RESEARCH ARTICLE OPEN ACCESS

Analysis of Building with and with out Shear Wall at Various Heights and Variation of Zone III and Zone V

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ABSTRACT
It is well recognized that the incorporation of lateral load resisting systems in the form of shear walls, bracing systems etc. improve the structural performance of buildings subjected to lateral forces due to earthquake excitation. The seismic behavior of buildings is strongly affected by the arrangement of shear walls, the rigidity of floors and the connections of floors to the walls. The building with structural shear walls Improve the lateral load resistance. In the present project, an analytical parameter study is done for the structural shear walls with varying height for different models. The load combinations are consideration as per IS 1893 (Part-1):2002. 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.As well as two reinforced concrete framed regular buildings with different zones locations of shear walls situated in seismic zone III and zone V have been analyzed in this study. Five-storied buildings were taken with shear-walls and without shear-walls. The design is above verified for this same structure using extended three dimensional analysis of buildings (STAAD Pro V8i) software.
Keywords: Shear wall, Wind loads, Earth quake loads, Staad pro v8i

I. INTRODUCTION

The primary purpose of all kinds of structural systems used in the building type of structures is to support gravity loads. The most common loads resulting from the effect of gravity are dead load, live load and snow load. Besides these vertical loads, buildings are also subjected to lateral loads caused by wind, blasting or earthquake. Lateral 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. Shear walls are vertical elements of the horizontal force resisting system. Shear walls are constructed to counter the effects of lateral load acting on a structure. In residential construction, shear walls are straight external walls that typically form a box which provides all of the lateral support for the building. When shear walls are designed and constructed properly, they will have the strength and stiffness to resist the horizontal forces. Shear walls are one of the most effective building elements in resisting lateral forces during earthquake. By constructing shear walls damages due to effect of lateral forces due to earth- quake and high winds can be minimized. Shear walls construction will provide larger stiffness to the buildings there by reducing the damage to structure and its contents.

II. LITERATUREREVIEW

2.1 Previous studies

Viviane Warnotte summarized basic concepts on which the seismic pounding effect occurs between adjacent buildings. He identified the conditions under which the seismic Pounding will occur between buildings and adequate information and, perhaps more importantly, pounding situation analyzed.

Shehata E. Abdel Raheem developed and implemented a tool for the inelastic analysis of seismic pounding effect between buildings. They carried out a parametric study on buildings pounding response as well as proper seismic hazard mitigation practice for adjacent buildings.

2.2 Present study

In the present problem the G+5 storey building with RCC elements as columns and beams, those building outside panels are provided with shear wall and the interior panels of the building are without shear wall are modeled of this problem. The model is prepared by using STAAD Pro analysis software.

The details of modeling are presented and prescribed the node displacements of buildings having with and without shear wall models of earthquake effect of Zone III. The bending moment of the members of the buildings having with and without shear wall models of earthquake effect of Zone III.The axial force of the members of the buildings having with and without shear wall models of earthquake effect of Zone III.The variation of node displacements of buildings having with and without shear wall of earthquake effect of Zone III and Zone V.The variation of axial force of the members of the buildings having with and without shear wall of earthquake effect of Zone III and Zone V.

III. LOAD CALUCULATIONS

Loads and load combinations are given as per Indian Standards.(IS 875:1987, IS 1893:2002 and IS800:2007)

3.1 Gravity Loading

Floor load and Dead loads are calculated as per genera considerations as per IS 875 Part- I.

Live load –4 kN/m^2

3.2 Wind Loading

Static wind load is given as per IS875-Part-III According to IS CODE (875 Part-III),

$V_z = V_b \times K_1 \times K_2 \times K_3$

Where

V_z is Design wind speed at a height z meter in m/s.

V_b is basic design wind speed at 10m height.

P_z is Design wind pressure at a height z meter.

$P_z = 0.6 V_z^2$.

The following assumptions are taken for the wind load calculation

- Location–Visakhapatnam
- Windspeed–50m/s (ref Appendix 5)
- Terraincategory–3 and Class–C
- K_1–1.08(life-100years)
- K_2–dependinguponthevariationofheight
- K_3–1.00(flat topography)

Dynamic wind load also calculated by using gust factor approach.

