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Drift Analysis of irregular High-rise Building

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Abstract - Drift can be defined as the lateral displacement of a building due to lateral forces such as seismic force, wind force or movement of sub soil structure. Lateral displacement plays vital role in high-rise building. Lateral displacement increases with increase in the height of the building. These lateral displacements will leads to catastrophic failure of the building. Such type of failures can be avoided by providing desired bracing systems or shear walls wherever required in the building. In this paper the lateral displacement of irregular high-rise building with bracing system and shear walls have been discussed. The G+35 stories irregular building has taken into account for drift analysis. ETABS known as Established Three Dimensional Analysis for Building System software has been chosen for analyze the lateral displacement of irregular high-rise building with bracing system and shear walls effectively.

Key Words: Drift analysis, lateral displacement, irregular high-rise building, ETABS

1. INTRODUCTION

Drift is the lateral displacement of one level of a multistory structure relative tothe level above or below due to lateral loads acting on the building in any direction. Lateral loads are mainly responsible for drift of the building. Due to lateral loads there will be a drift or sway on the tall structures and the magnitude of displacement at the top of a building relative to its base. Tall structure should be capable for resist any type of lateral loads as well as gravity and live loads without causing any damage to the structure. Sustainability and expected service life is the very important matter to consider the design process of high-rise structures. Lateral stability of structure is a very important issue in analysis, designing and construction of tall building in our area. The more height of a building that indicates more drift and the drift of the building decreases with increase in the width of the building. Drift often dictates the selection of structural systems for tall buildings. Reinforced concrete building can adequately resist both horizontal and vertical load. Whenever there is requirement for a tall building to resist higher value of seismic forces, lateral load resisting system such as shear wall, bracing systems should be introduced in a building. In order to make multi-storey Rigid framed structures stronger and stiffer, which are more susceptible to earthquake and wind forces, there is an introduction of new structural members such as steel bracing systems and RC shear walls.

2. SCOPE OF THE PROJECT

The scope of this project work involves

- Carry out 3-D modeling of the structure using ETABS Software.
- Drift analysis of irregular high-rise building with shear wall & steel-braced framed structure.

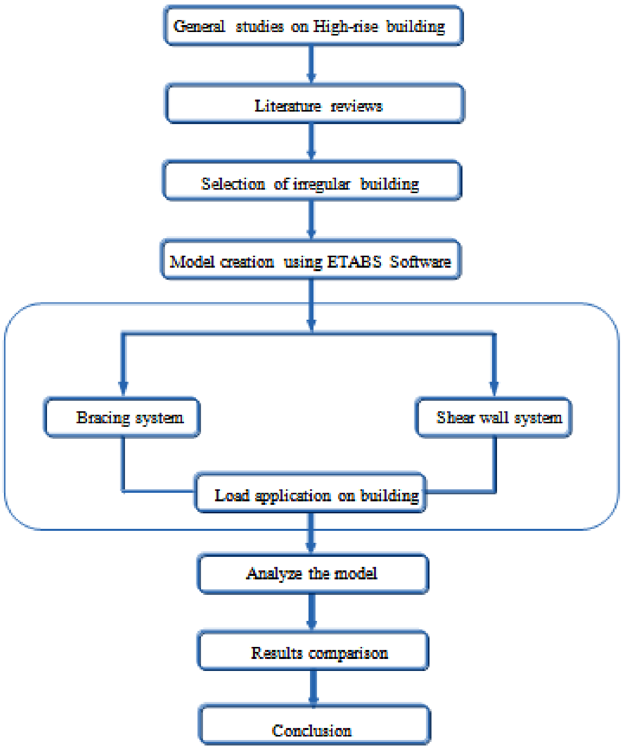
3. OBJECTIVES OF THE PROJECT

The objectives of this project work involves

- To study the structural behavior under seismic loads for all the differentzones.
- Predicting the behavior of shear wall and steel-braced framed structure using Equivalent Static Method and Response spectrum method.
- Validation of results will be obtained.

4. METHODOLOGY

The methodology which was followed in this project has shown in below flow chart.



