COMPARATIVE ANALYSIS OF EARTHQUAKE RESISTANT BUILDING DESIGN BY CONSIDERING BRACING AND SHEAR WALL SYSTEM IN STAADPRO SOFTWARE

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Abstract

In modern era due to increase in population people are moving from rural to urban areas and because of these construction of multi storied buildings is common now it is. As we go upwards in multi Storey buildings there is need of shear wall to resist high lateral forces like seismic and wind loads so nowadays shear wall becomes the most commonly used lateral resisting loads in high rise multi storied buildings. The study is done to analyse the behaviour of multi Storey structure with and without shear wall and structure with bracings in different seismic zones are compared and studied. In this research work G+5 and G+9 multi storeyed buildings with shear wall and without share wall in different stories and G+5 and G+9 multi Storey buildings with bracings are compared in Seismic zone 3 and 5. The designing an analysis part of the buildings are analysed using instead STAADPro V8i software (series 4). The main aim of this research work is to compare the buildings without and without shear wall and buildings with bracings. Parameters like story drift, story displacement, Base Shear, Eigen value, eigenvector and cost are also compared.

Keywords: Seismic analysis, Base shear, shear wall, bracings, story drift, STAADPRO V8i.

1. INTRODUCTION

In present scenario due to increasing population and shortage of land people are moving from rural to urban areas and construction of multi Storey building is common nowadays. In recent days earthquake has become a great concern in countries like India and due to earthquake many damages are caused in Asia and other continents. To resist plane lateral forces typically seismic and wind loads in high rise multi storeyed structure shear wall is used. It actually reduces the sway of the structure and +reduces the damage of the buildings. A rigid vertical diaphragm that can transfer lateral stresses from outside walls, floors and roofs in a direction parallel to their planes to the underlying foundation. At site it is easy to construct and because of thinner walls it is lightweight done also. It will provide more stiffness, stability and strength to the structure. By providing shear wall in the structure damage due to earthquake is low in structural and non-structural elements. To make structure earthquake resistant in system zones she had what is the most common structure in multi storey building.

1.1 RESEARCH OBJECTIVES:

1. To analyse the buildings with and without shear wall and buildings with bracings are designed and compared.
2. (G+5) and (G+9) multi-storeyed buildings in seismic zone III and V are designed using STAADPRo software.
3. To study Different parameters like story drift, story displacement, peak story shear, Eigen value Eigen vector and cost is also analysed.
4. To study the effect of shear wall and bracings when provided at different positions of the structure.

2. METHODOLOGY:

The building is analysed by using STAADPRO software and the structure is analysed in seismic zones III and V and soil type is medium.G+5, G+9 multi-storeyed building with shear wall and bracing has been designed and analysed. IS code 456-2000: plain and reinforced concrete, IS code 875-1987(part-2): Live load and is code 1893-2002: criteria for earthquake resistant design of structures are taken in to consideration.

Table1. Building Configuration of the project:

Type of structure	Multi-storey bay frame structure
No.of structure	G+5,G+9
Floor height	3.5 m each floor
Materials	M25 concrete,Fe415 steel
Size of columns	As per case
Size of beams	As per case
Type of soil	Medium soil type
Seismic zone	Zone III and Zone V
No of bays	Bay length as per plan
Imposed load	$3KN/m^2$
Response Reduction factor	5
Importance factor	1
Damping	5%

