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An Comparative Study Of Seismic Analysis Of Model With & Without Shear Wall

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Abstract: Earthquakes are among the most unpredictable and devastating natural disasters. Of all the methods used for constructing earthquake-resistant multi-storied structures, shear walls are the most commonly adopted. A shear wall is a structural member placed at various locations within a building, extending from the foundation level to the top parapet level, designed to resist lateral forces parallel to the wall plane. These walls are crucial in preventing damage from lateral forces due to earthquakes and wind. This paper reviews the research on multi-storied buildings with and without shear walls. In India, shear walls are the preferred choice for earthquake-resistant structures. The configuration and utility of these structural walls may vary, but their placement within a building is critical for effectively resisting lateral forces.

***Index Terms* - Shear Wall, Non-Shear wall, Lateral forces, Seismic etc.**

I. Introduction

India's economy at such a faster rate that it needs development of infrastructure facilities with growth in population. The value of land in the metropolitan cities is increasing now a days. To reach the petition for the land the elevated buildings are the only alternative in these areas.Dead loads and live loads are the most common type of loads which are resulted from the effect of gravity. Apart from these loads the tall buildings are also subjected to lateral forces such as wind and earthquake. Wind loads source a severe effect on the height of the building. Earthquake loads are resulted from the moment of tectonic plates. Wind and earthquake forces would cause high stresses, and can lead to complete failure of the building.Using an appropriate structural system is menacing to good seismic performance of buildings. As moment-frame are normally used lateral load resisting structural system, other structural systems also are commonly used like structural walls, frame-wall system, and braced-frame system. To improve the earthquake behaviour sometimes even other redundant structural systems are used and they are tube, tube-in-tube and bundled tube systems. These structural systems are used depending on the size, loading, and other design requirements of the building. One structural system commonly used poses special challenges in ensuring good seismic performance of buildings.

1.1 Lateral resisting system

Earthquake resistant buildings should have at least a minimum lateral stiffness, so that they do no swing too much during small levels of shaking. Moment frame buildings may not be able to offer this always. When lateral displacement is large in a building with moment frames only, structural walls, often commonly called shear walls, can be introduced to help reduce overall movement of buildings, because these vertical plate-like structural elements have large in-plane stiffness and strength. Structural walls resist lateral forces through combined axial-flexure-shear action. Shear wall reduce the shear and moment capacity on beam and column. Structural walls should be provided throughout the height of buildings for best earthquake performance.

1.2 Scope of the work

In the present study it is carry out analytical study multi-storey building without lateral resisting system and with lateral resisting system that is shear wall . These structural forms are subjected to static analysis. The parameters such as storey drift and displacements are obtained and comparisons are drawn .

1.3 Methodology

Literature survey has been carried out for multi-storey building for lateral resisting system such as shear wall.

Modelling is done with ETABS software. The different models used for study are as follows

a) Multi -storey building without shear wall
b) Multi- storey building with Shear wall

- The lateral displacement, base shear and storey drift for different models is obtained and compared.
- Based on all these results obtained conclusions are drawn.

1.4 Objective

1. To study the multi- storey building using static analysis.
2. To evaluate the effect of lateral resisting system.

To compare the study of a structure with shear wall and without shear wall with respect to their base shear, storey drift and displacement.

II. LITERATURE REVIEW

2.1 General

The literature survey has been carried out for multi-storey building with lateral resisting system such as shear wall and without shear wall using static analysis is studied.

Ashwini A. Gadling : **[1]**, have used shear wall in multi-storied building and they have changed the positions of the shear wall.It can be concluded from the study that

- Changing the position of shear wall will affect the attraction of forces, so that wall must be in proper position.
- If the dimensions of shear wall are large then major amount of horizontal forces are taken by shear wall.
- Providing shear walls at adequate locations substantially reduces the displacements due to earthquake.
- Storey drift of building provided with openings in shear wall is greater than shear wall without openings .

Varsha Patil , Devikrishna. P. M. **: [2]**, have used the shear walls in G+5 multi- storey building and they kept the different shapes of shear walls for the study.It can be concluded from the study that

- Different location of shear wall effect on axial load on the column. The available literature from books, codes and research papers gives proper designing, positioning and introducing the shear wall in building , a building is made more strong to resist earthquake.
- Even though there are many methods for dissipating earthquake energy, shear walls are observed to be simple, efficient, economical and long lasting.