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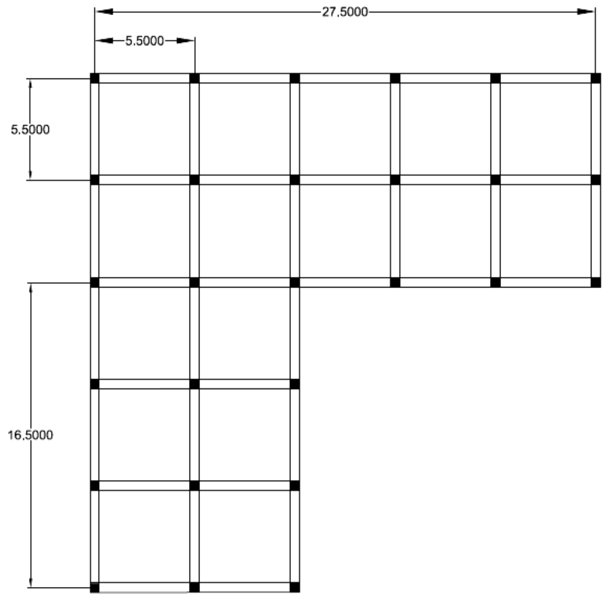
5. BUILDING PLAN

The desired shape of irregular building plans was done by using AutoCAD Software.

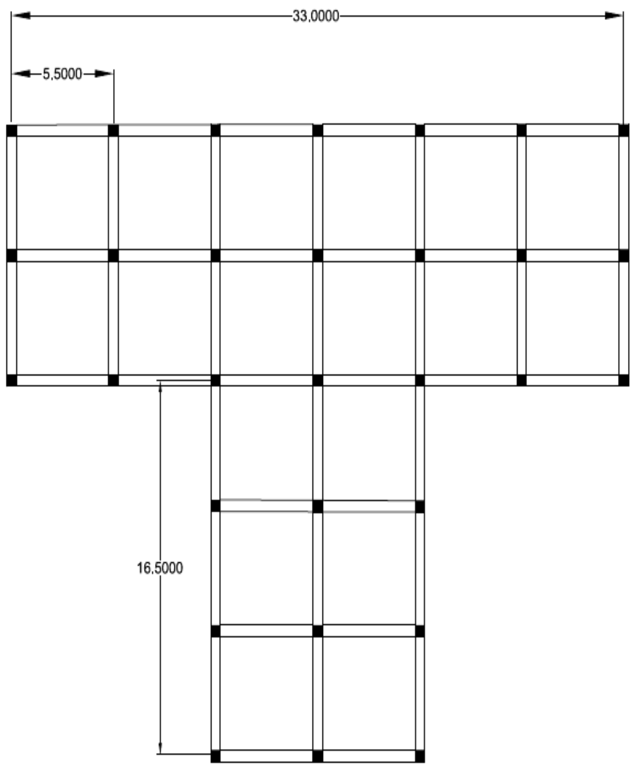
a. L-Shape of the Building



Plinth Area for single floor = 484sq.m.

Fig -1: Plan of L-shape building

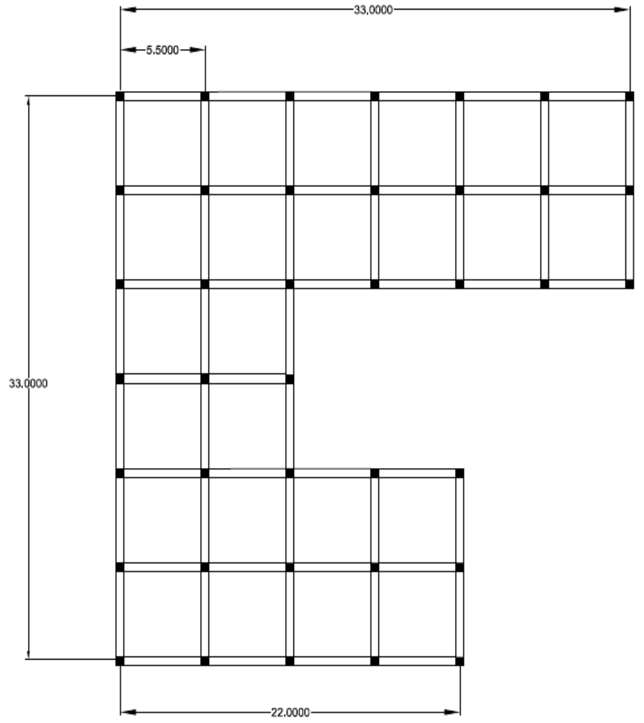
b. T-Shape of the Building



Plinth Area for single floor = 544.5sq.m.

