Study on Lateral Structural System on Different Height on Asymmetrical Shape Structure

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Abstract *As per previous record of earthquake, there is a increase in the demand of use of earthquake resisting structure. Recent day, structures are becoming more and more susceptible and slender to sway and hence dangerous in the earthquake one of the most important aspects is to construct a building structure which can withstand the action of seismic force efficiently. Study is made on the different system for different location to find out the most optimized solution to produce an efficient safe earthquake resistant structure. From many studies it has found out that use of lateral load resisting system in the building has enormously give better performance of the structure in earthquake. In present study we have use unsymmetrical building which has being modeled using software Etab, the work has being carried out for different cases using shear wall and bracing for different heights. The study has been carried out for Zone V and medium type of soil*.

Key Words: Bare frame, Shear wall, Bracing, Response Spectrum method, Lateral Displacement, Drift, Base shear, Seismic zone.

1. INTRODUCTION

Today tall structures become more and more slender, leading to the possibility of more sway in comparison with earlier high rise structures. This has brought more difficult task for the engineers to satisfy both gravity loads as well as lateral loads, previously building were designed for the gravity loads but now because of tall height and seismic zone the engineer has to take care of lateral loads due to earthquake and wind forces. Earthquake zone plays an important factor in the earthquake resistant design of building structure because the zone factor changes as the seismic intensity changes. Another important aspect in the design of earthquake resistant structures is soil type changes the whole behavior and design of structure changes. So to cater all the lateral forces, we have to design the structure very uniquely so that the structure can withstand for the maximum time period so that there is no harm to the society. It is important to construct the structure resistant to earthquake. In present study we have to analyze asymmetrical shape structure of different height considered. In these study shear wall and bracing at different location is to be place to the structure. An earthquake load is calculated as per IS 1893-2002 (part-I) applied to different height of building under consideration of high seismic zone for medium soil consideration by using Response spectrum method. From this we determine the displacement, base shear and drift values. After analyzing the building has been compare using table and graph to find most optimized solution.

1.1 Moment resisting frame:

Moment resisting frame is a assembly of beam and column, with the beam rigidly connected to column. The bending rigidity and strength of the frame member is the primary source of lateral stiffness and strength for the complete frame. In these moments are transferred through the connection. The advantage of moment resisting frame is it is open rectangular arrangement.

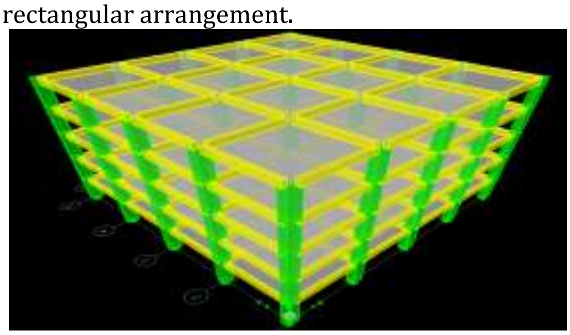

Fig -1: Moment resisting frame

1.2 Shear wall

Shear walls are structural elements in addition to slabs, beam and columns. It is continuous concrete vertical wall serve both architecturally as partition and structurally to carry gravity and lateral loads. These walls are usually start from foundation level and are continuous up to the building height. Shear wall system is one of the most common used lateral load resisting systems in high rise buildings. Shear walls are mainly vertically oriented wide beams that lift earthquake loads downwards to the foundation. Shear wall has high in plane stiffness and strength which can be used to simultaneously resist large lateral loads and properly support gravity loads, which significantly reduces lateral sway of the building and often reduces damage to structure and its elements. Shear wall system have been shown to perform well in earthquake for which ductility becomes an important consideration in their design.

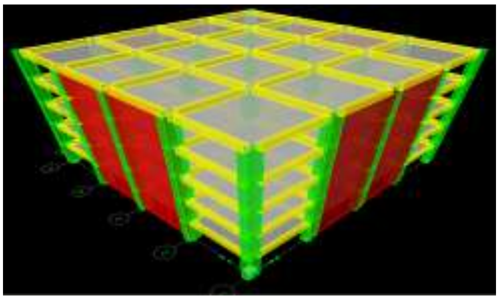

Fig -2: Shear wall

1.2.1 Advantages of shear wall in RCC structure

Shear wall are easy to construct, because reinforcement detailing of wall is relative straight forward therefore easily implemented on site. Shear wall are efficient in terms of both cost and effectiveness in minimizing in earthquake damage since shear wall carry large horizontal earthquake forces, the overturning effect on them are large.

1.2.2 Effects of shear wall

Shear wall is one of the structural resisting elements which are used commonly. Shear wall give high stiffness to the structure so as the structure will be stable. Applying shear wall will effectively reduce the displacement and storey drift of the structure. Shear wall reduce the damages come from lateral loads such as an earthquake. Shear walls not only have a very large in plane stiffness and therefore resist lateral load and control deflection very efficiently but they also help in reduction of structural and non structural damages.

