# "Comparative Study of G+16 Building Regular and Irregular buildings Design with Shear wall and without shear wall in E-TABS for Zone-3"

**Harish babu Aluri, M. Ramachandra Rao**

[1] P.G. Student, Department of Civil Engineering, NRI Institute of technology, Vijayawada, Andhra Pradesh
[2] Assistant Professor, Department of Civil Engineering, NRI Institute of technology, Vijayawada, Andhra Pradesh

---------------------------------------------------------------------***---------------------------------------------------------------------

**Abstract -** The primary goal of this project is to use ETABS to analyze and design. "**Comparative study of G+16 building regular and irregular buildings design with shear wall and without shear wall in E-tabs for different seismic zones** This work considers three zones and three soil types for all four zones, though I only worked on some. Medium-type soil is one of those zones, and medium-type soil is one of those soil types. When it comes to analyzing and designing structures, this is the only application that comes close to ETABS (Extended Three-Dimensional Analysis of Building Systems).

Nowadays, constructions of high raised buildings, major problems are facing seismic effect and wind effect is difficult to design for structural engineers. This earthquake resistance design mainly depends on types of structures and zone of building. This lateral effects completely resolved by using shear wall design both regular structures and irregular type of structures.

Comparative study of G+16 high raised building with shear wall and without shear wall (IS 13920-1993) design, both regular and irregular structures of building in the zone of three(0.16) and medium type of soil. Regular plan is consisting of two types (square and rectangle of building) and irregular plan type of structure is consists of three types(plus shaped, T shaped, L shaped) building designs by using ETABS V 2015 program Hyderabad, India zone of (seismic zone 2). All type of loads are applying based on the IS CODE book, Dead load(IS 875 PART 1-1987) and Live load(IS 875 PART 2-1987), Wind loads(IS 875 PART 3-1987), Seismic load(IS 1893 PART1-2002) design of structures by using equivalent linear static method.

A comparison of results of parameters between both plan regular and irregularity plan of structures of building with shear wall and without shear wall, maximum storey displacement, auto lateral seismic loads to stories and storey stiffness, storey shear, maximum storey drift, base shear, storey overturning moment, weight of building structure.

***Key Words***: Equivalent linear static, maximum storey displacement, storey drift, base shear, re-entrant corners plan of building..

## 1. INTRODUCSTION

- Earthquakes are caused by the sudden and temporary movement of the earth's surface.
- It is very important modify the seismic behaviour of existing structures.
- Seismology data from multiple earthquakes was compiled and processed to create seismic zones and explain the phenomenon.

The loads are considered for analysis-

a) Dead Load (IS 875 part1:1987)
b) Live Load (IS 875 Part2:1987)
c) Seismic coefficient method for earthquake loads (IS 1893 Part1:2002)

Designing a building's structure for resistance to shaking from earthquakes is dependent on careful consideration of seismic loads

### 1.1 Introduction to ETABS software:

- The Burj Khalifa, the world's tallest building, was also planned and analyzed with this approach.
- ETABS is the software of choice for designing steel, concrete, timber, aluminum, and coldformed steel structures, bridges, tunnels, and piles.

ETABS is an engineering program made specifically for tall buildings research and planning. As a result of its grid-like geometry, this type of building requires special modeling software, templates, and analysis and solution procedures. ETABS can analyze simple or complex systems in static or dynamic settings. P-Delta and Large Displacement effects can be coupled with modal and direct-integration time-history analysis for a more nuanced seismic performance evaluation. Material nonlinearity under monotonic or hysteretic behaviour could be captured by nonlinear linkages and focused PMM or fiber hinges. Applications of any complexity can be easily implemented because of the system's intuitive and unified design. Since it is compatible with various design and documentation platforms, ETABS may be used to create anything from a simple 2D frame to an intricate modern skyscraper.

## 1.2 WORKING PROCESS OF ETABS SOFTWARE:

### 1.2.1 Modeling of Structural Systems:

To accurately represent multi-story structures effectively, ETABS is based on the assumption that most floors will be identical or very similar from one level to the next. The following are examples of modeling features that facilitate the development of analytical models and the simulation of difficult seismic systems.

- Global system and local element modeling designs
- Variable shape and constitutive behavior of sections
- Object grouping and shelling
- The assignment of links for modeling isolators, dampers, and other advanced seismic systems
- Specifications for nonlinear hinges
- Meshing can be done automatically or manually
- Features for editing and assigning plan, elevation, and 3D view.

### 1.2.2 Loading, Analysis, and Design

When the modeling phase is complete, ETABS will provide code-compliant loading conditions for things like gravity, seismic, wind, and thermal forces. Infinite load cases and variations may be defined by the user.

The analysis tools also provide cutting-edge nonlinear techniques for characterizing static-pushover and dynamic responses. Modal, response-spectrum, or time history analysis are all viable options for dynamic concerns. The P-delta effect explains the linearity in geometry.

Features of the design will automatically determine the appropriate sizes for elements and systems, create reinforcing schemes, and optimize the structure for the specified performance metrics given an enclosing specification.

### 1.2.3 Output, Interoperability, and Versatility

Furthermore, the output and display formats are user-friendly. Reports can be structured in any way the user sees suitable, including the presentation of moment, shear, and axial force diagrams in 2D and 3D perspectives alongside associated data sets. There are also precise cross-sectional images displaying the varied regional responses. There are also global viewpoints showing dynamically relocated setups or time-history response animations in visual form.

## 1.3 ADVANTAGES OF ETABS SOFTWARE:

- The model can be viewed in a 3D axonometric perspective, as well as in a plan view, an elevation development view, or a user-defined perspective.
- The section designer allows for the graphic input of cross sections of any geometry and material.
- Model geometry can be copied and pasted to and from spreadsheets.
- It's simple to create.pdf files from the model's geometry.

## 1.4 DISADVANTAGES OF ETABS:

- Direct input file editing is not possible in ETABS.
- There is no user guide for STAAD, thus you can't print out or read the input file.
- In complicated models, it's easy to overlook a few loads. There is a difficulty in authenticating statements.
- The analytical technique can be time-consuming and disk-intensive.

## 1.5 GENERAL DATA

Slabs are not provided for the ground level; therefore, the flooring will be placed directly on the soil below. Ground beams provided as connection beams can only do so because they pass through the columns. As a result, the ground floor doesn't have any support beams.

- Modeling, designing, and analyzing were the key operations performed with ETABS.
- Slabs are designed in M30 grade for structural components such as columns and beams. This shear wall is primarily an M20 grade design.
- Beam and column sizes are consistent from the roof to the foundation.
- Assuming the diaphragms in the floor to be rigid.
- Beams sizes are 300mm x 600mm and design for concrete M30 grade.
- Columns sizes are 500mm x 500mm and design for concrete M30grade.
- Slab size of thickness is 150mm and design for concrete M30 grade.
- Shear wall size of thickness is 203.2mm (8inches) and design for concrete M20 grade.
- Structural supports are fixed.
- Dead loads and Live loads are considered as gravity loads.(its acting on vertical direction of structure)
- Earthquake loads and wind loads are considered as lateral loads.(its acting on horizontal direction of structure)

## 1.6 Aim and objective of the study

- How a building's seismic evaluation should be carried out.