Himalee Rahangdale, S.R.Satone : [3**]**, have used Different location of shear wall effect on axial load on the column. It can be concluded from the study that

- Different location of shear wall effect on axial load on the column. In absence of shear wall axial load and moments are maximum on column.
- Shear walls are easy to construct, because reinforcement detailing of walls is relatively straight forward and therefore easily implemented at site.
- The 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 earthquake 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.

III. METHODS OF ANALYSIS

3.1 Introduction

Structural analysis is mainly concerned with finding out the behaviour of a structure when subjected to some action. This action can be in the form of load due to the weight of things such as people, furniture, wind, snow, etc. or some other kind of excitation such as an earthquake, shaking of the ground due to a blast nearby, etc. In essence all these loads are dynamic including the self-weight of the structure because at some point in time these loads were not there. The distinction is made between the dynamic and the static analysis on the basis of whether the applied action has enough acceleration in comparison to the structure's natural frequency. If a load is applied sufficiently slowly, the inertia forces can be ignored and the analysis can be simplified as static analysis. Structural dynamics, therefore, is a type of structural analysis which covers the behaviour of structures subjected to dynamic (actions having high acceleration) loading. Dynamic loads include people, wind, waves, traffic, earthquakes, and blasts.

A static load is one which varies very slowly. A dynamic load is one which changes with time fairly quickly in comparison to the structure's natural frequency. If it changes slowly, the structure's response may be determined with static analysis, but if it varies quickly i.e. relative to the structure's ability to respond, the response must be determined with a dynamic analysis. A dynamic analysis is also related to the inertia forces developed by a structure when it is excited by means of dynamic loads applied suddenly (e.g., wind blasts, explosion and earthquake).

3.2 Shear wall

Shear wall are very important in high rise buildings in the seismic prone areas. Lateral displacement can be reduced by these shear wall. These are designed to resist both self-weight of the structure (gravity loads) and lateral forces.

Natural calamities (Earthquakes, wind forces) force causes several kinds of stresses such as shear, tension, and torsion etc., the structure may experience Storey displacement or may collapse suddenly. Shear wall reduces the severity of lateral displacement

The shear wall are used in tall building due to their advantages as a structural element. Shear wall is a vertical wall reinforces concrete element which resist the lateral forces parallel to the plane of wall. They start at the foundation stage and are continuous throughout the building height. The minimum and maximum dimension of the shear wall is 150mm and 400mm. If the structure is designed using shear wall then frame element takes 25% of the lateral force and 75% is taken by the shear wall. Shear wall acts as the deep rectangular cantilever beam to resist the lateral forces. Shear wall in flat slab increases the stiffness and reduces the storey drift. The concrete shear wall is one of the most effective solution for increasing the resistance and stiffness of the structure due to lateral forces which subjected to wind and earthquake loads. This method is most effective in controlling the lateral drift and reducing the structural damage .
Most effective in controlling the lateral drift and reducing the structural damage in the structure. Shear wall of different thickness and at different locations have given good results

Consider the two type of structure, first type consist of shear wall at the outer periphery and other type consist of two wall combined to form one long wall. Shear walls which having large lateral stiffness, draw most of the lateral forces and they help in reducing the demands on columns and beams. It is not only enough to provide shear walls in buildings but their location in a building also governs the overall response of the building. It is useful to have one long structural wall than two short ones separated by interconnecting beams. The Wall area is equal in both of the buildings in the Y-direction, the building with longer structural wall is much stiffer than the others. Hence it offers more resistance to lateral displacement. The force demands on beams and columns are reduced by using of double length walls.

