SEISMIC ANALYSIS OF HIGH RISE BUILDING WITH SHEAR WALL AT DIFFERENT LOCATIONS

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***Abstract*: Modern trends towards high rise buildings increases recently due to the high increase in the number of tall buildings, both residential and commercial .Shear walls are structural members used to augment the strength of RCC structures. The concrete vertical walls will serve both architecturally as partitions and structurally to carry gravity and lateral loading .construction made of shear wall high in strength they are highly efficient in taking load in earthquake prone area as they have peculiar behavior towards various types of loads. There are four models of G+15 storey building located in seismic zone III for earthquake is studied using software packages ETABS. The aim is to study the behavior of reinforced concrete building by conducting dynamic analysis for most suited position and location of shear wall with and without openings. The seismic parameters are considered as displacements, base shear, storey drift. Earthquake responses under zone III earthquake as per IS 1893(Part 1): 2016 have been carried out. The most important responsibility is to ensure that our buildings are safe in earthquakes. Shear wall can be one of the structural systems for high rise building to withstand earthquake.**

***Keywords*: Shear Wall, ETABS, High Rise, Seismic Analysis, Storey drift, storey displacement.**

Introduction

Life of a person is the most precious thing in the world. Disasters are unexpected, so life of people is in danger due to some natural disasters. Among all the natural disasters, Earthquake causes maximum loss of life. We are heavily dependent upon the civic amenities; earthquake can disturb them in major way. Sudden rapid shaking of the earth when the energy stored in the rock is released is an Earthquake. "**Earthquake doesn't kill people but buildings do**."

History from ancient pyramids to today's modern skyscrapers has always fascinated mankind with height. There is rapid increase of tall building development throughout worldwide. Housing demand is increasing significantly, especially in countries with high population growth and rapidly developing economies. In comparison with earlier high-rise buildings, today's tall buildings are becoming more and more slender and leading to the possibility of more sway.[2] Earthquake loads can develop high stresses, produce sway movement or cause vibration. Therefore, it is very important for the structure to have sufficient strength against vertical loads together with adequate stiffness to resist lateral forces. The design criteria for tall buildings are stability, strength, serviceability and human comfort. There are many vertical and lateral systems for earthquake performance. (a) Moment Frame Systems (b) Structural Wall-Frame Systems (c) Braced Frame Systems (d) Tube System Shear wall (Structural wall system) is one of the structural systems that provide lateral resistance to a structure.

"We cannot afford to build concrete buildings meant to resist severe earthquakes without shear walls".[11] Properly-designed shear walls not only provide safety but also give a proper measure of protection against costly structural as well as non-structural damage during seismic activity.[7] Shear walls (structural wall system) are a type of structural system that provides lateral resistance to a building or structure. They resist in plane loads that are applied along its height. By constructing shear walls damages due to effect of lateral forces due to earthquake and high winds can be minimized [12]. Shear walls are structurally integrated into the roof / floor that run at right angles to them and other side walls, providing three-dimensional stability to the building. Architects and Structural Engineers should consider the safety factor while designing high rise Buildings. As earthquakes are becoming more intense due to the key that is ground water depleashement, hence in order to overcome the diverse effect of earthquake it's always best to save ourselves from future disasters. Shear wall thickness can be as low as 150mm, or as high as 400mm in high rise buildings. Seismic structures are structures designed to withstand earthquakes, but no structure is completely immune to seismic damage, but the goal is to build structures that perform better during seismic activity.

OBJECTIVES

1. To study the location of shear wall in high rise building
2. To study the design consideration for shear wall.
   a) Thickness
   b) Rigidity of shear wall
3. The effect of types of shear wall on structural response under seismic loading.
   a) Simply rectangular.
   b) Shear wall with opening.
   c) Core type shear wall.
4. To compare the deflection due to provision of Shear walls at different positions.

5. To check the base shear, storey displacement, storey drifts.

ANALYSIS:
In this study, There are four models of G+15 storey building with 3meters height of each storey located in seismic zone III for earthquake is studied using software packages ETABS. The models are symmetric in plan was modeled. These buildings were designed according to the Indian code Practice of seismic design of buildings. Models were studied in zone III and comparison is done for storey drift, storey displacement in X and Y direction.