3. BUILDING MODELS:

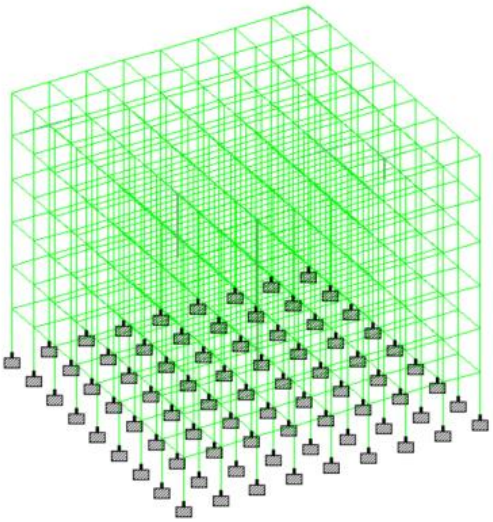


Fig1. Structure without Shear Wall

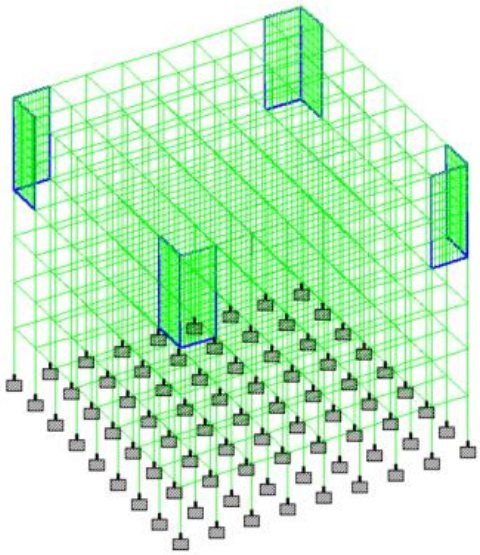


Fig 2. G+5 Shear Wall at Corners

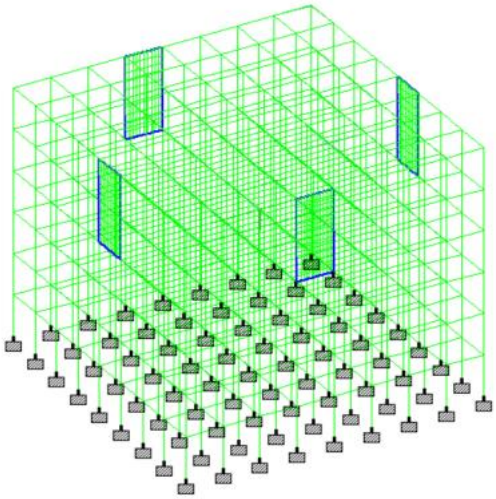


Fig 3. G+5 Shear Wall at Walls

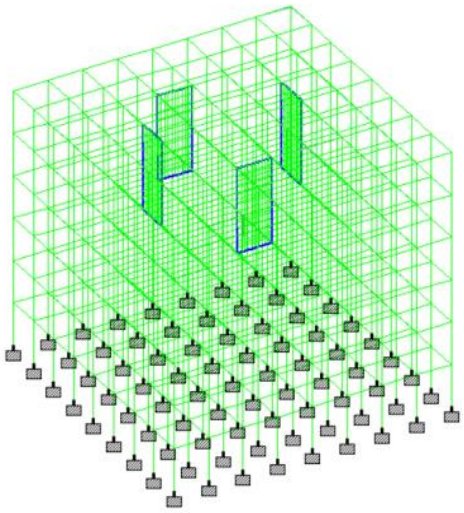


Fig 4. G+5 Shear Wall at Center

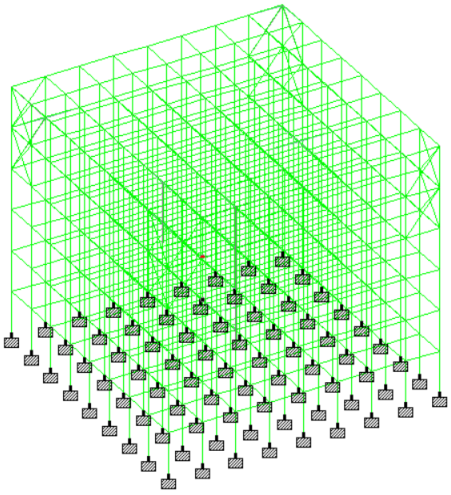


Fig 5.G+5 Bracing At Corners