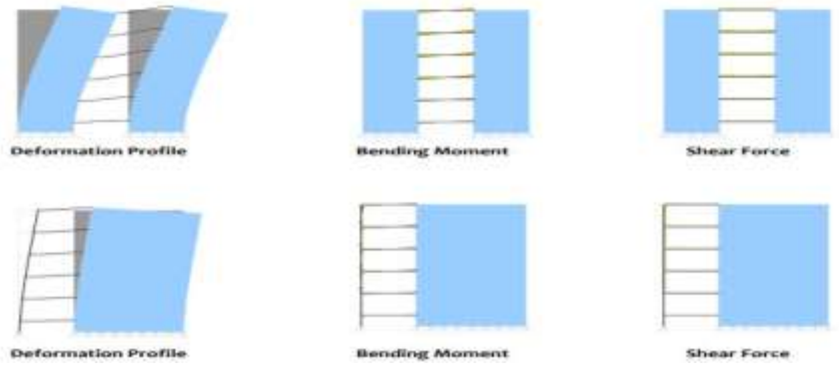


fig3.2(b) Building with different position of Shear wall

These are provided along the height to resist the in-plane loads. Shear wall mainly experience the seismic and wind loads. Generally, the loads are transferred to walls by Diaphragm (The structural element which transverse the lateral load to the vertical resisting elements of a structure. These are mainly in horizontal, but can be in sloped in special case like ramp for parking the vehicle.) They may be wood, concrete and masonry. Shear walls have high strength and stiffness to resist the lateral forces.

Shear wall are very important in high rise buildings in the seismic prone areas. Lateral displacement can be reduced by these shear wall. These are designed to resist both self-weight of the structure (gravity loads) and lateral forces.Natural calamities (Earthquakes, wind forces) force causes several kinds of stresses such as shear, tension, and torsion etc., the structure may experience Storey displacement or may collapse suddenly. Shear wall reduces the severity of lateral displacement.

VI. STRUCTURAL MODELLING

4.1 Parameters

Parameters considered for the study are discussed in particular for three dimensional ten storey building. Parameters considered in the study are given below.

a) Types of models

There are four different models considered for study and they are as follows:

- Multi- storey without shear wall
- Multi - storey with shear wall

b) Model Geometry

There are five number of bays in both horizontal X-direction and vertical Y-direction and each bay is having of dimension of 3m x 3m spacing.

c) Building Height

The height of each floor is 3m.

4.2 Material properties

Sl.No	**Property**	**Details**
1	Concrete grade	M30
2	Rebar grade	HYSD500
3	Density of Brick wall	20kN/m^3
4	Density of RCC	25 kN/m^3
5	Modulus of Elasticity of Concrete	27386.1 N/mm^2
6	Modulus of Elasticity of Masonry infill	14000 N/mm^2

7	Modulus of Elasticity of Masonry infill	14000 N/mm^2
8	Poisson's Ratio of Concrete μ	0.17

4.3 Properties of structural elements

Load calculations

Four types of loads are used in analysis of structures and they are as follows:

- Dead Load (IS:875(Part I)-1987)
- Live Load (IS:875(Part II)-1987)
- Seismic Load (IS:1893(Part III)-2002)

a. **Dead load**
Self-weight of the structure is calculated by multiplying volume of the section with the density of the material.

b. **Super-imposed dead load on slab:**
Floor finishes: 1.5kN/m^2
Live Load: 4 kN/m^2 (IS: 875(Part 2)-1987)

c. **Earthquake Forces**
Lateral load consist of earth quake load in X and Y direction as per the IS: 1893 (Part 1)-2002

Earthquake load for the building has been calculated as per IS: 1893-2002:

Data for calculation of Horizontal seismic coefficient:

Sl.No	Property	Details
1	Zone (Z)	IV
2	Response Reduction Factor (RF)	5
3	Importance Factor (I)	1
4	Rock and soil site factor	2
5	Type of Structures	1
6	Damping Ratio (DM)	0.05

d. **Percentage of Imposed Load For Seismic Weight**
Percentage of imposed load considered is taken as per IS 1893(Part1):2002. In addition to dead load, 25% of imposed load is considered for analysis if uniformly distributed load intensity is 3kN/m^2 or less and 50% if imposed load is more than 3kN/m^2.

e. **Support Condition**
The columns is fixed at the bottom.