- Using ETAB Software, compare various analysis results of buildings in zonesIII.
- Comparative study of regular and irregular building with shear wall design and also without shear wall design.
- To determine the types of loads acting on such structures.
- To learn about seismic analysis techniques such as response spectrum analysis and how to apply them with software.
- The results are interpreted using various values of the zone factor and their corresponding effects.
- The main goal of this research is to use ETABS software to analyses and design a G+16 buildings.
- Analyze the structure in accordance with IS 1893:2002(part I) earthquake resistance criteria.
- ETABS will be used to Drawing (or) modelling, design, and analyses a high-rise structure model.
- Buildings should be able to withstand large earthquakes without collapsing.
- To protect high risk seismic zones by using shear wall design.

## 2. METHODOLOGY

Analyzing and designing a building to withstand lateral seismic stresses has been covered in previous chapters. This chapter uses ETABS software and the response spectrum method to discuss the steps involved in the study and design of a G+16 story residential building. Predicting displacements and member forces in structural systems using the response spectrum approach of seismic analysis has computational advantages. Smooth design spectra, which is the average of numerous earthquake motions, are used in this method to calculate only the greatest values of the displacements and member forces in each mode. Results of construction, including how it responds to various seismic zones and soil types, are obtained by sampling these environments.

- **2.1 Defining materials. Section properties**

| S.NO | TYPE OF GRADES | USED |
|---|---|---|
| 1 | M30 | It is used for column and beams slab. |
| 2 | M20 | It is used for shear wall design |
| 3 | HYSD415 | It is used longitudinal bars and tiles. |

| S.NO | TYPE OF GRADE | REGION | MATERIAL TYPE | STANDARD |
|---|---|---|---|---|
| 1 | M30 | India | Concrete | Indian |
| 2 | M25 | India | Concrete | Indian |
| 3 | HYSD415 | India | Rebar | Indian |

### 2.2 Model description.

Grid dimension (plan) and uniform grid spacing

Number of grid lines in x direction =depends on structure

Number of grid lines in y direction =depends on shapes

Spacing of grids in x direction =its varies from storey to storey in terms of meters(M).

Spacing of grids in y direction = its varies from storey to storey in terms of meters(M).

Building height = 48m

Floor to floor height =3m

### 2.3 Framesection

Column =(500mm x500mm) for m30 grade of concrete

Beam = (300mm x 600mm) for m30 grade of concrete.

Slab thickness =150mm & Shear wall thickness =8”

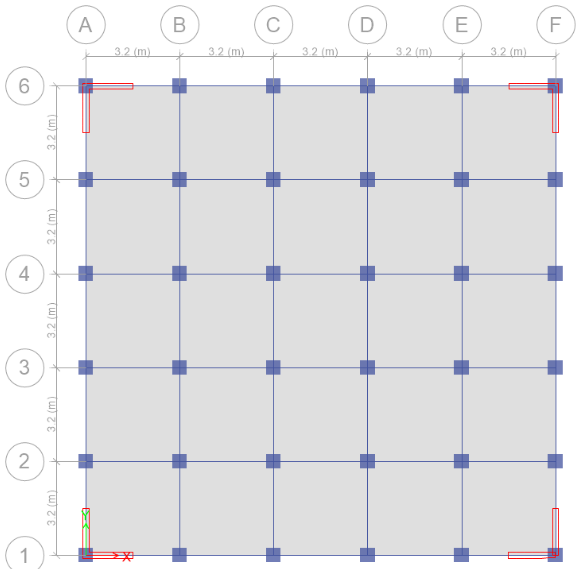
Fck =20 and 30 n/mm^2

### 2.4 DATA FOR MODELLING OF STRUCTURE

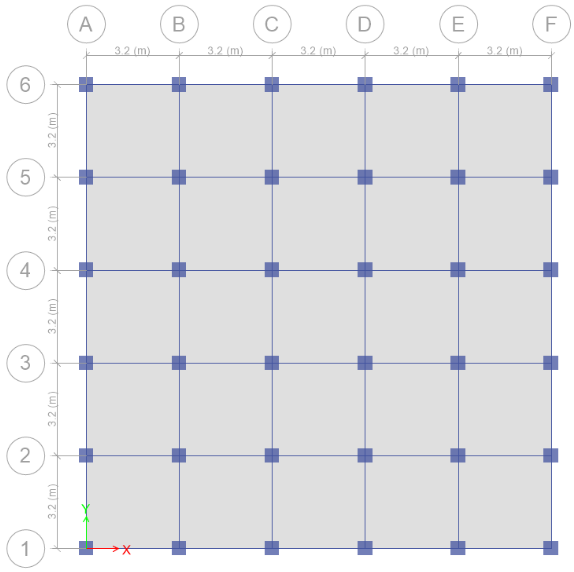
| | |
|---|---|
| Type of structure | RCC Frame structure |
| No. of stories | G+16 building |
| Storey to storey height | 3M |
| Building area | 256 sq.meters |
| Column | 500mm x 500mm |
| Beam | 300mm x 600mm |
| Slab thickness | 150mm |
| Type of grades | M30, M20 USED FOR GRADE OF CONCRETE |
| Shear wall thickness | 8”(203.2mm) |
| No. of structures | 5 |
| Dead load | 2.5 KN/M^2 |
| Live load | 4 KN/M^2 For typical , 1.5 KN/M^2 For Terrace level |
| Earth quake | as per followed IS1893 2002 part1 |
| Wind loads | IS 1987-part 3 |
| Seismic zone factor | Z=0.16 |
| Importance factor | I=1 |

| | |
|---|---|
| Type of support | Fixed |
| Wall load | wall thickness*grade of masonry*height of storey |