3.3 Seismic Load

Vertical Distribution of Base Shear to Different Floor Level.

The design base shear (V) shall be distributed along the height of the building as per the following expression:

$$Q_i = V_B \frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2}$$

Qi =Design lateral force at floor

Wi =Seismic weight of floor i,

hi =Height of floor i measured from base, and

n=Number of storeys in the building is the number of levels at which the masses are located.

IV. MODELING OF STRUCTURE

4.1Description of Building

The size of the building in plan - 12 m x 16 m.

Type of structure: Multi-storey RC frame structure

Occupancy: Commercial building

Number of stories: 6 (G+5)

Ground storey height: 2 m

Intermediate floor height: 3 m

Type of soil: Medium soil

Site location: Visakhapatnam

4.2 Materials

Grade of concrete: M_{25}

Grade of steel: Fe-415

Modulus of elasticity of brick masonry:13.8x10^6 kN/m^2

Density of concrete: 25 KN/m^3

Density of masonry infill: 22 KN/m^3

4.3 Member Dimensions

Column size: 400 mm * 400 mm

Slab thickness: 150 mm * 150 mm

Beam size: 450 mm * 230 mm

Wall thickness: 230 mm

Live load on floor: 4kN/m^2

Live load on roof: 1.5 KN/m^2

All the supports are assumed to be fixed in nature.

4.4 Model of structure

The modeling and analysis are done using STAAD ProV8i software, and then the nodal displacements, bending moments and axial forces have been obtained as a result of analysis.