Fig -2: Plan of T-shape building

c. C-Shape of the Building



Plinth Area for single floor = 726sq.m.

Fig -3: Plan of C-shape building

6. MODELING OF BUILDING USING ETABS SOFTWARE

Details of the L-shape model:

- No. of bays in x-direction = 6
- No. of bays in y-direction = 6
- No. of bays in z-direction = 35
- Total height of the building = 108m
- Beam size = 900x600mm
- Colum size = 900x900mm
- Slab thickness = 150mm
- Concrete = M40 grade
- Steel = Fe500HYSD
- Shear wall thickness = 200mm
- Steel bracings = X-type bracings of 22mmx97mm

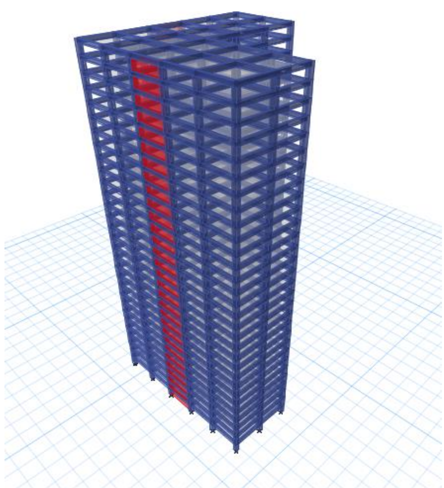


Fig -4: 3D Model of L-shape building with shear wall

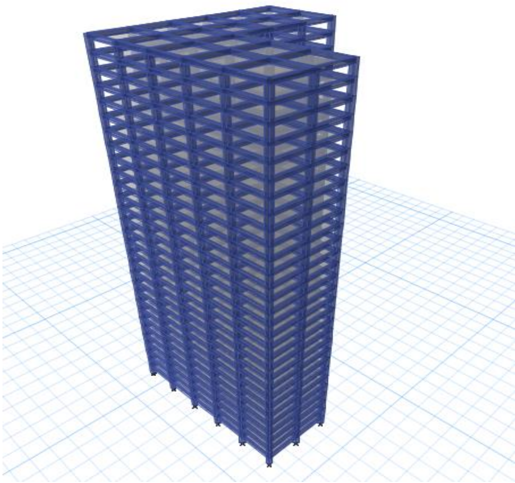


Fig -5: 3D Model of L-shape building with bracings

Details of the T-shape model:

- No. of bays in x-direction = 7
- No. of bays in y-direction = 6
- No. of bays in z-direction = 35
- Total height of the building = 108m
- Beam size = 900x600mm
- Colum size = 900x900mm
- Slab thickness = 150mm
- Concrete = M40 grade
- Steel = Fe500HYSD
- Shear wall thickness = 200mm
- Steel bracings = X-type bracings of 22mmx97mm

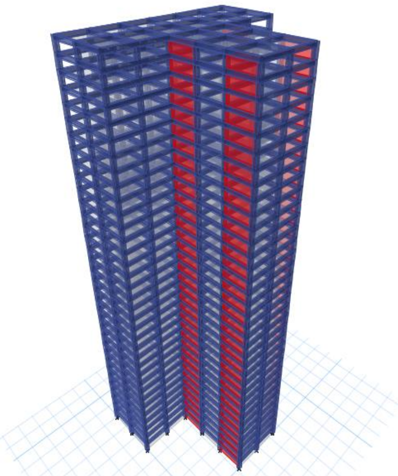


Fig -6: 3D Model of T-shape building with shear wall

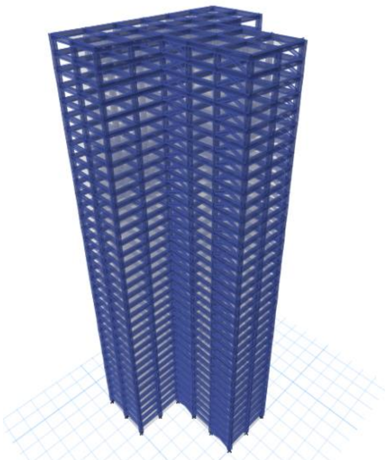


Fig -7: 3D Model of T-shape building with bracings

Details of the C-shape model:

- No. of bays in x-direction = 7
- No. of bays in y-direction = 7
- No. of bays in z-direction = 35
- Total height of the building = 108m
- Beam size = 900x600mm
- Colum size = 900x900mm
- Slab thickness = 150mm
- Concrete = M40 grade
- Steel = Fe500HYSD
- Shear wall thickness = 200mm
- Steel bracings = X-type bracings of 22mmx97mm

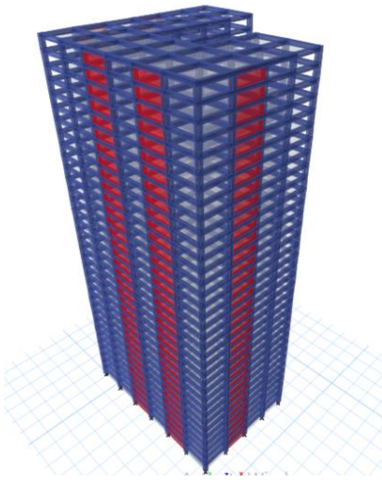


Fig -8: 3D Model C-shape building with shear wall

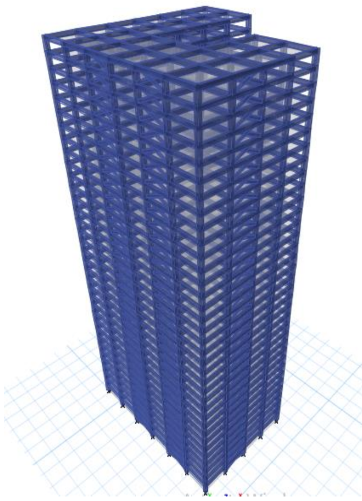


Fig -9: 3D Model of C-shape building with bracings

7. LOAD APPLICATION

a. Dead load

Dead loads applied on irregular building models have shown in below table.

Table -1: Dead load details

S. No.	Parameters	Dead load
1	Roof Beams (main wall)	12.42 kN/m^2
2	Terrace beams (parapet wall)	4.14 kN/m^2
3	Floors (floor finish)	2.5 kN/m^2

b. Live load

Live loads applied on irregular building models have shown in below table.

Table -2: Live load details

S. No.	Parameters	Live load
1	Roof Beams (main wall)	-
2	Terrace beams (parapet wall)	-
3	Floors	3 kN/m^2

c. Wind load

Wind load data applied on irregular building models have shown in below table.

Table -3: Wind load details

S. No.	Parameters	Wind load
1	Terrain category	1
2	Class of structure	B
3	Wind angle	0^0
4	Windward coefficient	0.80
5	Leeward coefficient	0.25
6	Wind speed	Zone 5: 55m/s

d. Seismic load

Seismic loads applied on irregular building models have shown in below table.

Table -4: Seismic load details

S. No.	Parameters	Response reduction factor	Importance factor	Seismic Zone factor
1	Seismic in X-direction	5	1	Zone 5: 0.36
2	Seismic in Y-direction	5	1	Zone 5: 0.36

8. RESULTS AND DISCUSSION

a. T-Shape Building

The storey displacement or storey drift comparison of the conventional building, building with shear wall and building with steel bracing system for T-shape building has been compared in the following graph. The maximum storey displacement was 0.62m and it can be minimized to 0.13m by providing shear wall in appropriate faces.