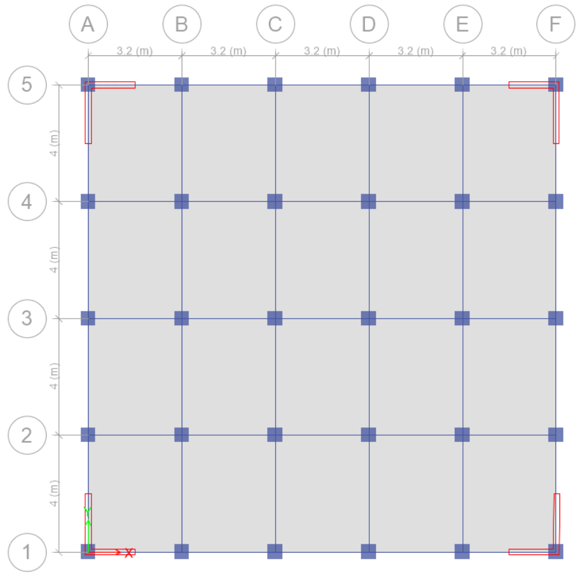
### 2.5 PLANS FOR REGULAR AND IRREGULAR STRUCTURES



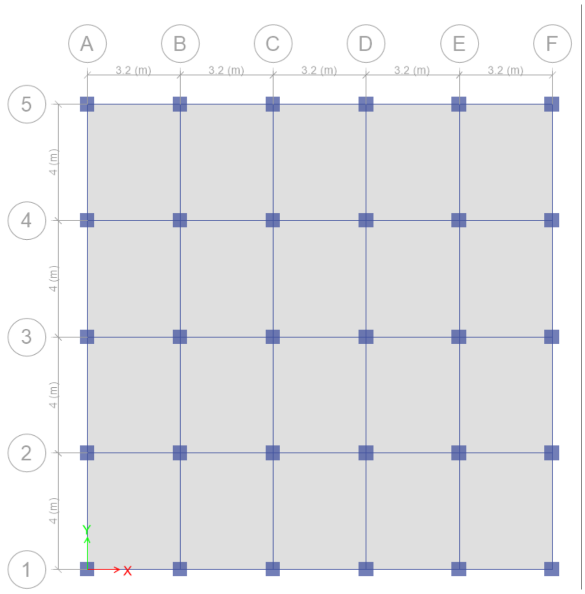

1. SQUARE WITH SHEAR WALL



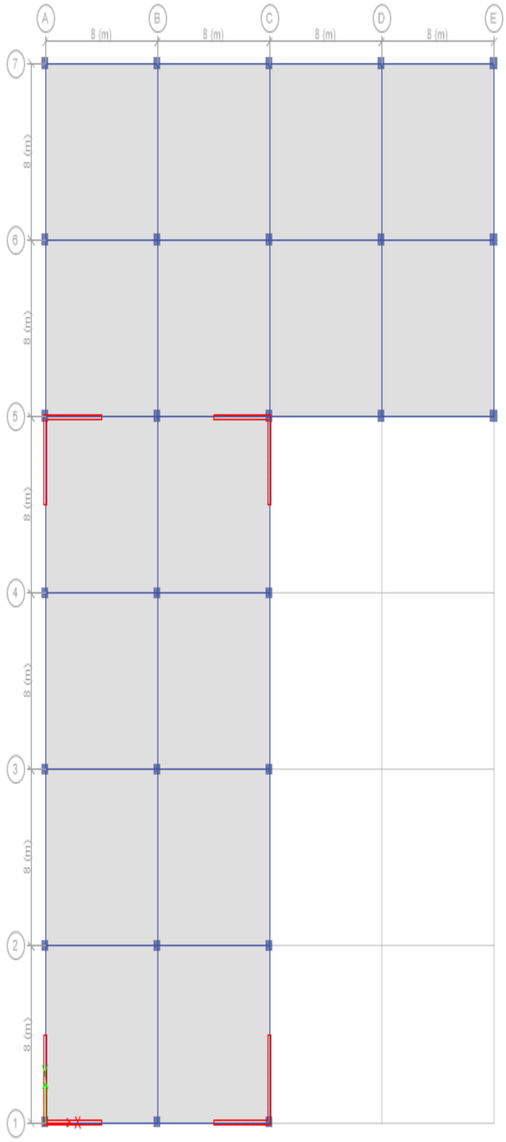

2.SQUARE WITHOUT SHEAR WALL



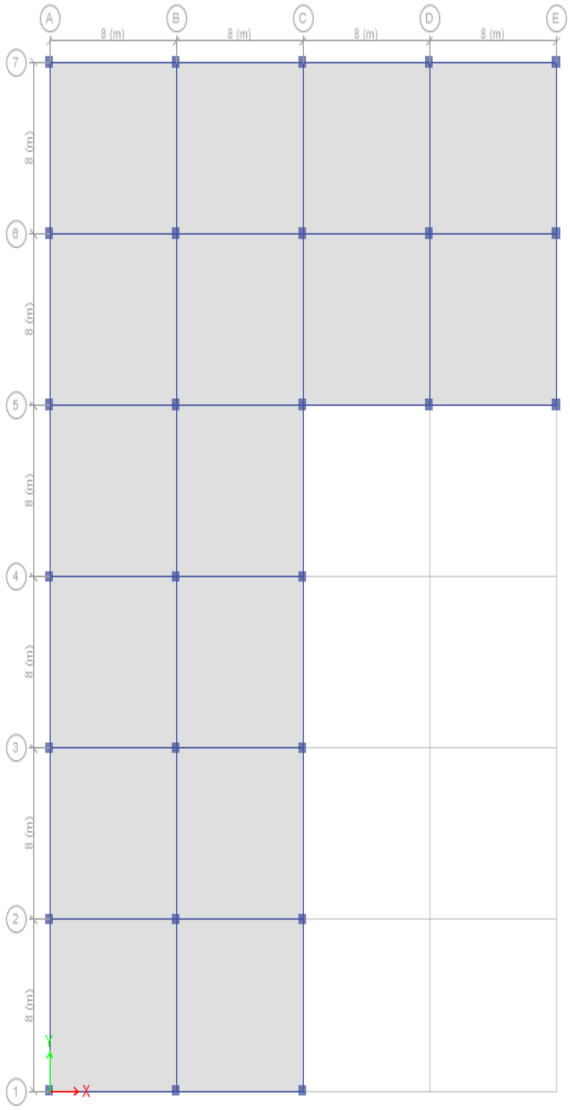

3. RECTANGULAR WITH SHEAR WALL



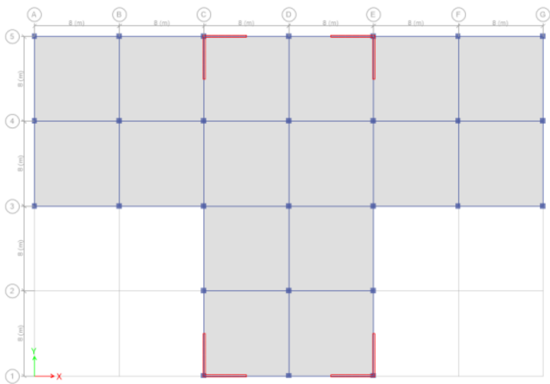

4. RECTANGULAR WITHOUT SHEAR WALL



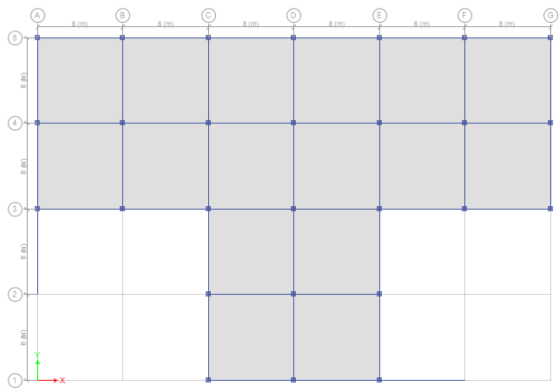
L SHAPED WITH SHEAR WALL



L SHAPED WITHOUT SHEAR WALL

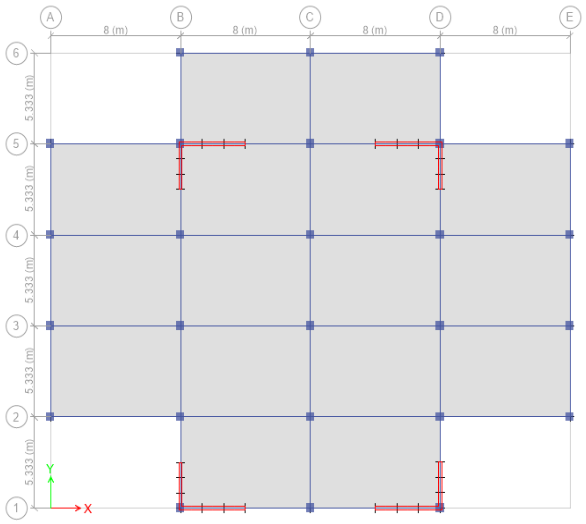


T SHAPED WITH SHEAR WALL

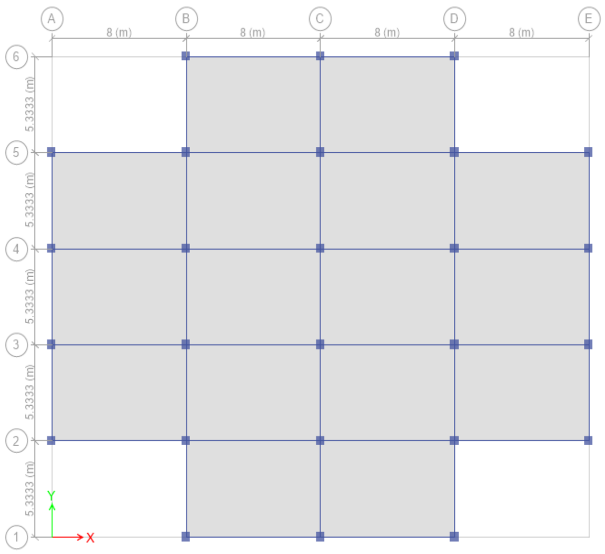


T SHAPED WITHOUT SHEAR WALL

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 07 | July 2023 www.irjet.net p-ISSN: 2395-0072




PLUS SHAPED WITH SHEAR WALL




PLUS SHAPED WITHOUT SHEAR WALL

ACTUAL STEP BY STEP PROCESS FOR ETABS SOFTWARE.

**2.6 MODELLING OF STRUCTURE**

MODELLING: modelling is consists of various types of materials and load patterns as follow below as:

1. Defining materials.
2. Defining sections.
3. Defining diaphragm.
4. Defining load pattern.
5. Defining mass source.

2.7 **DRAWING**

1. Assigning support.
2. Assigning load.
3. Assigning diaphragm.
4. Assigning mesh.
5. Defining load combination .

2.8 **ANALYSIS OF STRUCTURE :**

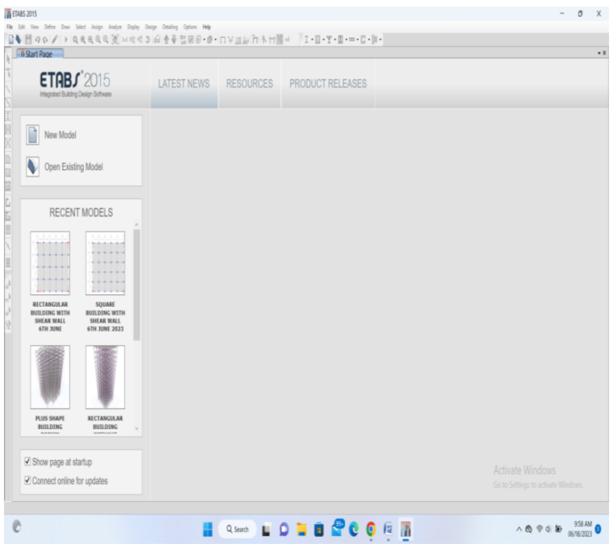
ANALYSIS : The analysis of structure consists of shear force and bending moments of entire structure.

1. Bending moment diagram.
2. Shear force diagram.
3. Axial force diagram.
4. Reactions.
5. Response spectrum.
6. Storey drift.
7. Storey displacement.
8. Time period.
9. Modal participating mass ratio

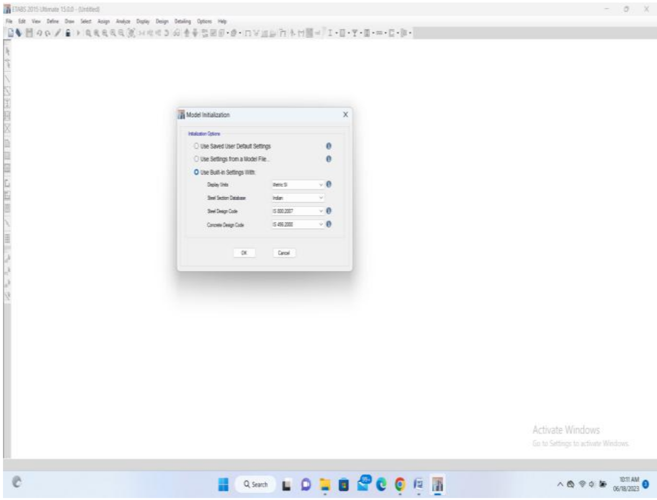
3. Designing of building:

- Designing: The designing is important part of structure.
- Designing is mainly used to calculation of area of reinforcement of structure and number bars calculating of structure. STEP BY STEP