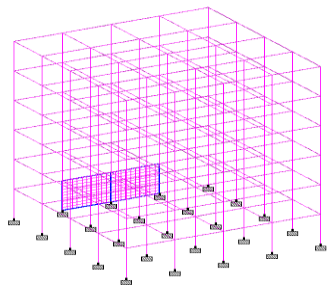


Figure 1 *with Shear Wall Model -1*

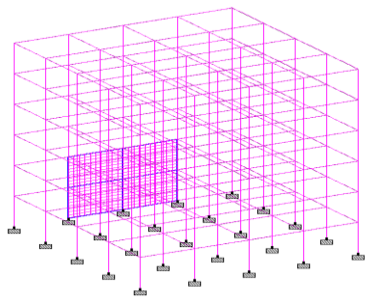


Figure 2 With Shear up to 1st floor Wall Model -2

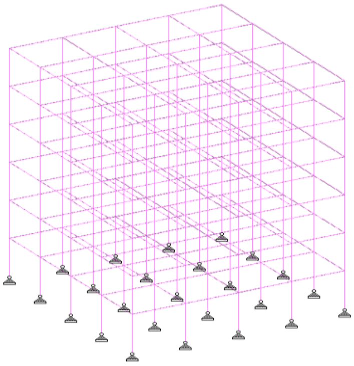


Figure 3 *without shear wall*

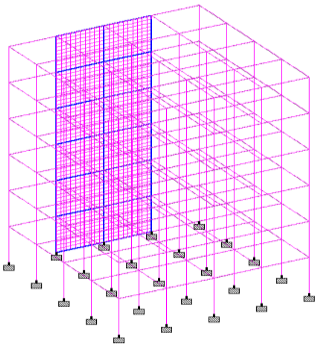


Figure 4 *With Shear up to 5th floor Wall Model – 6*

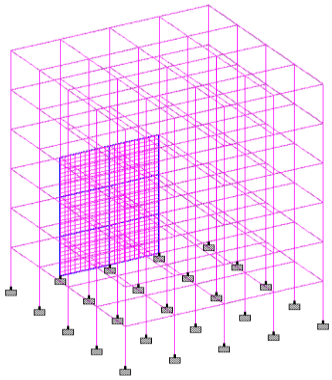


Figure 1 *With Shear up to 2nd floor Wall Model -3*

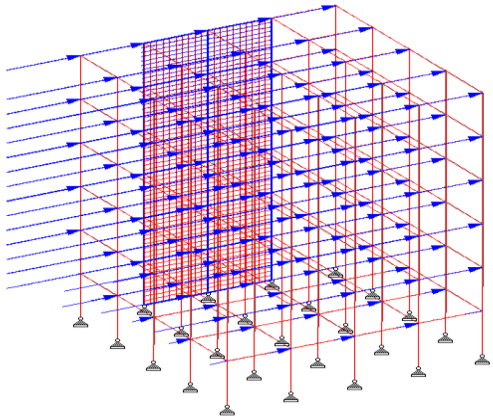


Figure 5 *With Shear up to 5th floor Wall Model – 6 Shear wall with earthquake load +x*

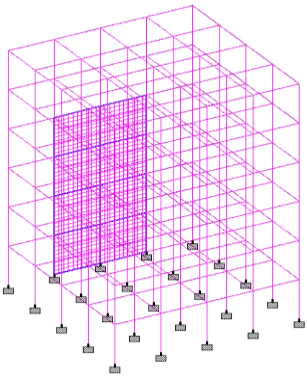


Figure 2 *With Shear up to 3rd floor Wall Model -4*

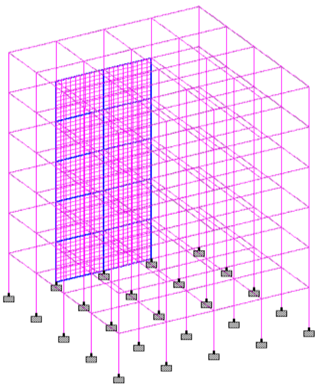
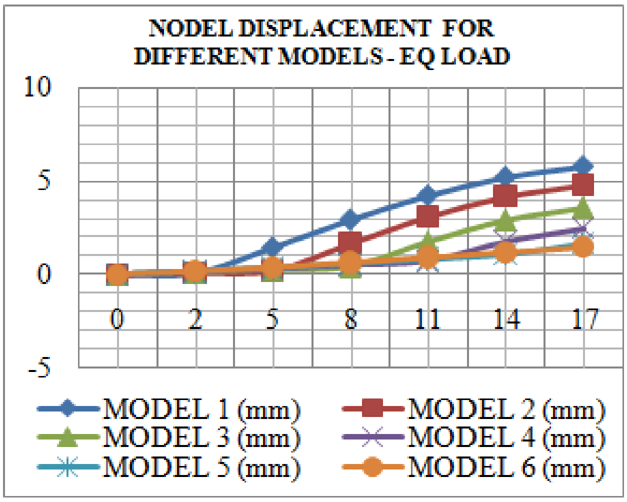


Figure 3 *With Shear up to 4th floor Wall Model -5*

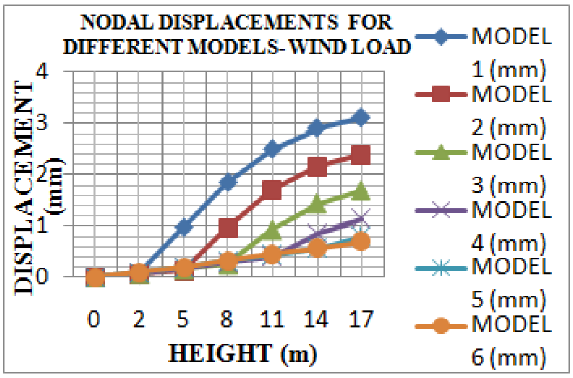
V. RESULTS AND GRAPHS

5.1 Analysis Results of Nodal Displacements

5.1.1 For Zone III, Variation of node displacements with heights for external column in X-direction (without and with shear wall for different models)



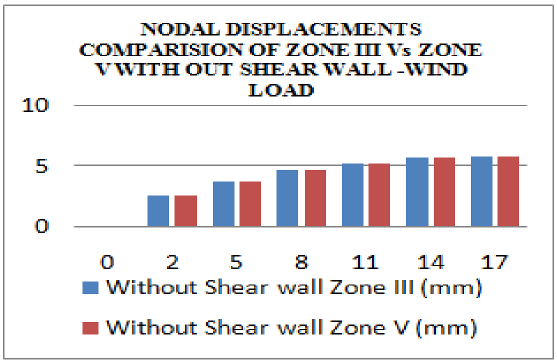
Graph 1: *Variation of node displacements (on Y-axis) with heights(on X-axis) for earthquake load.*