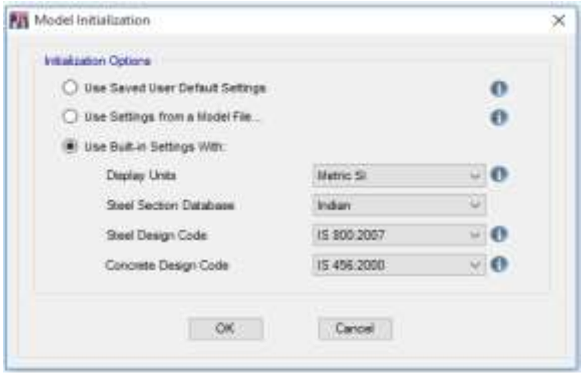
4.4 Types of loads cases

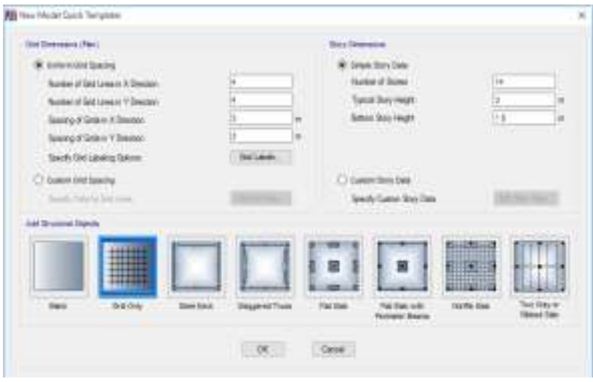
The structural systems has been subjected to seven types of Load Cases and they are as follows:-

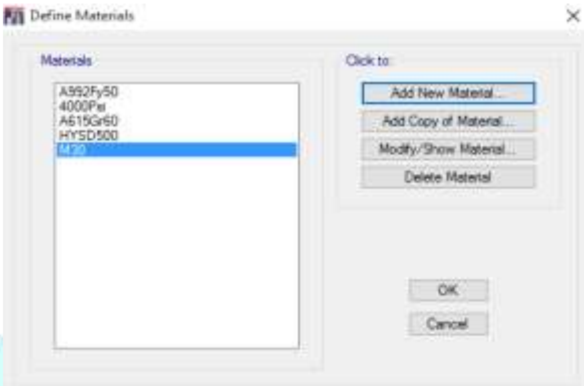
1) Dead Load Case (Gravity Load) and is designated as 'DEAD'.
2) Live Load Case (Gravity Load) and is designated as 'LIVE'.
3) Super Imposed Dead Load (Gravity Load) and is designated as 'SIDL'.
4) Seismic Load Case in direction-X (Static Load) and is designated as' EQX'.
5) Seismic Load Case in direction-Y (Static Load) and is designated as 'EQY'

4.5 Modelling in ETABS

ETABS software is used for the analysis of the building. Plan and 3D view is shown .B are frame analysis.