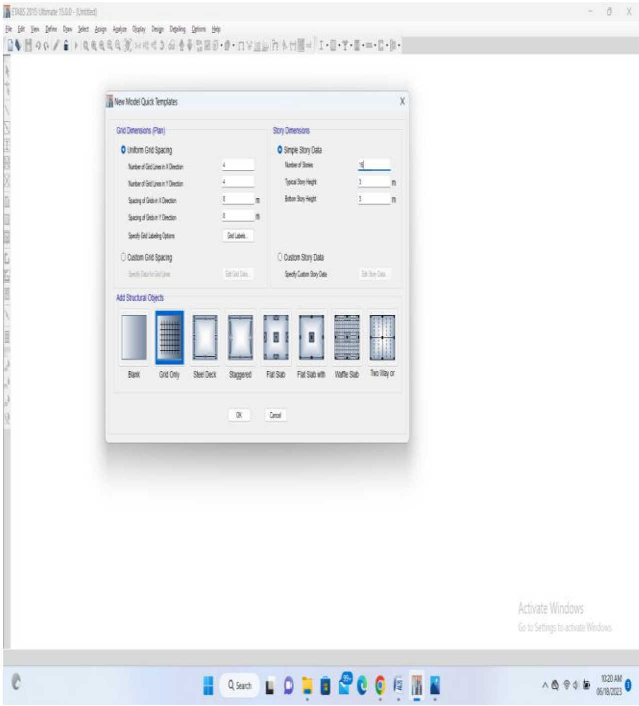
**Step-1: Open ETABS Software**



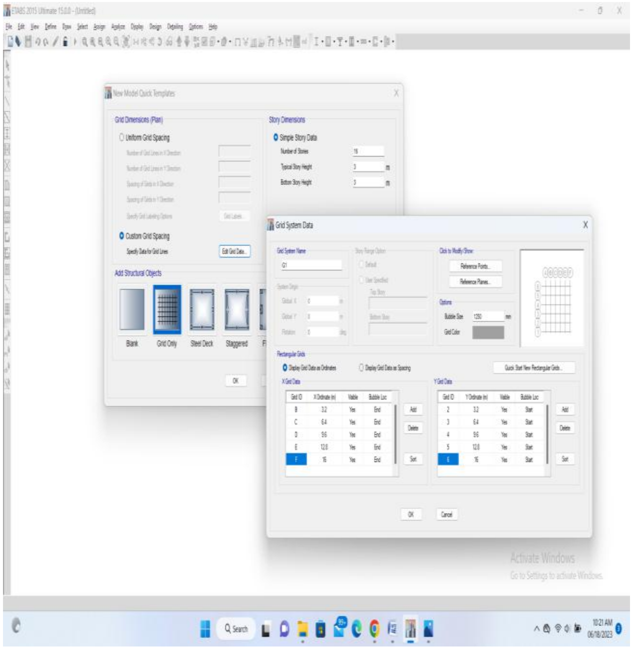

- **Click > New model**
- **One dialogue box will open**



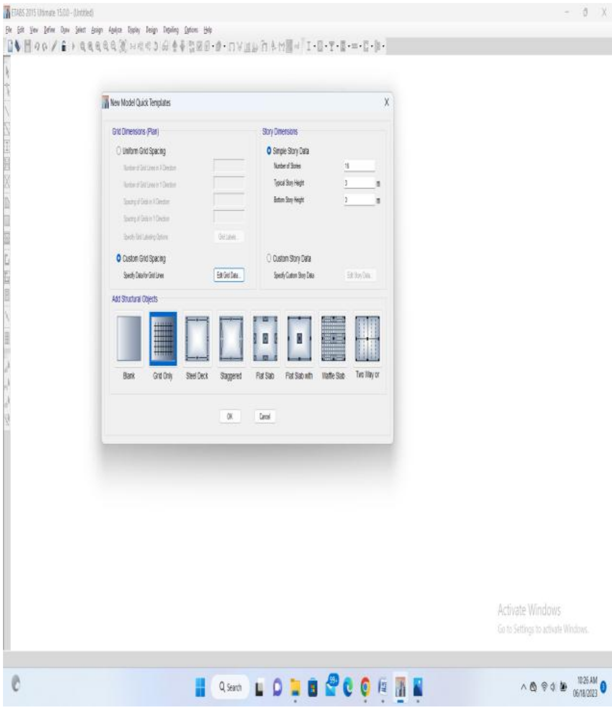
- **Select all appropriate data and click OK**
- **Again one dialogue box will open**



- **Click >custom grid spacing > Edit grid data**
- **set the x and y ordinates as below**



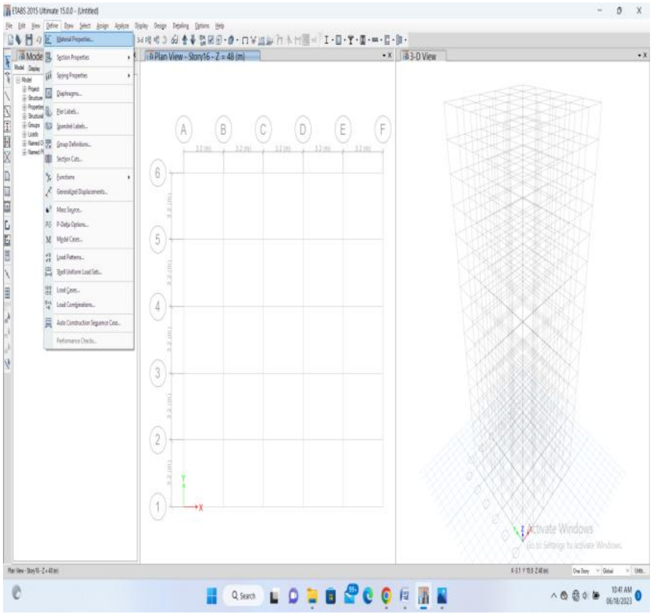
- **click > Ok**
- **click > custom story data > Edit story data**