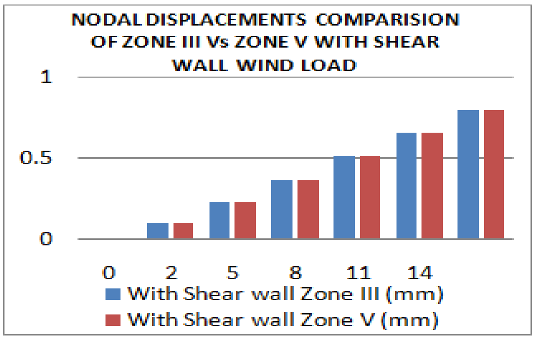
Graph 2:*Variation of node displacements with heights for wind load condition.*

The nodal displacements in the exterior columns of building without shear walls are more compared to building with shear wall for both earthquake and wind loads.

5.1.2 Variation of nodal displacements by comparing Zone III and Zone V for external column in X-direction.

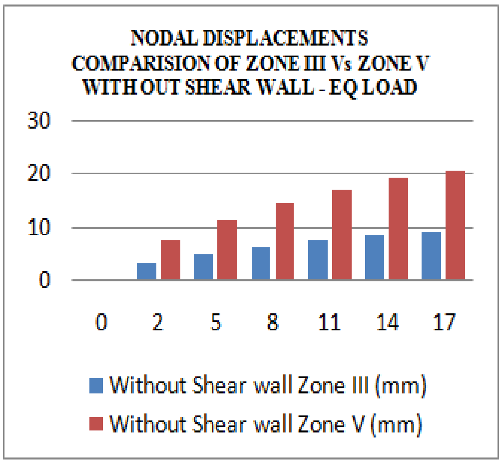


Graph 3: *Variation of node displacements(on Y-axis) with heights (on X-axis) (with out shear wall- wind load)*

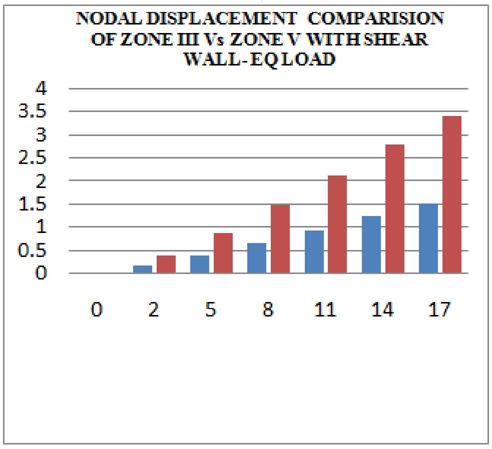


Graph 4: *Variation of node displacements (Y-axis) with heights (X-axis) (with shear wall–wind load)).*

Comparison of Zone III and V for the wind effect, the nodal displacements in the exterior columns with Shear wall and without shear wall structure are same.



Graph 5:*Variation of node displacements (Y-axis) with heights (X-axis) (with out shear wall –EQ load).*

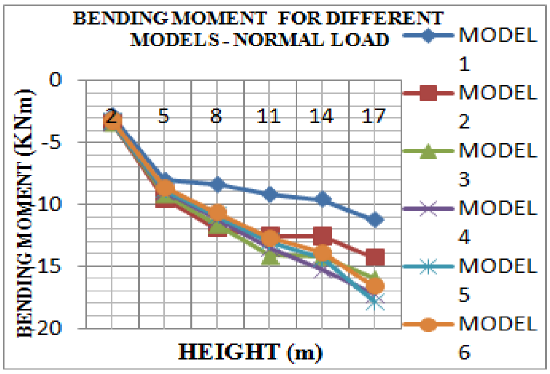


Graph 6: *Variation of node displacements (Y-axis) with heights(X-axis) (with shear wall –EQ load).*