1.3 Bracing

Bracing is a construction technique used to improve the structural performance of a building. Bracing systems include wood, steel or concrete that help evenly distribute loads and increase the safety of the structure. In braced frame the lateral resistance of the structure it's provided by the diagonal member that together with the beams from the web of the vertical truss with the column acting as chords. Because the horizontal shear on the building is resist by the horizontal component of the axial tensile and the compression action in the web member bracing systems are highly efficient in resisting lateral loads.

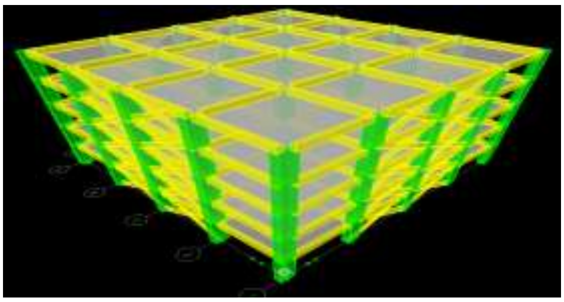

Fig -3: Bracing

2. STRUCTURAL MODELLING

In these research 3 different model MRF, shear wall and bracing for different heights. The modelling is done to examine the effect of different structural system with different height on seismic parameter like base shear, lateral displacement and lateral drift. The analysis is to be done for seismic zone V as per IS 1893. Damping value is taken as 5 percent.

2.1 Modelling Data

Material Properties:
Density of Reinforced Concrete = 25kN/m³
Density of brick masonry = 20kN/m³
Assumed Dead load intensities:
Floor = 1.5 kN/m²
Live load intensities:
Imposed = 4 KN/ m²
Member properties:
Thickness of Slab = 0.150m
Column size = (0.6 m x 0.6 m)
Beam size = (0.3 m x 0.6m)
Thickness of shear wall = 0.3 m

Seismic zone = V
Number of storey = 10, 15, 25
Floor height = 3.2m

Spacing between frames = 5.0 m along x direction & 5.0 m along y direction

Materials = M 40 concrete, Fe 500 steel
Type of soil = Medium soil
Damping of structure = 5 percent
Importance factor, I = 1.5

Response reduction factor, R = 5.0

Type of frame: Special RC moment resisting frame fixed at the base.

Table -1: Percentage live load to be considered in seismic calculation as per IS (1893-2002)

Live load (KN/m²)	Percentage of live load
Upto and including 3	25
Above 3	50

Table -2: Model for Analysis

Model 1	Bare Frame
Model 2	Shear wall in middle
Model 3	Shear wall at corner
Model 4	Bracing in middle
Model 5	Bracing at corner