Table 1 List of models

Model 1	Building with shear wall at centre core
Model 2	Building with shear wall opening one on each side at centre
Model 3	Building with shear wall one on each side at centre on inner side
Model 4	Building with shear wall at corners on each side

DETAILS OF BUILDINGS:

Building Parameters	Details
Type of frame	Special RC moment resisting frame fixed at the base
Building plan	17.5mx17.5m
Number of storey	15
Floor Height	3.0m
Depth of slab	150mm
Size of beam	(230x600)mm
Size of column	(300x600)mm
Spacing between frames	3.5m along x-direction 3.5m along y-direction
Live load on floor	2KN/m2
Floor finish	1.5KN/m2
Wall load	9KN/m2
Grade of concrete	M25
Grade of steel	Fe500
Thickness of shear wall	200mm
Seismic zone	III
Type of soil	Medium
Damping	5 percent

Building Design Requirements:
The proposed reinforced concrete shear wall buildings are located in zone III, India. Code requirements from IS 456: 2000, IS 13920: 1993 and IS 1893 (part 1): 2002 were used for structural design. In the ETABS design model, modeling was done in order to verify sufficient strength and stiffness.

Load combinations:
As per IS 1893 (Part 1): 2002 Clause no. 6.3.1.2, the following load cases have to be considered for analysis:
1.5 (DL + LL)
1.2 (DL + LL ± EL)
1.5 (DL ± EL)
0.9 DL ± 1.5 EL
Earthquake load must be considered for +X, -X, +Y and –Y directions.
Design of beams:
General requirements:
The flexural members shall fulfill the following general requirements. (IS 13920; Clause 6.1.2)
$b/D \geq 0.3$
In the present study beam of size (300X 600) mm has been used.
Here, b/D= 230/ 600 = 0.38> 0.3.
Hence, ok.
As per IS 13920; Clause 6.1.3
b ≥ 200 mm
Here b = 300 mm ≥ 200 mm
Hence, ok.
As per IS 13920; Clause 6.1.4
The depth D of the member shall preferably be not more than ¼ of the clear span. Here, D=600mm and clear span length is 3500mm. ¼ (clear span) = 3500/4 =875 mm > 600mm

Hence, ok.

Design of columns:

In the present study, the minimum dimension of the member provided is 300mm. Also the shortest dimension provided is 300 mm. As per IS 13920; Clause 7.1.2, the minimum dimension of the member shall not be less than 200 mm. Hence the above clause is in fulfillment of the building models.

Column has a cross section of 300 X 600 mm.

b/D =300/600 =0.5> 0.4.

Hence, ok.

As per IS 13920; Clause 7.1.3, the ratio of the shortest cross sectional dimension to the perpendicular dimension shall preferably not be less than 0.4.

Hence, the columns satisfy the clause.

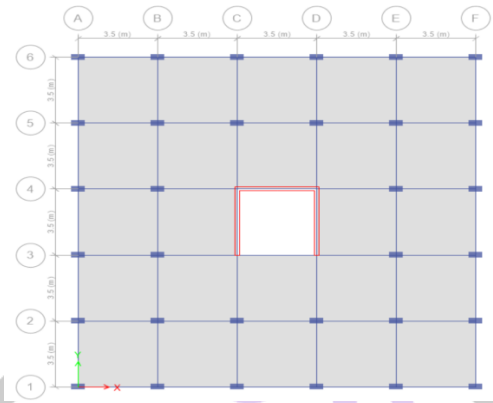


Figure 1: Plan of building with shear wall at center core

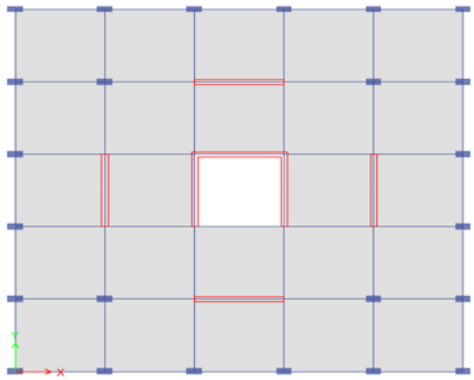


Figure 2: Plan of building with shear wall opening one on each side at center

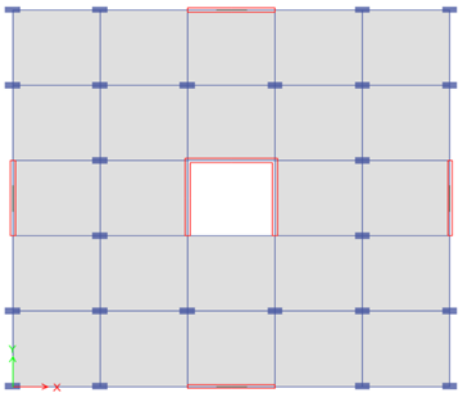


Figure 3: Plan of building with shear wall one on each side at centre on inner side