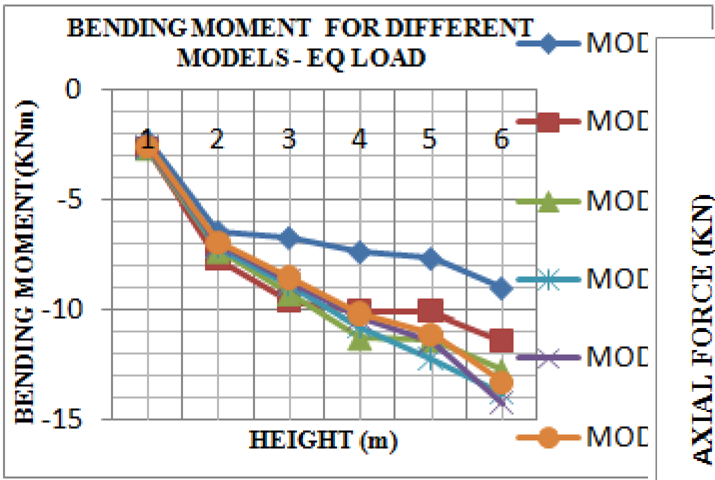
The nodal displacement is more for Zone V compared with Zone III for earthquake load.

5.2 Analysis Results of Bending Moment

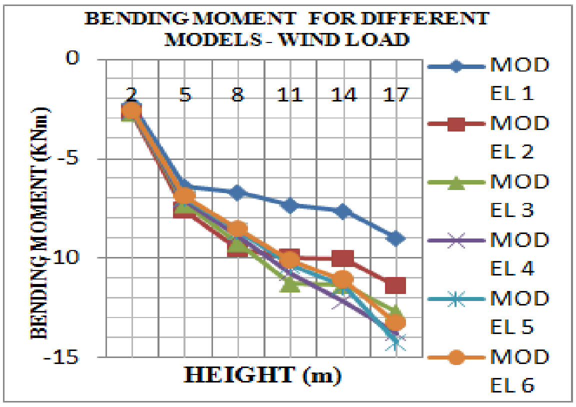
5.2.1 for Zone III, variation of Bending Moment with heights for external column in X-direction (without and with shear wall for different models).



Graph 7: *variation of bending moment with heights for normal load condition.*



Graph 8:*variation of bending moments wih heights for eq load condition*

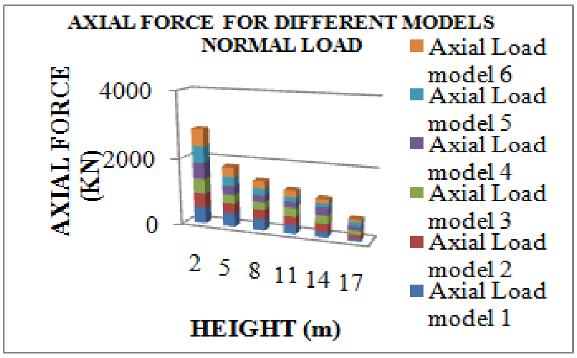


Graph 9: *variation of bending moment with heights for wind load condition*

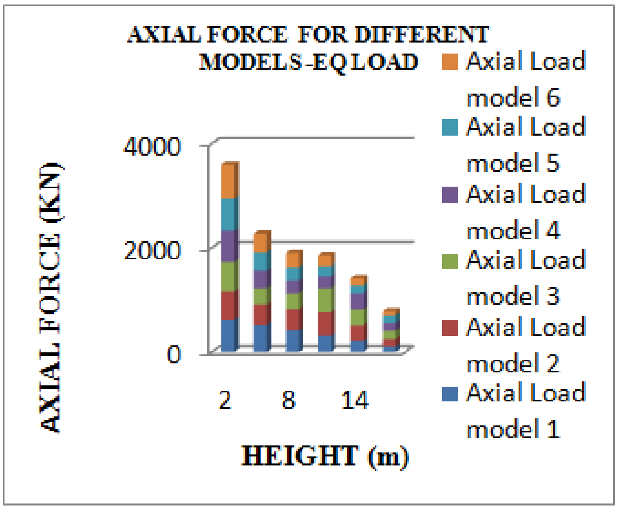
There is a small variation of Bending moment for building with and without shear wall.