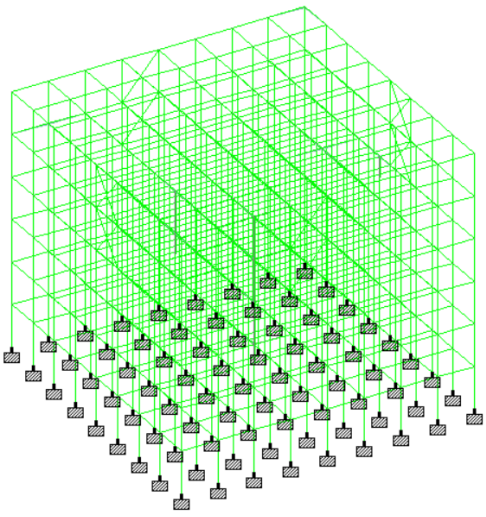


Fig 6.G+5 Bracing at Walls

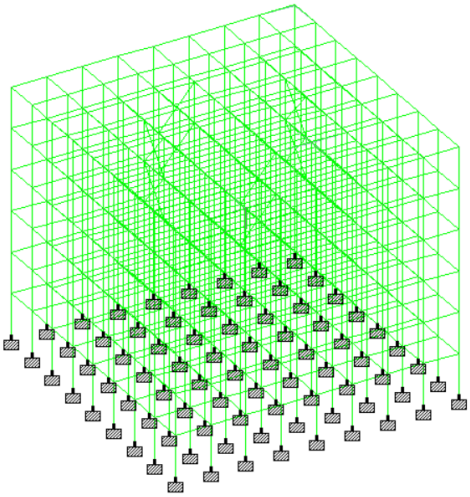


Fig 7. G+5 Bracing At Center

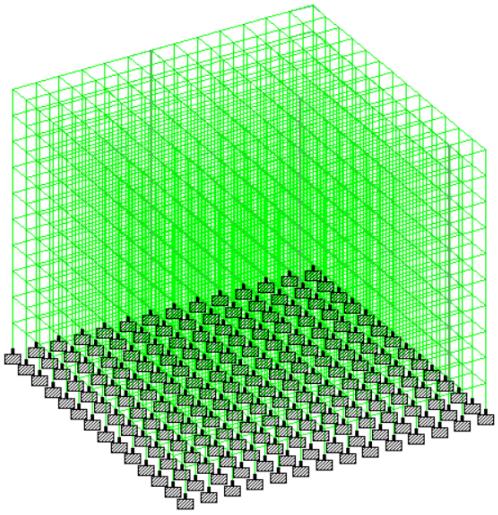


Fig 8.G+9 Structures without Shear Wall

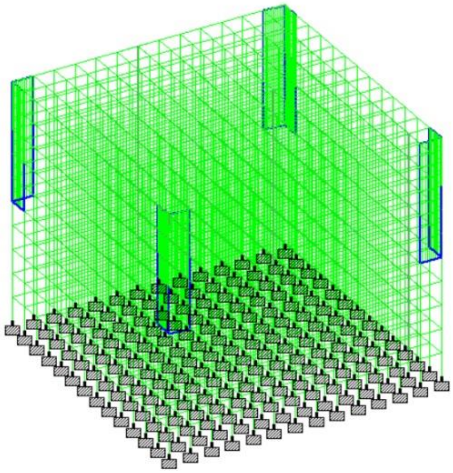


Fig 9. G+9 Shear Wall at Corners

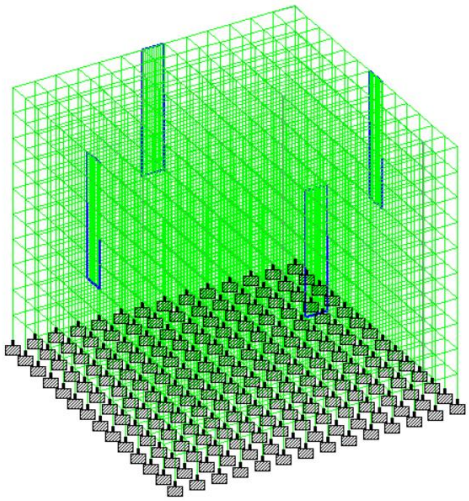


Fig 10.G+9 Shear wall At Walls

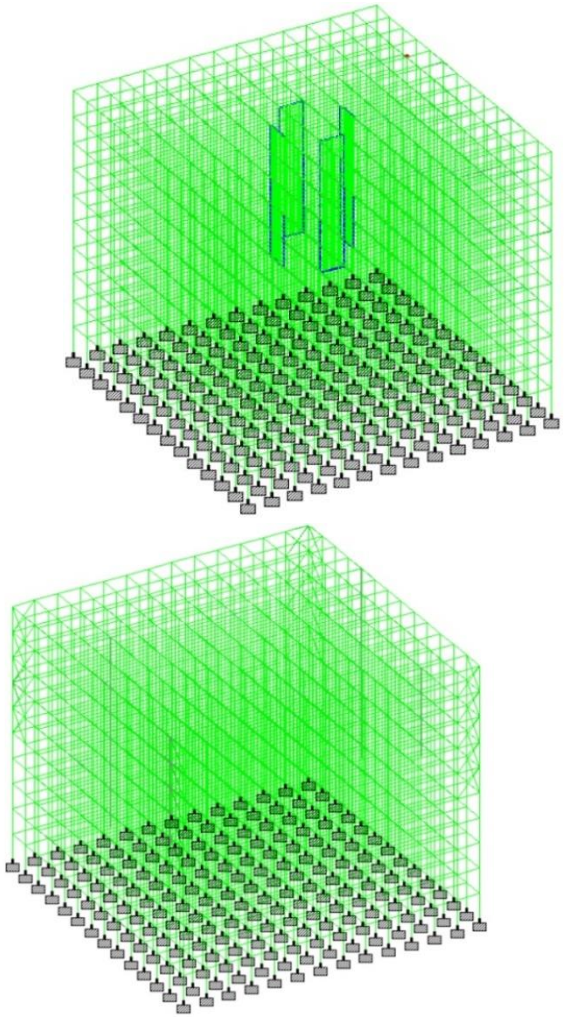