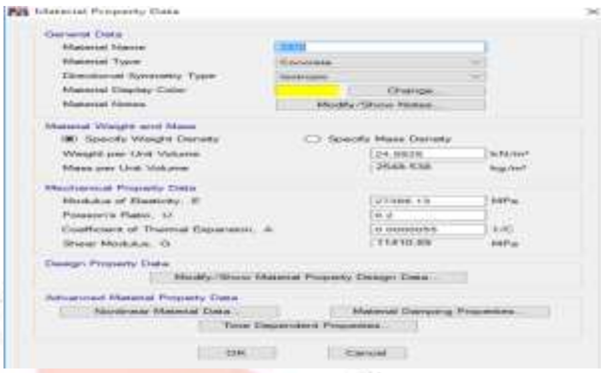


Fig 4.5.1 Material Defining

fig 4.5.2 Beam defining

fig.4.5.3. Column defining

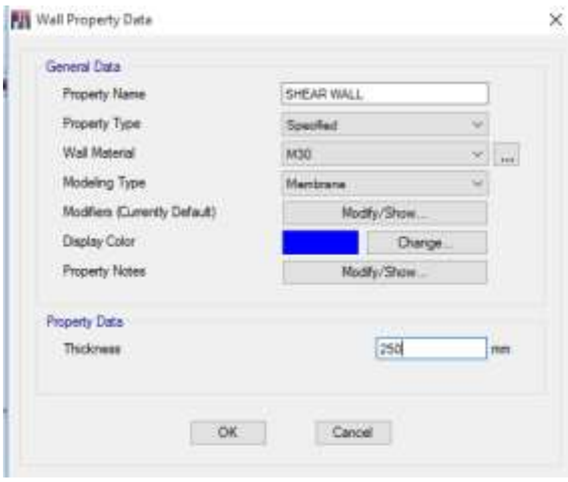


fig.4.5.4 Shear wall defining

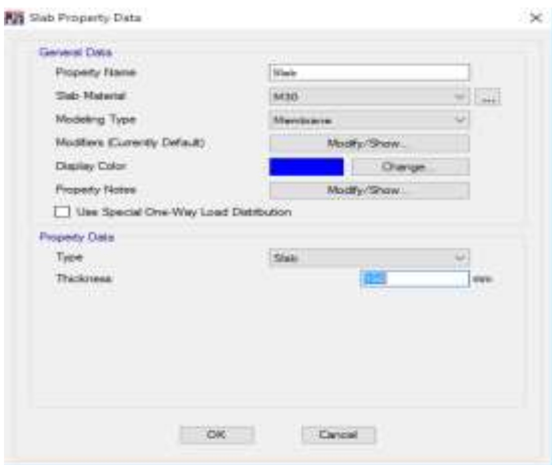


fig. 4.5.5. Slab defining

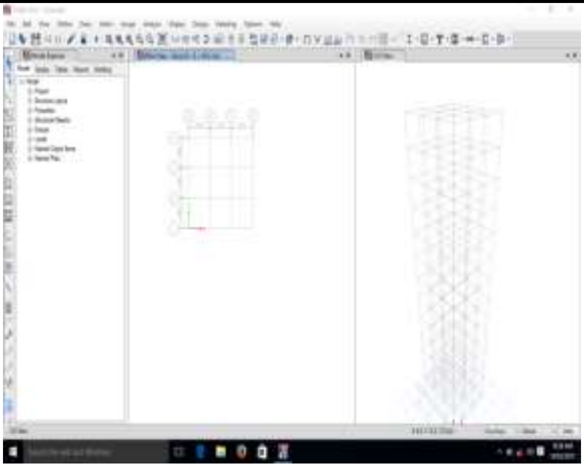


fig. 4.5.6 Modelling without shear wall