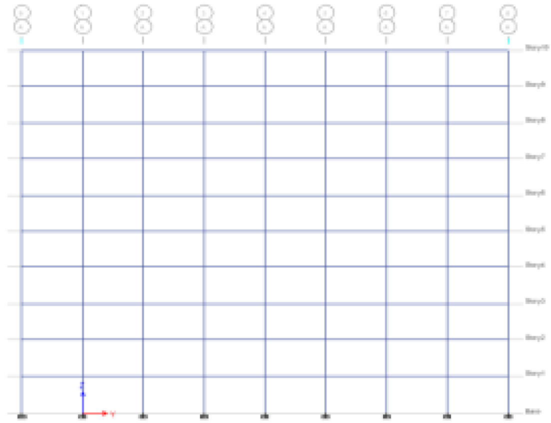

Fig -4: Elevation of G+9 building bare frame

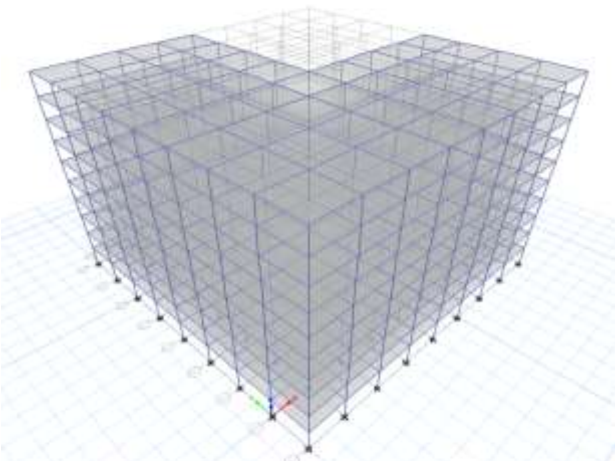

Fig -5: 3D of G+9 building bare frame

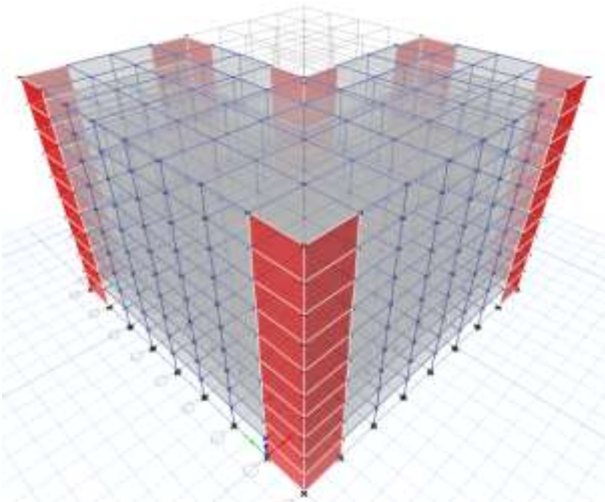

Fig -6: 3D of G+9 building with shear wall

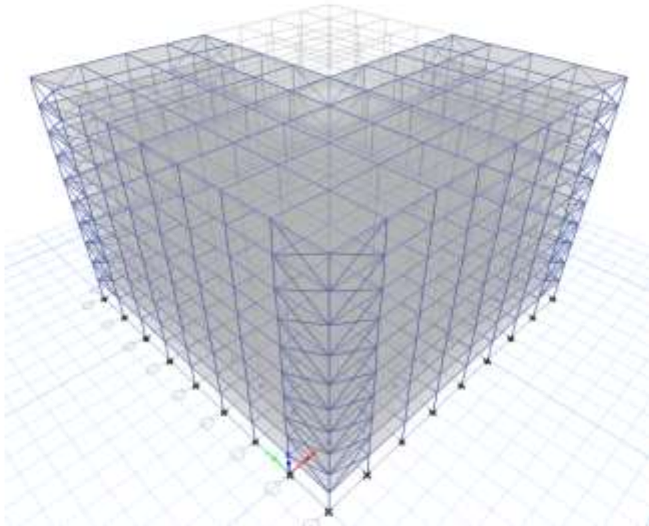

Fig -7: 3D of G+9 building with Bracing

3. RESULT AND DISCUSSION

Most of the past studies on building have adopted idealized structural systems without considering the effect concrete shear walls and bracings. Although these systems are sufficient to understand the general effect of building, it would be interesting to know how real building will respond to earthquake forces.

3.1 Results

Table -3: Comparison of displacement in X direction of G+9 Building

Storey	Model 1	Model 2	Model 3	Model 4	Model 5
10	49.83	20.03	15.14	27.12	22.72
9	47.79	17.85	13.42	24.88	21.03
8	44.55	15.53	11.61	22.30	18.94
7	40.21	13.11	9.75	19.48	16.62
6	35.01	10.65	7.88	16.49	14.16
5	29.18	8.21	6.06	13.44	11.63
4	22.92	5.87	4.34	10.44	9.12
3	16.41	3.75	2.79	7.60	6.72
2	9.87	1.98	1.48	5.08	4.52
1	3.77	0.67	0.51	2.83	2.47
0	0.00	0.00	0.00	0.00	0.00

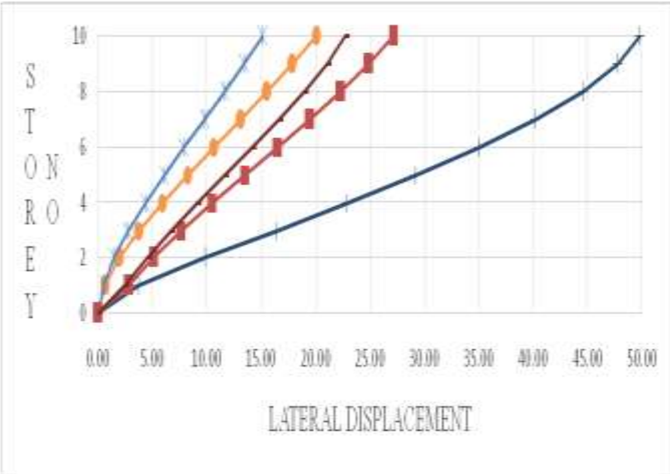

Fig -8: Displacement graph

Table -4: Comparison of base shear in X and Y direction of G+9 Building

Base shear	Model 1	Model 2	Model 3	Model 4	Model 5
X Dir	-9329.18	-9819.43	-9823.39	-9700.81	-9700.81
Y Dir	-9329.18	-9819.43	-9823.39	-9700.81	-9700.81

4. Conclusion

- Shear wall & Braced frame structure should be preferred in seismic regions with different location of shear walls & bracing systems as they have less displacement, Inter storey drift & more base shear.
- It has been found that the Building with shear wall shows better performance compared to buildings with bracings therefore Building with shear can be preferred over bracing systems.

4.1 Scope for future work

- Seismic analysis of reinforced concrete frame structure with openings in the shear walls.
- Seismic analysis of reinforced concrete frame structure using Non-Linear Static & Non-Linear dynamic analysis.
- Future study can be done by using different types of bracing.

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