Fig 11.G+9 Shear Walls At Center

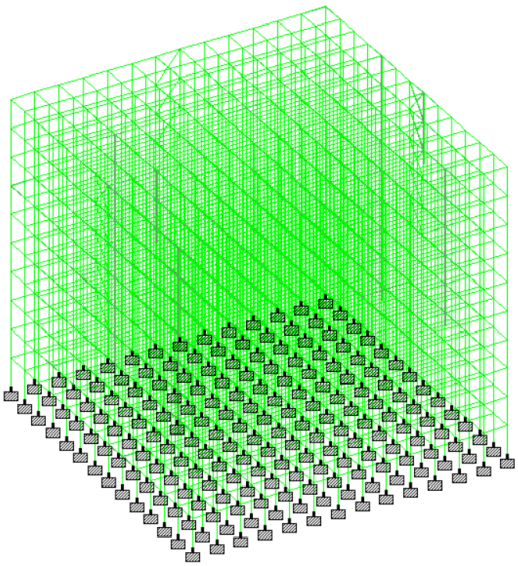


Fig 13. G+9 Bracing At Walls

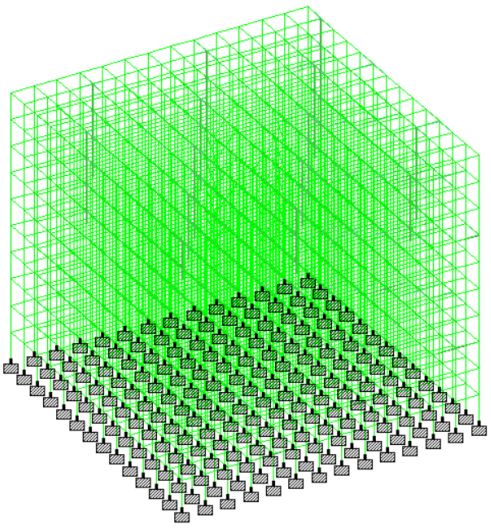


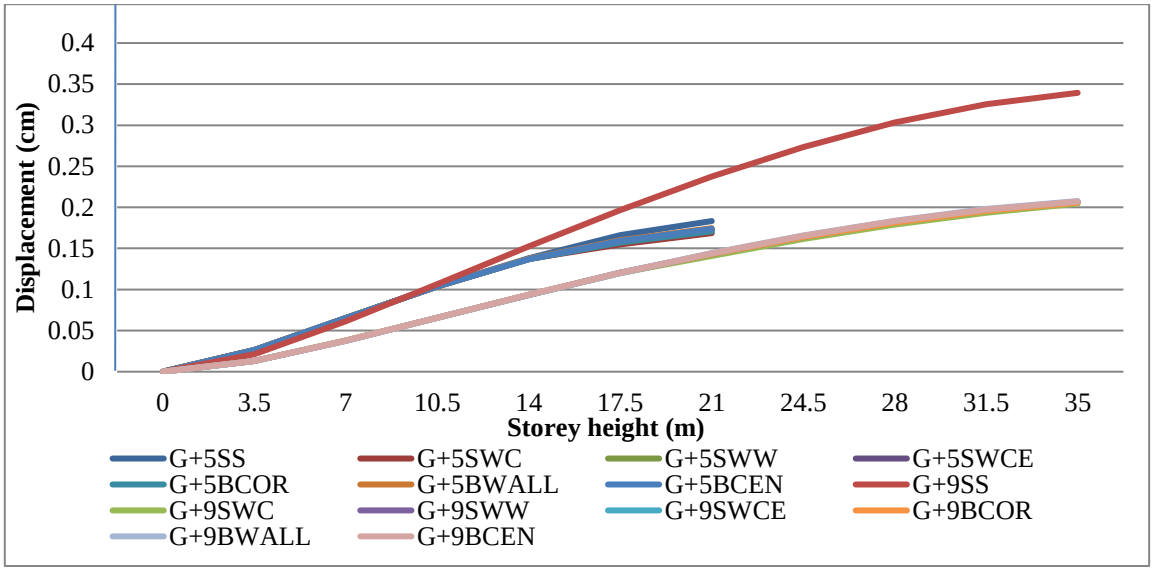
Fig 14. G+9 Bracing At Center

Fig 12.G+9 Bracing at Corners

4. RESULTS AND DISCUSSION:

4.1 Storey Displacement:

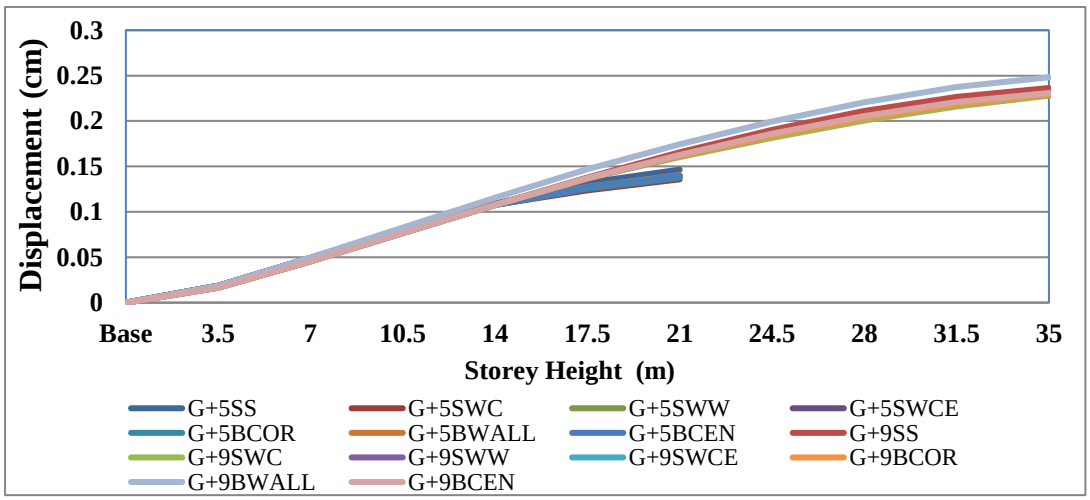
4.1.1 Story Displacement in Zone III in X Direction:



Graph 1. Story Displacement in Zone III in X Direction

G+ 9 simple structures show maximum displacement as compared to all other buildings. Buildings with shear wall and bracing show approximate same values in buildings. In (G+5) building without shear wall shows maximum displacement.

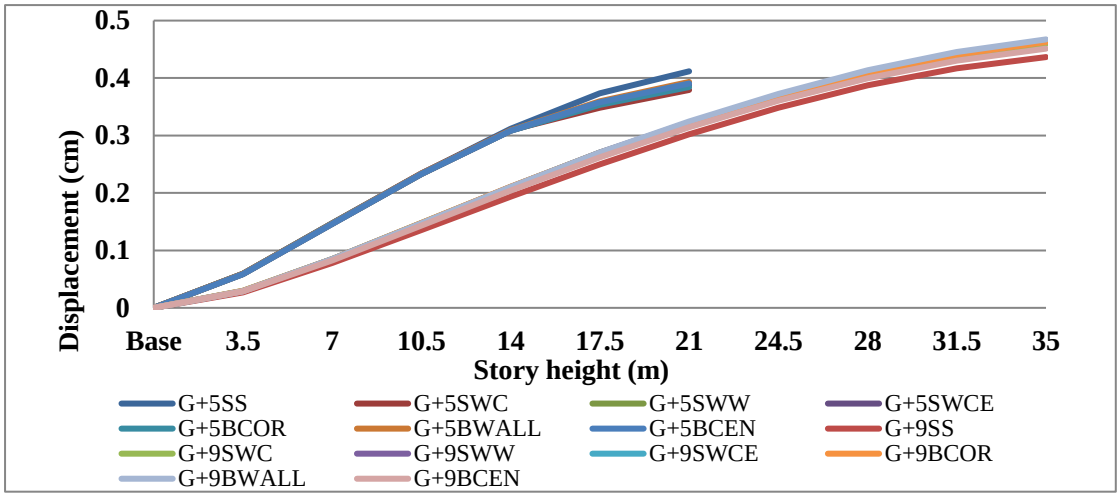
4.1.2 Story Displacement in Zone III in Z Direction:



Graph 2. Story Displacement in Zone III in Z Direction

In zone III in z direction buildings with bracing show higher displacement as compared to all other buildings and building with shear wall at walls and bracings at center of the structure shows approximate same values. Displacement increases as story height increases. (G+5) simple structure shows maximum displacement as compared to other buildings of five stories.

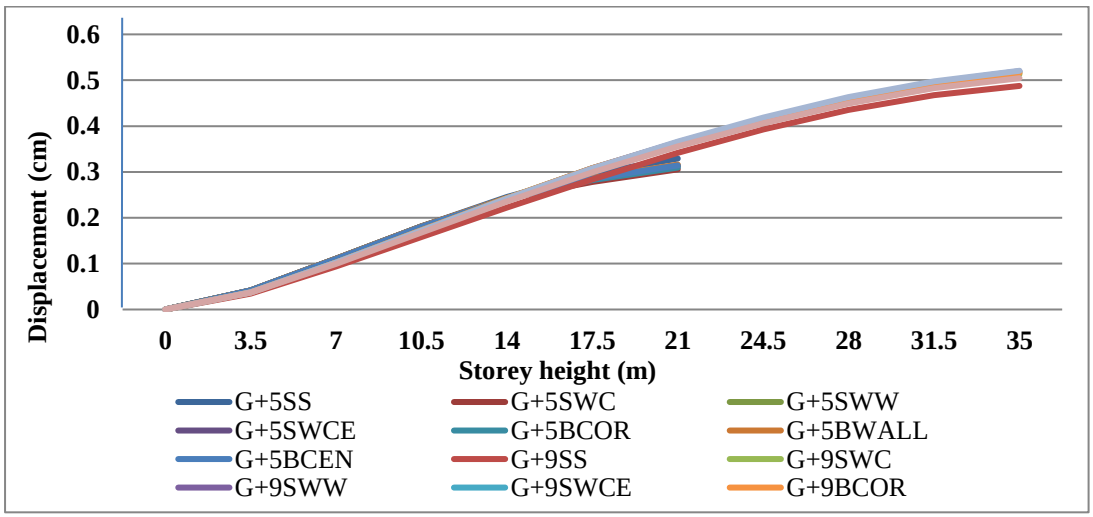
4.1.3 Story Displacement in Zone V in X Direction:



Graph 3. Story Displacement in Zone V in X Direction

In zone V in X direction G+9 multi-storeyed building with bracings at corners shows maximum displacement as compared to all other structures. Least story displacement is shown in G+ 5 multi-storeyed structures without shear wall and bracings. Moving from lower seismic zone to higher seismic zone displacement is increased.

