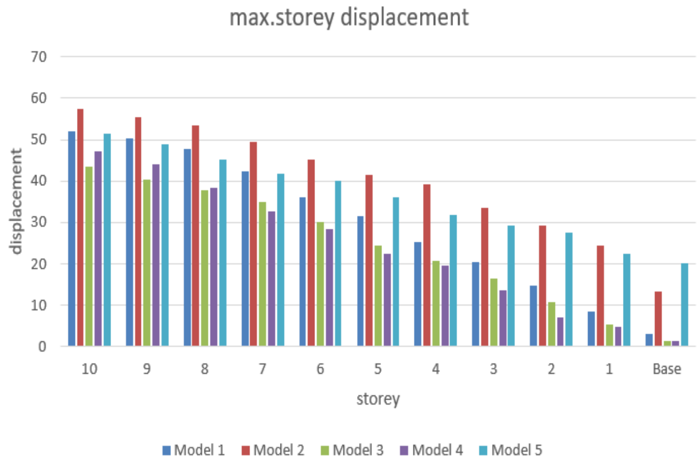

Chart 2: Maximum Storey displacement for Zone V

2.2 Storey Shear

Storey shear factor is the ratio of the storey shear force when storey collapse occurs to storey shear force when total collapse occurs. And base shear is an estimation of the maximum expected lateral force that will occur due to seismic ground motion at the base of structure.

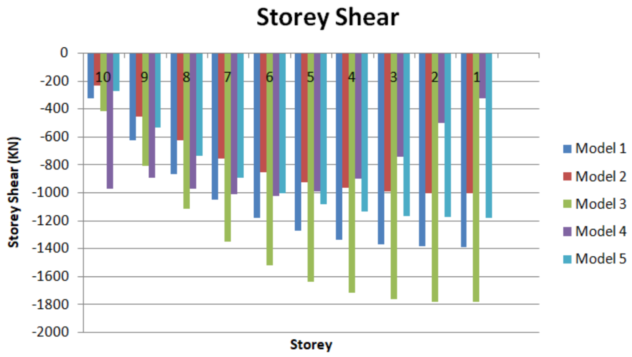

Chart 3 : Maximum Storey Shear for Zone IV

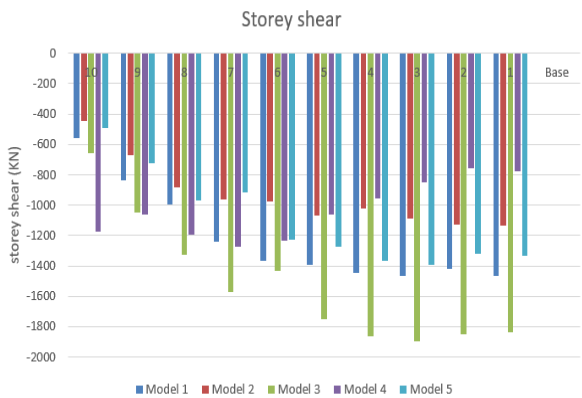

Chart 4 : Maximum Stroey Shear for Zone V

2.3 Storey drift

Storey drift is the lateral displacement of one level relative to the level above or below. Storey drift ratio is the storey drift divided by the storey height. Stroey drift is the difference of displacement between two consecutive storey divided by the height of that storey.

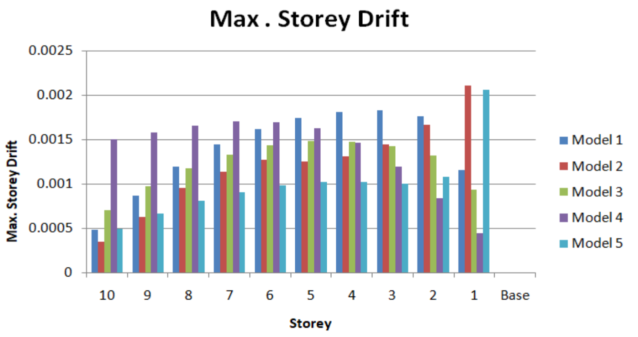

Chart 5: Maximum storey drift for Zone IV

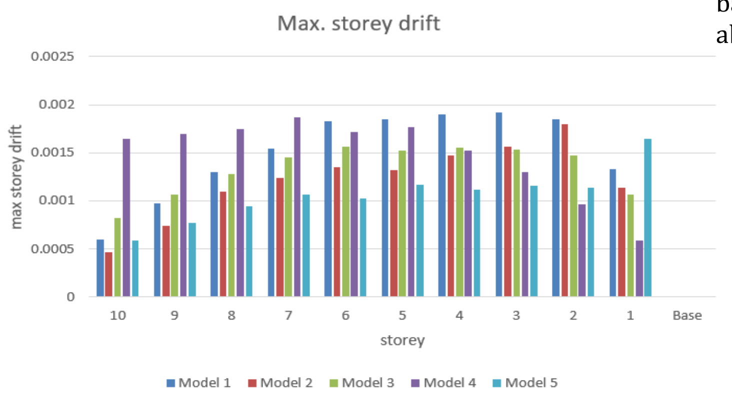

Chart 6: Maximum storey drift for Zone V

2.4 Storey Stiffness

storey stiffness is estimated as the lateral force producing unit translational lateral deformation in that storey, with the bottom of the storey restrained from moving laterally, i.e., only translational motion of the bottom of the storey is restrained while it is free to rotate. Storey