MODELLING OF MULTI-STOREY BUILDING WITH SHEAR WALL

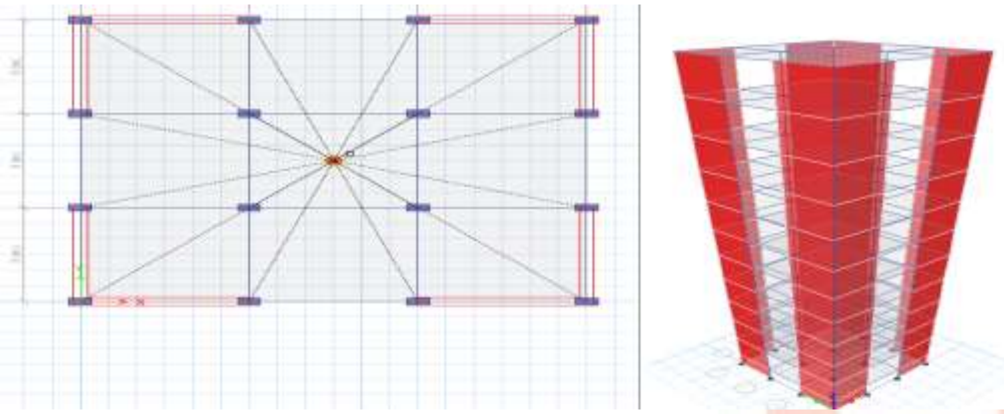


fig. 4.5.7 Modelling with shear wall

MODELLING OF MULTI-STOREY BUILDING WITHOUT SHEAR WALL

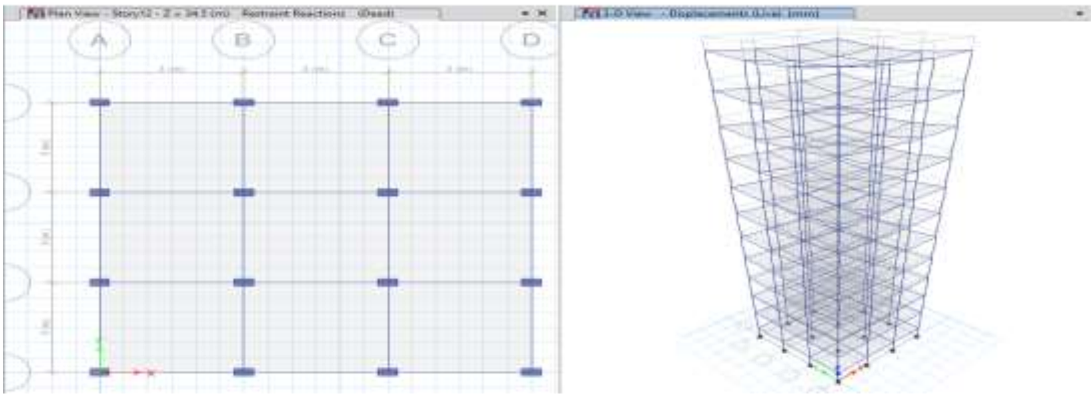


fig.4.5.8 Showcasing the Plan (Left) & 3D model (Right) of the ETAB model

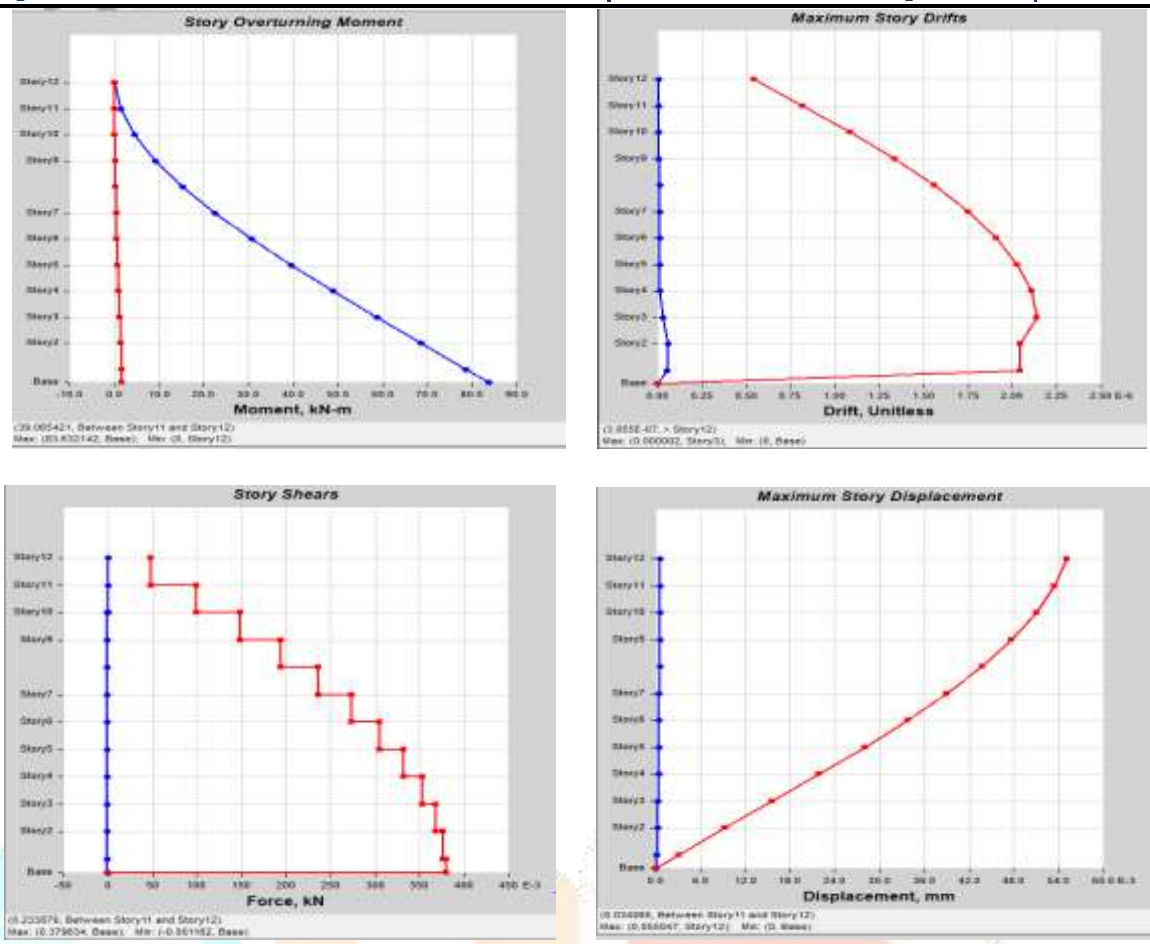
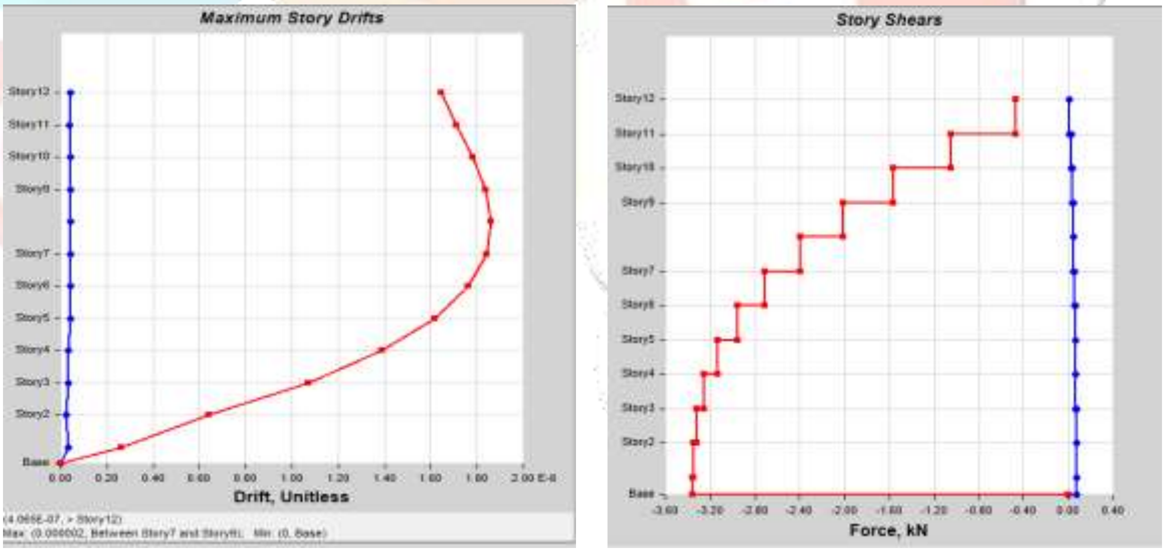