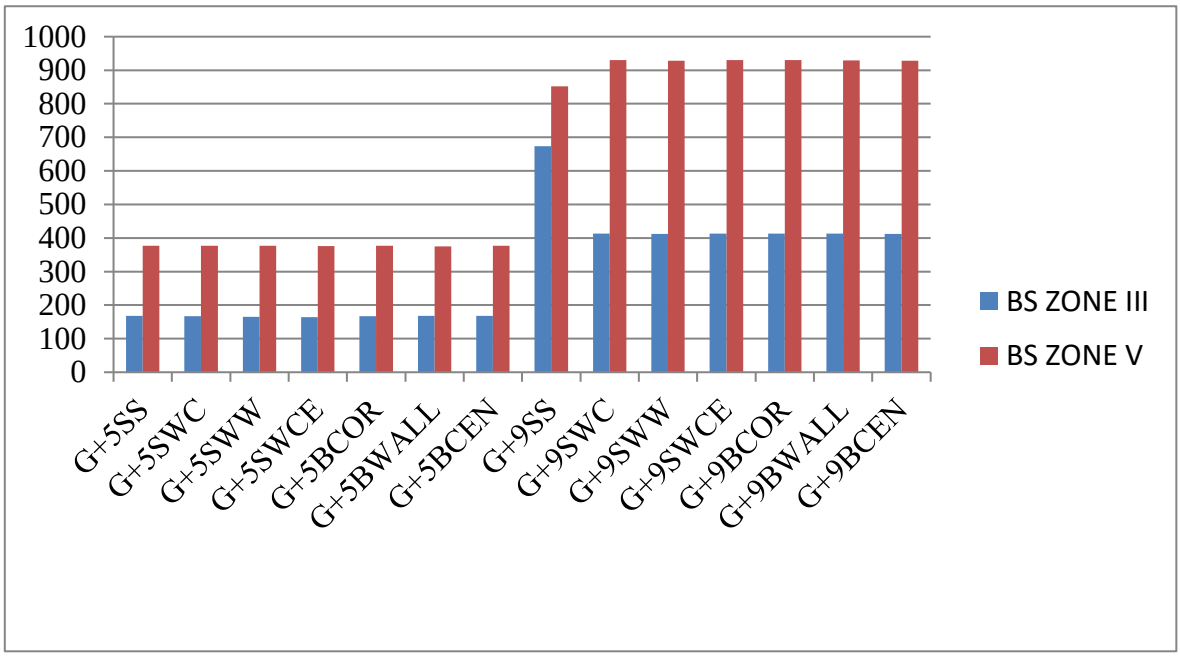
4.1.4 Story Displacement in Zone V in Z Direction:



Graph 4. Story Displacement in Zone V in Z Direction

G+5 building without shear wall in zone V in Z direction shows maximum displacement as compared buildings with shear wall and bracings and in all G+5 buildings displacement is approximately same up to third storey from base and there is slightly variation in fourth and fifth due to shear wall and bracings. (G+9) building with bracing at walls up to fifth storey from above shows maximum displacement in zone V.

4.2 BASE SHEAR:



Graph 5. Comparison graph of Base shear between Zone III and Zone V

From above comparison of both zone 3 and zone 5 of base shear, zone V shows higher value of Base shear as compared to zone III. G+5 & G+9 buildings without shear wall shows higher base shear as compared structure with shear wall and bracings and in zone V, G+5 building without shear wall shows maximum base shear then buildings with shear wall and bracings and G+9 building with shear wall and bracings shows high base shear as compared to building without shear wall. So it is concluded that higher is the story height higher the base shear.

5. CONCLUSION:

1. The primary goal of this study was to compare shear wall and bracings effects at various multi-storey frame locations and the variables for comparison were base shear, and storey displacement, Eigen value, Eigen vector, story drift.

2.Base shear of G+5 simple structure is 4.01 times higher than the base shear of (G+9) building in zone III.(G+9) simple structure in zone V is 1.26 times the base shear of (G+9) in zone III.

3.(G+9) building with shear wall in zone V is 2.24 times the base shear of (G+9) building with shear wall in zone III.as story height increases base shear also increases and it depends on weight and stiffness of the structure.

4. Base shear in zone III is maximum in structure without shear wall and bracings and minimum in structures with shear wall and bracings but in zone V, Base shear is minimum in G+ 9 structures without shear wall and maximum in structures with bracings and shear wall. In this project maximum base shear is observed in building with shear wall and bracing at corners so these structures provide maximum safety against earthquake load.

5. Story displacement in zone V shows higher values of displacement in (G+5) structures than (G+9) in both X and Z direction. Zone V shows higher values of displacement than zone III. (G+9) buildings with shear wall in Z direction in zone V is 1.27 times more as compared to shear wall in X direction in zone Similarly in zone III bracing at centre in (G+5) building in Z direction is 1.41 times more than the building in zone III in X Direction. As the story height increases displacement also increases.

6. As we move from lower seismic zones to higher seismic zones displacement increases with the addition of shear wall.

6. REFERENCES

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