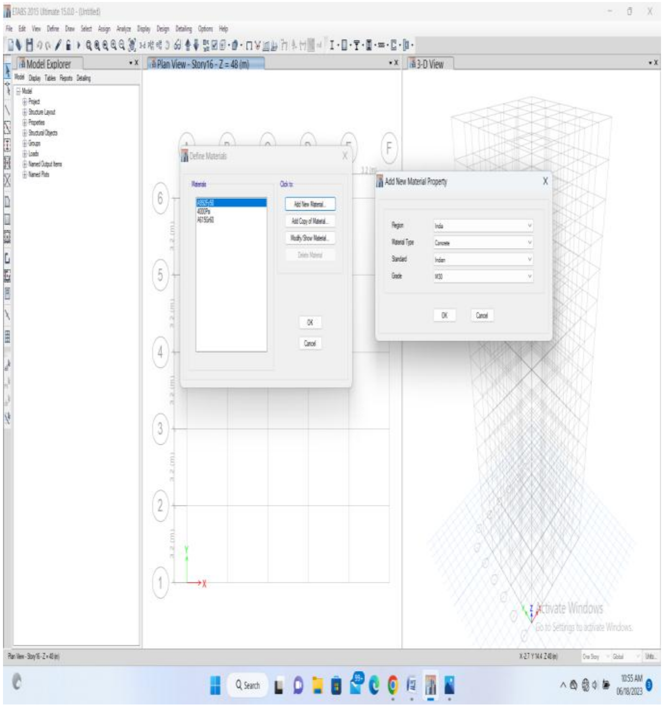
- **click > OK**
- **STEP-2**

- **Go to Define tab**

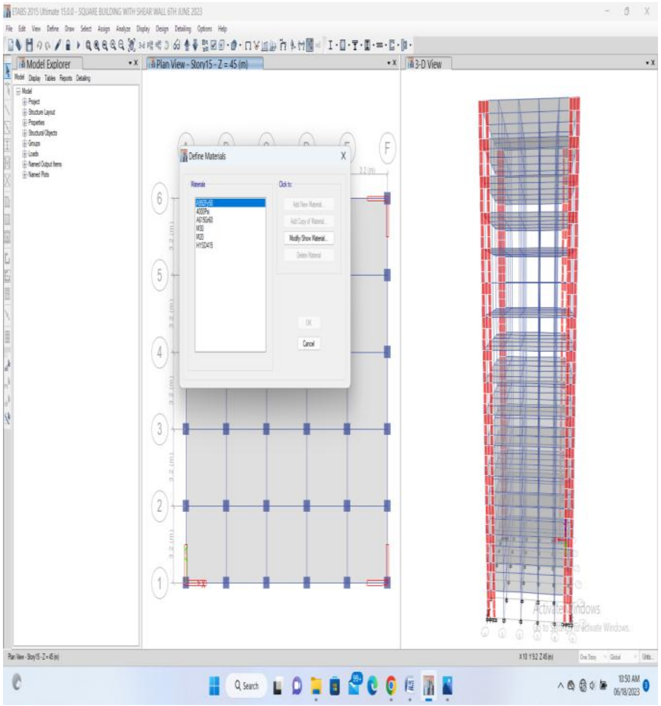
- **Click > define materials**



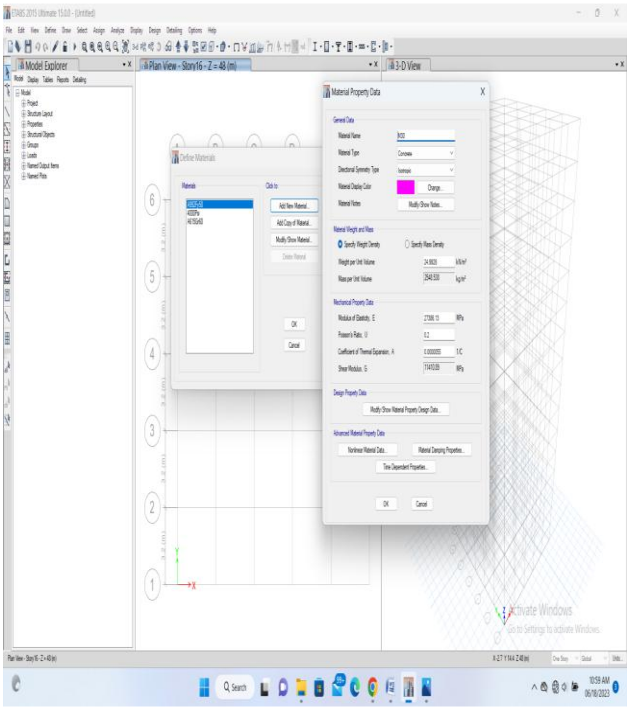
- one dialogue box will open



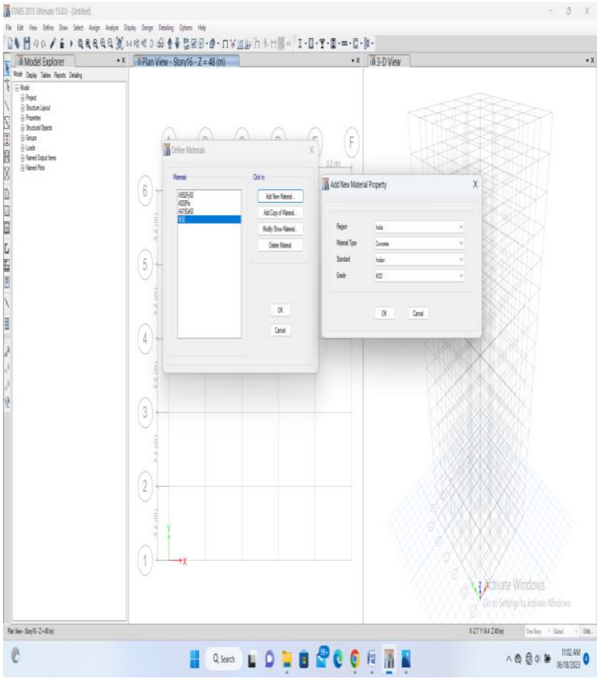
- Define material of M30 grade



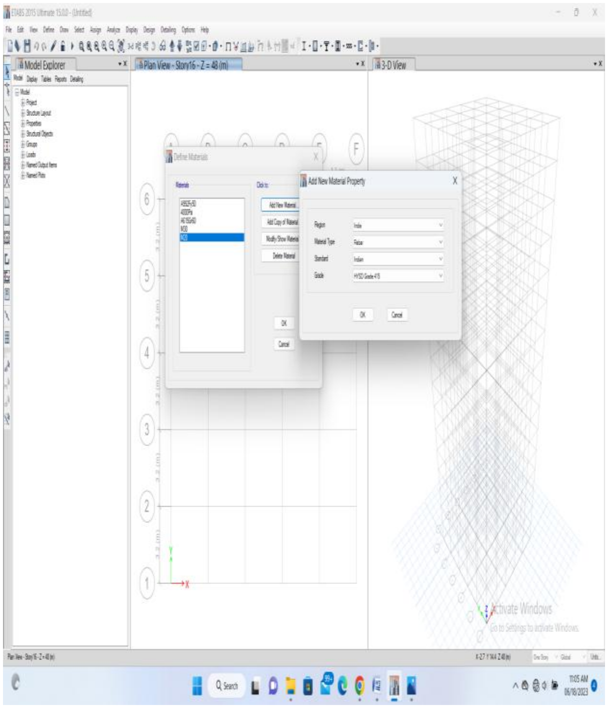
- Again one more dialogue box will open



- Define material of M20 grade



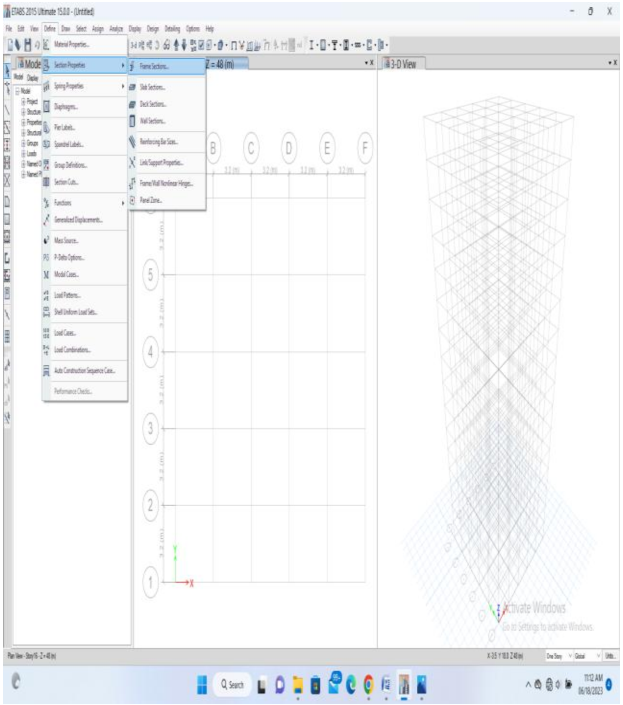