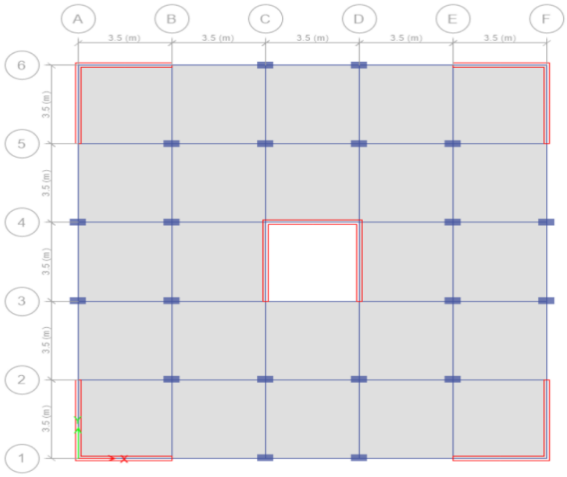
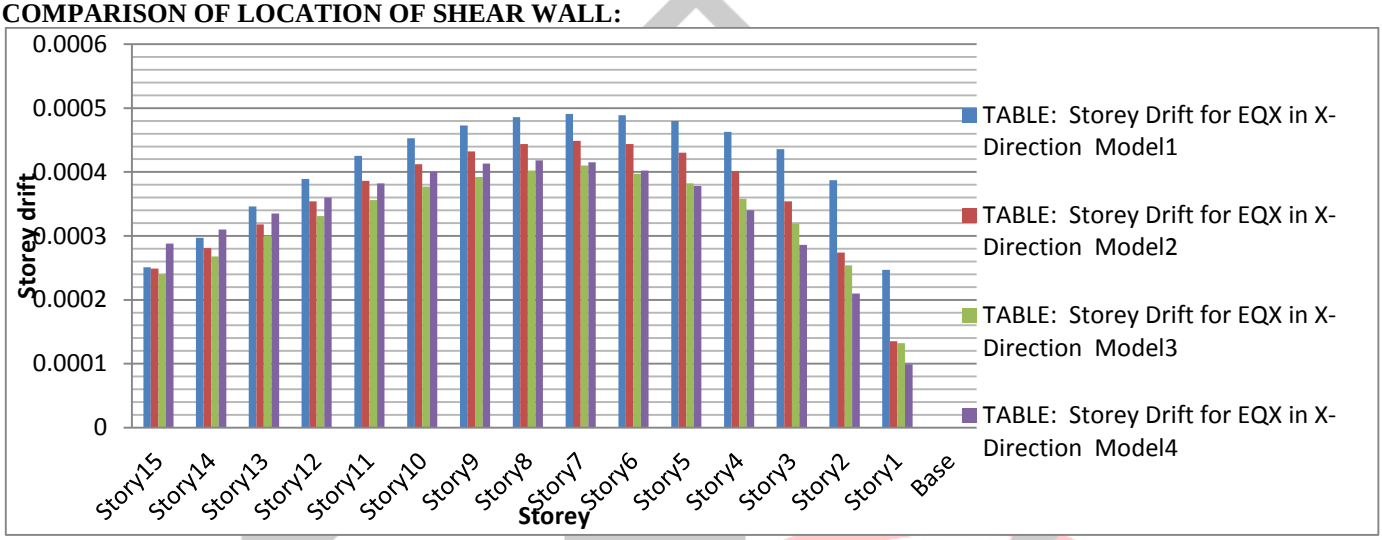
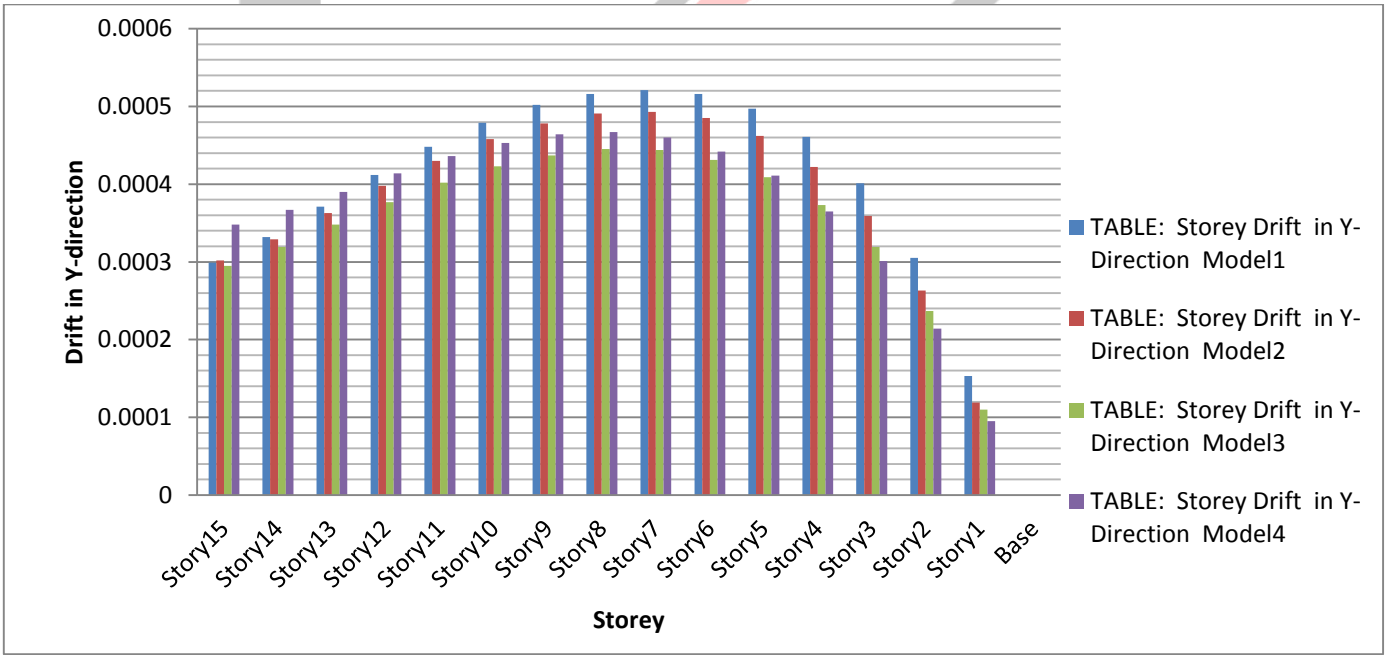