fig.4.5.9 normal multi- storey seismic analysis without shear wall results



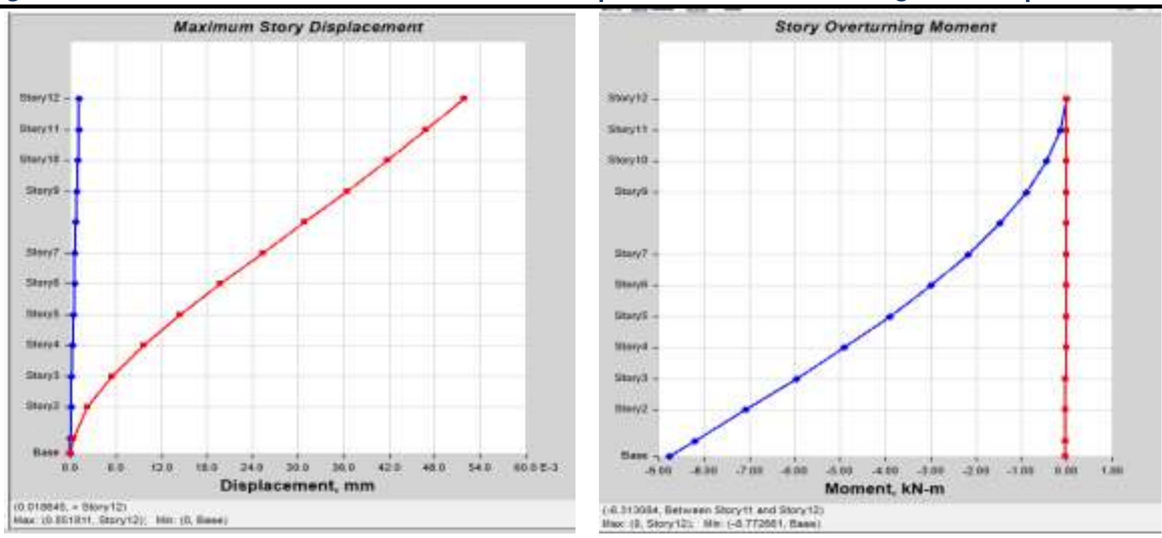


fig.4.5.10 multi storey seismic analysis with shear wall results

V. CONCLUSIONS

The analysis of buildings considering shear wall provided at the corners positions we concluded that the
A)maximum displacement at the shear wall is less compared to the building without shear wall.
B) The storey drift is less for shear wall compared to without shear building concluded by plotting graphs .
C) Storey shear is lesser in shear wall compared to without shear wall buildings.
By observing from above graphs and above all points we can say that the shear wall can resist the lateral forces on the structures. And its provides the rigidity to the building.

V.ACKNOWLEDGMENT

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