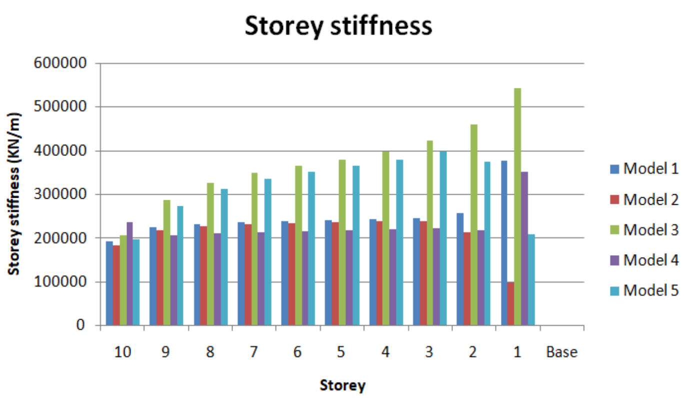

Chart 7: Maximum storey Stiffness for Zone IV

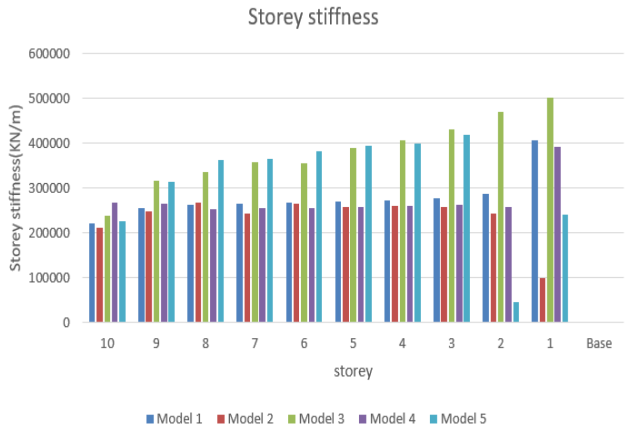

Chart 8: Maximum storey Stiffness for Zone V

2.5 Overturning moments

Overturning moment is the torque due to the resulting applied forces about the points of contact with the ground or base. If the torque is more than the torque due to self-weight about the base line the body will overturn.

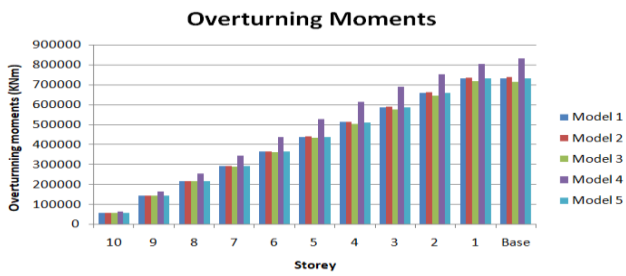

Chart 9: Overturning moments for Zone IV

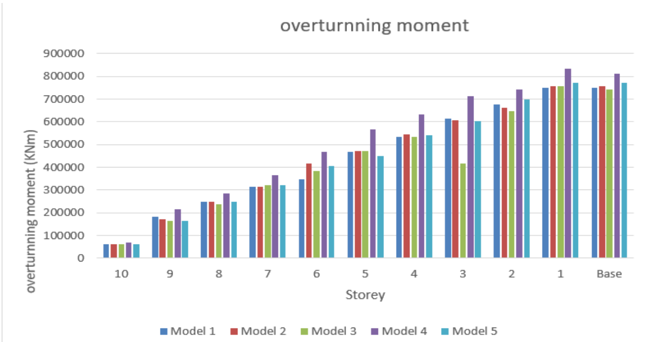

Chart 10: Overturning moments for Zone V

3. CONCLUSIONS

Conclusions that can be drawn from study are as follows-

1. Use of corner shear wall in Zone IV and V with 50% opening increases the maximum storey displacement of the structure by average of 40%. This increases the flexibility of structure and makes the structure stable during earthquake occurrence.

2. According to results for Zone IV and V , Story drift is reduced by 29% due to use shear wall at corner with 50% opening which gives satisfactory performance during events of earthquakes.

3. Story shear is reduced by 31% due to use corner shear wall with 50% opening in Zone IV and V. This makes the structure stable during earthquake.

4. Story stiffness is not much affected. It is increased, but with less rate for same zone IV and V .

5. Time period is considerably increased for corner shear wall building with 50% opening for Zone IV and V. This increased time period reduces the acceleration and increases the reaction time for structure. This improves the performance of the structure against the earthquake.

From above results it conclude that, Shear wall located at corner with 50 % opening is give better performance than the other location with different percentage of opening of shear wall in high seismic zone IV and V comparatively plain RCC building without shear wall.

3.1 Future Scope of work

1. Present work is comparison for for seismic zones IV and V. This method can be studied for zone I, II, III.

2. This study is conducted by using RCC shear wall. Use another types of shear wall for further study.

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