- **Define rebar's materials**



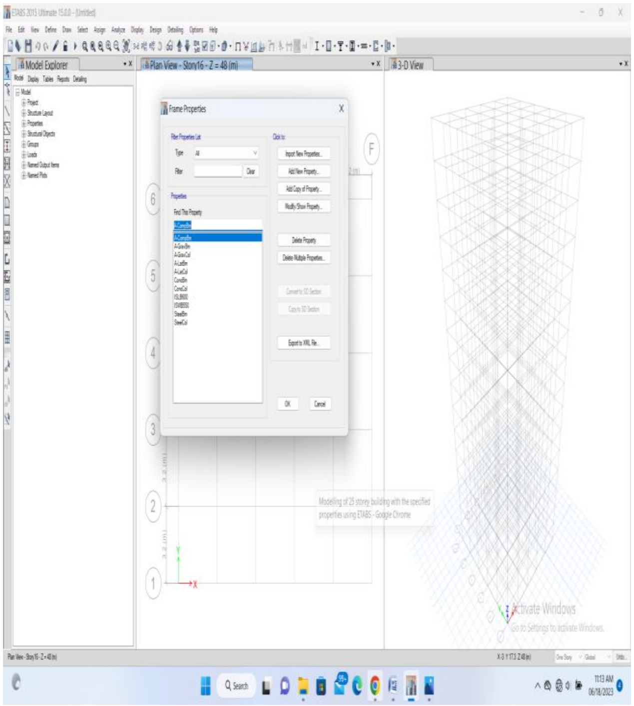
- **Click ok**

**Step -3**

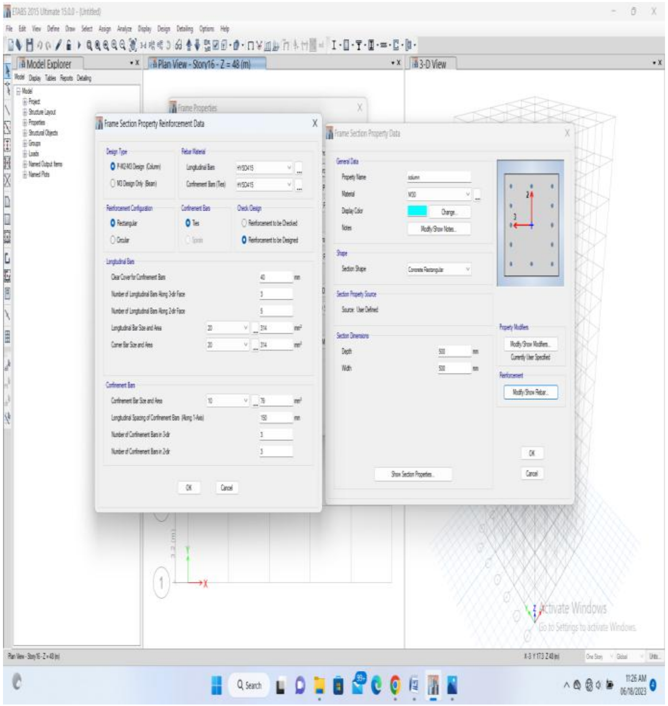
- **click on > define, then click >>> section properties**
- **again click >>> frame sections**



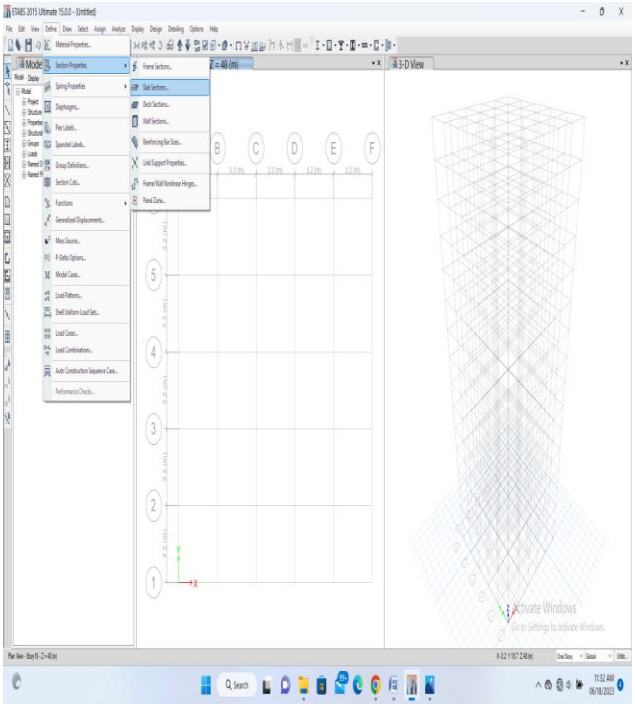
- **One dialogue box will open**



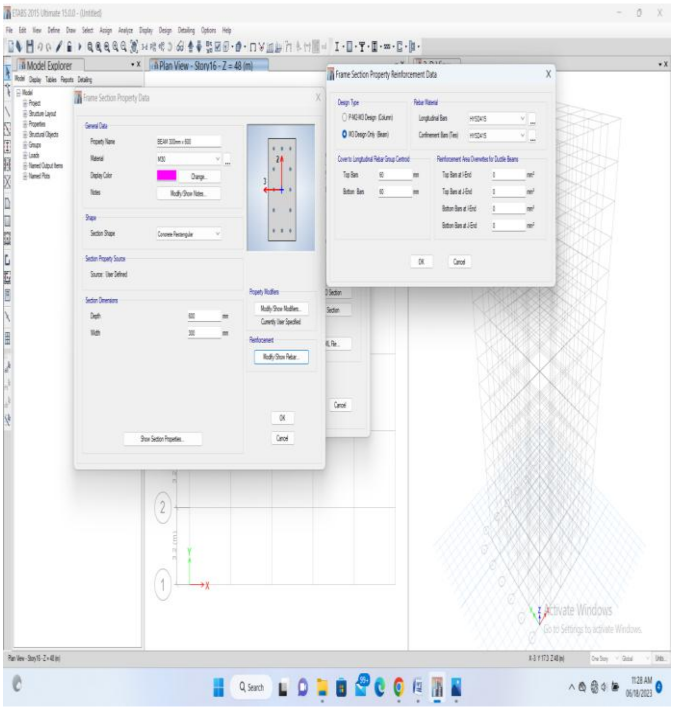
- **Click add new property**
- **Column (500mm X 500mm)**
- **Beam (300mm X 600mm)**
- **Column details**