Figure 4: Plan of building with shear walls at corners on each side

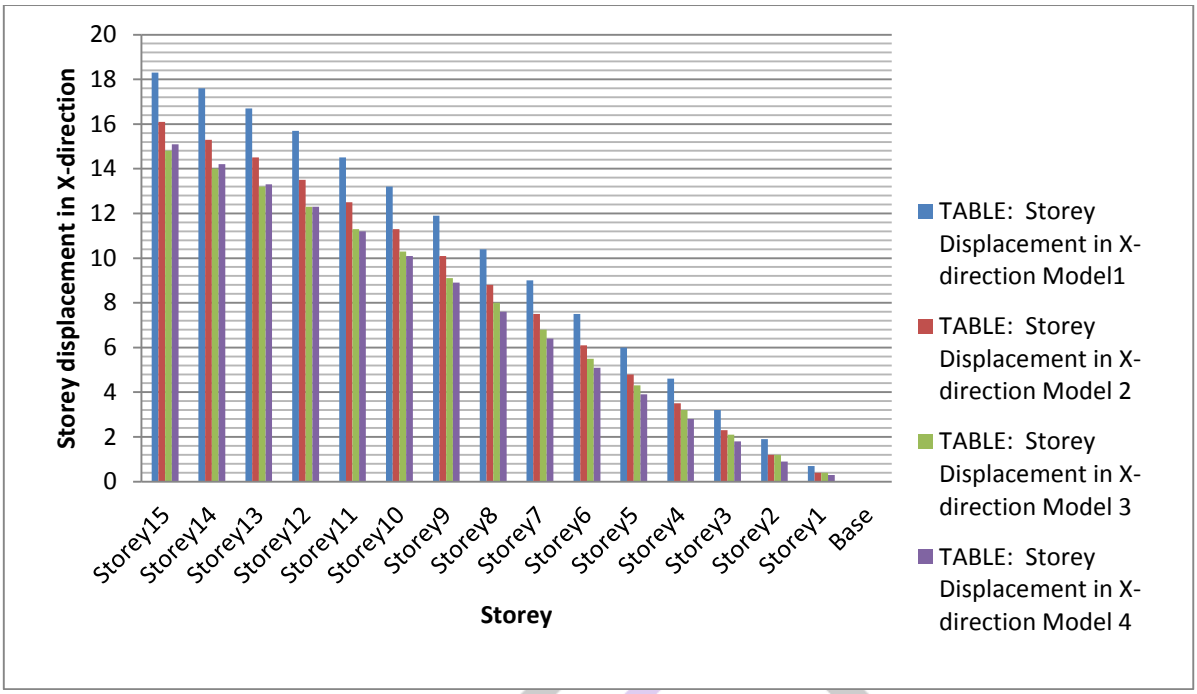
COMPARISON OF LOCATION OF SHEAR WALL:



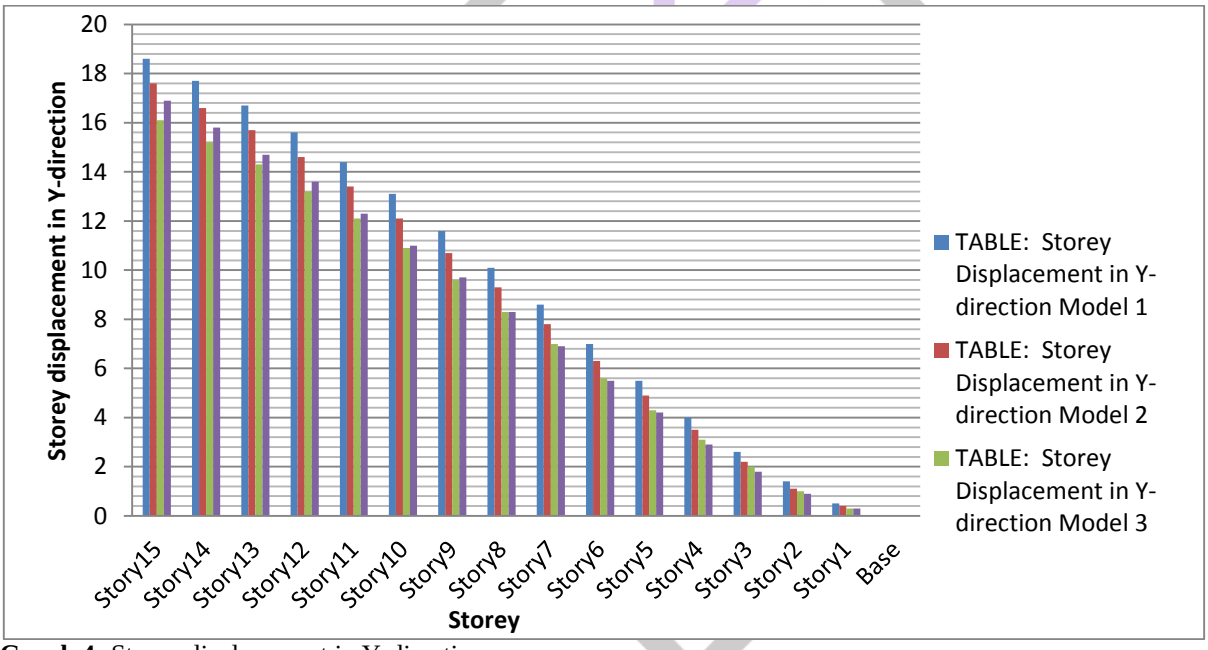
Graph 1: Storey drift in X-Direction



Graph 2: Storey drift in Y-Direction



Graph 3: Storey displacement in X- direction



Graph 4: Storey displacement in Y-direction

Proper position of shear walls will provide effective and efficient building performance during earthquake. This study of Zone III G + 15-storey buildings presents several studies. These investigations are analyzed by changing the various positions of the shear walls to determine parameters such as storey drift, storey displacement and base shear.

The above graph (1 and 2) shows that the storey drift in X-direction and Y-direction of model 3(i.e building with shear wall one on each side at centre on inner side) shows the minimum storey drift in X and Y direction.

The above graph (3 and 4) shows that the storey displacement in X-direction is minimum for top storey of model 3 and in Y-direction storey displacement is minimum for model 3(i.e building with shear wall one on each side at centre on inner side) is minimum as compared to other models.

Base shear is very important in seismic analysis and the design of the building.

CONCLUSION:

1. Storey displacements are lesser when the shear walls are introduced in the building.
2. Storey drifts of a structure are at the bottom storey is less compared to top storey.
3. Storey stiffness of a structure at the bottom storey is more compared to top storey of the structure.
4. The provision of shear wall has significant effect on base shear, storey drift, storey displacement. The presence of shear wall can increase the strength and stiffness of the structure.

5. Building with shear wall are more resistive to earthquake prone area due to its higher resistive to earthquake loads.
6. On the basis of study we can conclude that the best location of shear wall is at the corner on each side on inner side of building.
7. Thus the behavior of shear wall is studied through above objectives, hence storey drift and storey displacement should be considered while designing high rise building.

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