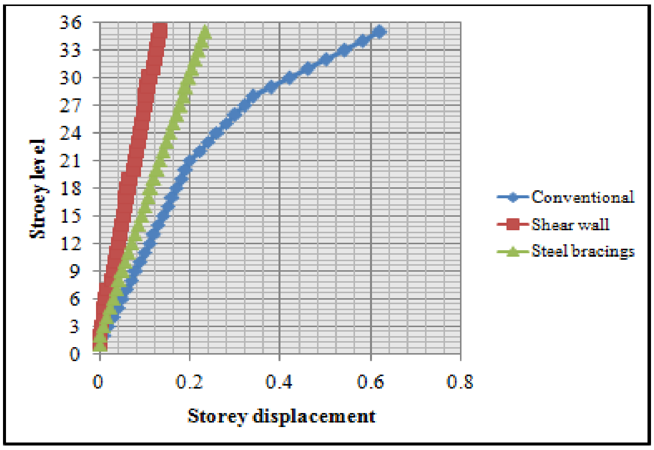


Fig -10: Storey displacement comparison of T-shape building

b. L-Shape Building

The storey displacement or storey drift of the conventional building, building with shear wall and building with steel bracing system for L-shape building has been compared in the following graph. The maximum storey displacement was 1.55m and it can be minimized to 0.205m by providing shear wall in appropriate faces.

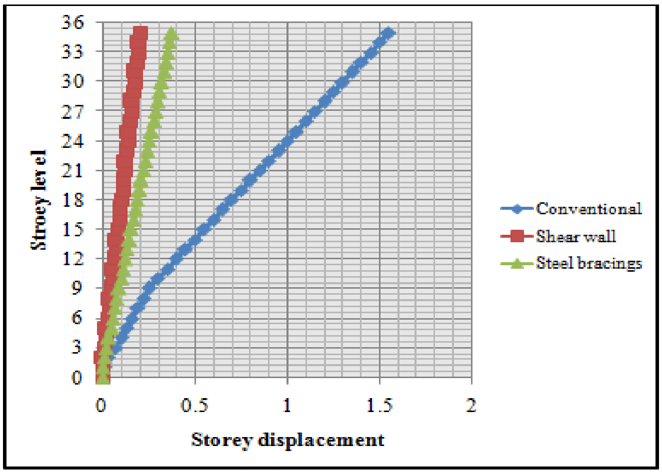


Fig -11: Storey displacement comparison of L-shape building

c. C-Shape Building

The storey displacement or storey drift of the conventional building, building with shear wall and building with steel bracing system for irregular C-shape building has been compared in the following graph. The maximum storey displacement was 1.09m and it can be minimized to 0.171m by providing shear wall in appropriate faces.

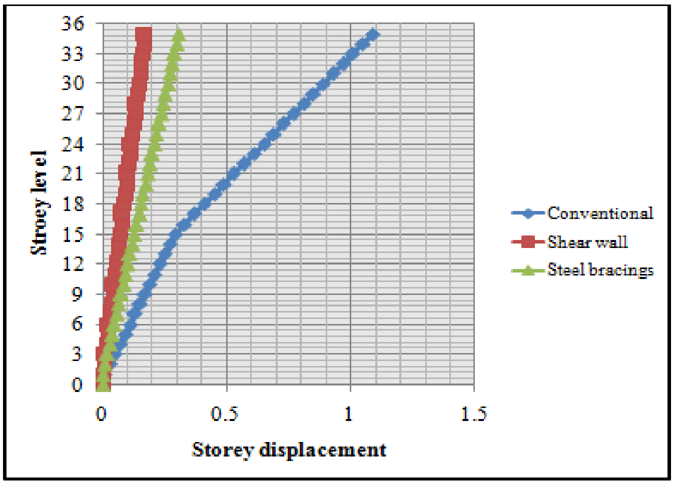


Fig -12: Storey displacement comparison of C-shape building

9. CONCLUSIONS

The following points have been concluded from this project.

The storey displacement or storey drift of the structure increases with increase in the height of building.

The storey displacement can be minimized with increase in width of the building.

Irregular shape of the buildings showed maximum storey displacement in high seismic zones. And it can be mitigated by providing shear wall and steel bracing systems. It is determined that the storey displacement can be minimized effectively by providing shear walls in appropriate faces of the building.

Shear wall system is the best method to minimize the storey displacement or storey drift over the steel bracing system in high seismic zone against lateral forces like wind and seismic forces.

It is recommended that irregular high-rise buildings should be avoided in high seismic zone. If want to construct, building should be constructed with shear walls in appropriate faces of building to minimize lateral displacement.

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BIOGRAPHIES

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