5.3 Analysis Results of Axial Forces

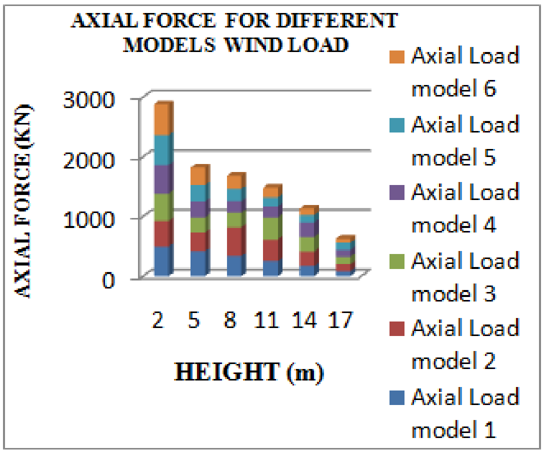
5.3.1 for ZoneIII, Variation of Axial Force with heights for external column in X-direction (without and with shear wall for different models)



Graph 10:*Variation of axial force with height for normal load*



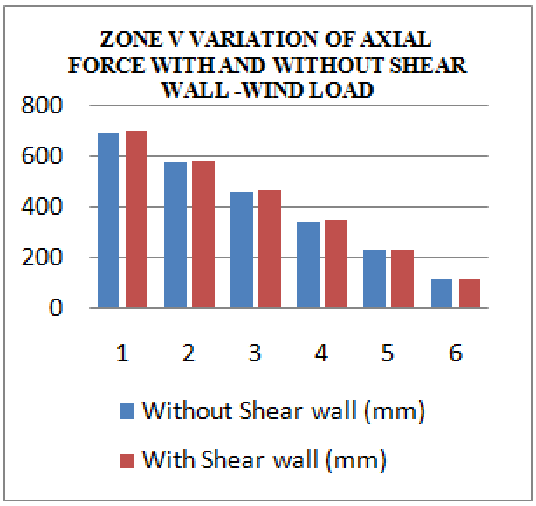
Graph 11:*variation of axial force with heights for EQ load*



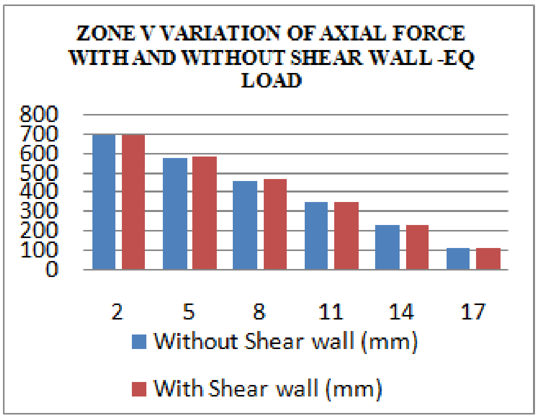
Graph 12: variation of axial force with heights for wind load

The axial forces are decreased with increasing structural height for all models.

5.3.2 for Zone V, variation of Axial Force with heights for external column in X-direction (without and with shear wall)



Graph 13:*Variation of axial force with heights (without and with shear wall- wind load)*



Graph 14: *Variation of axial force(Y-axis) with heights (X-axis) for EQ load*

There is a small variation of Axial Forces for building with and without shear wall for Zone V (wind and earthquake loads). The maximum variation of Axial Force is 1%.

VI. CONCLUSION

The final conclusions of our present study are

- The displacements are reduced in building with shear wall compared to building without shear wall
- The building with shear wall has more earthquake resistance compared to building without shear wall.
- There is no variation on wind effect for with and without shear wall building.
- There is small variation on bending moment and axial force for with and without shear wall.
- The node displacements are more for Zone V compared to Zone III for earth quake load.
- The Axial forces are decreased with increasing structural height for all models.
- Comparison of Zone III and Zone V for the wind effect, the nodal displacements in the exterior columns with shear wall and without shear wall structure are same.

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