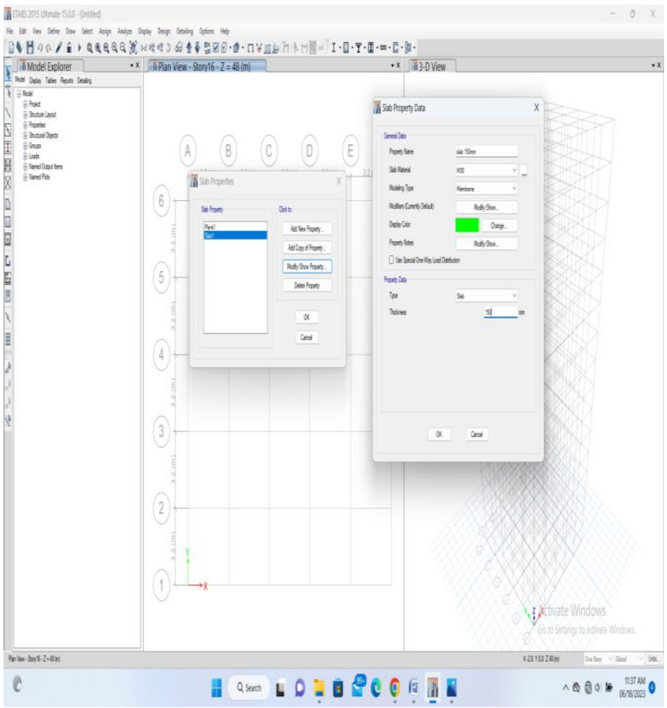
- **Beam details**



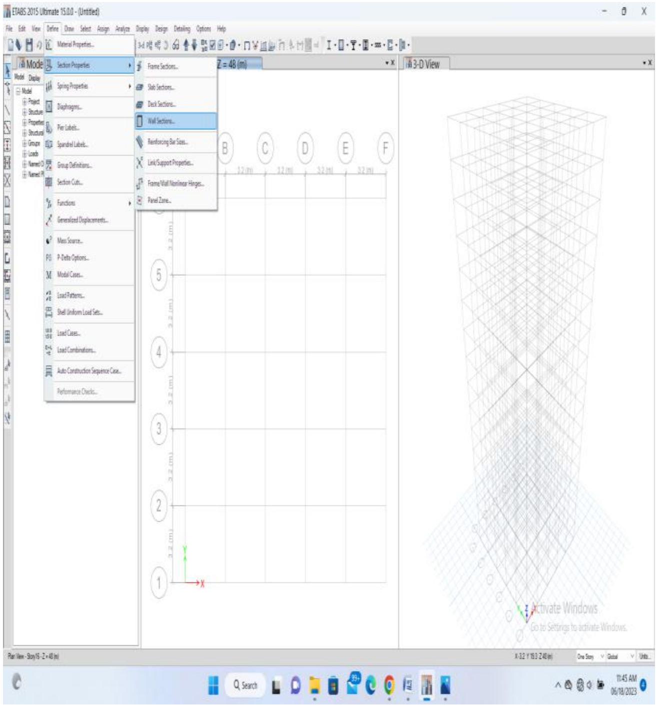
- **click >>> add new property**
- **slab is 150mm thickness for m30**



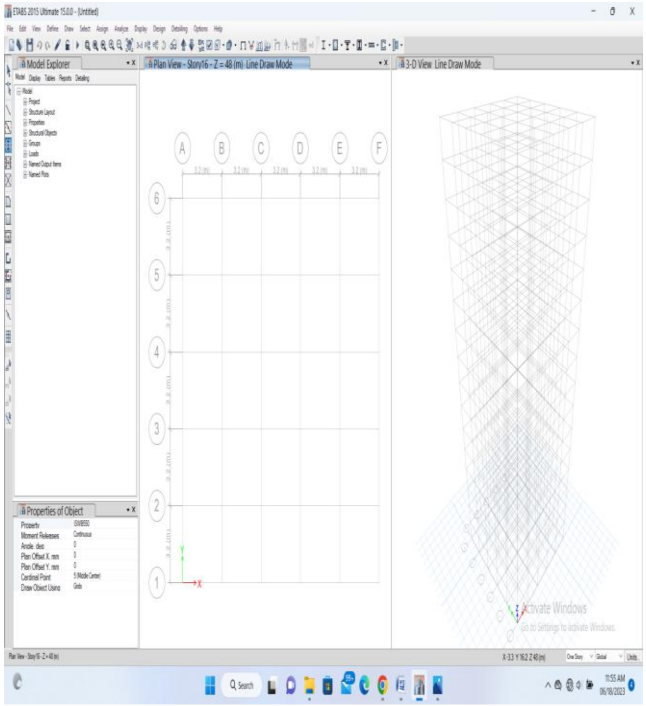
- **click on > define, then click >>> section properties**
- **again click >>> slab section**



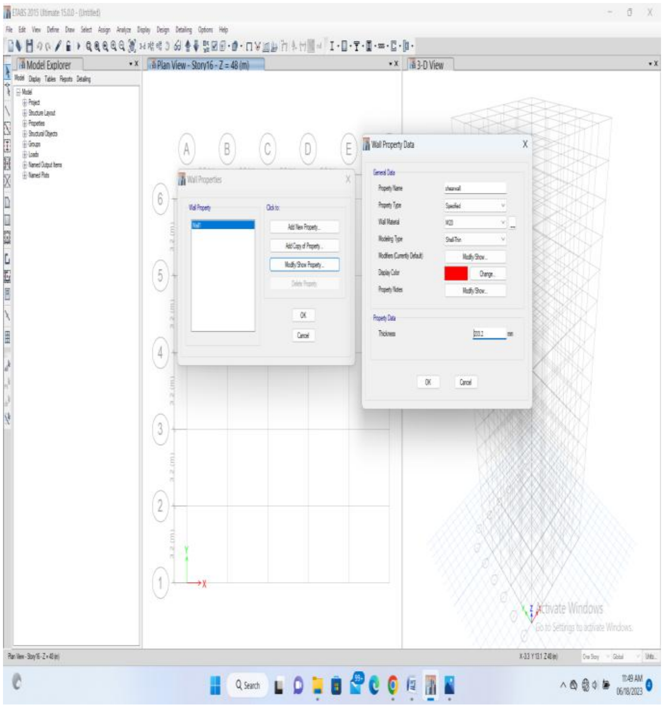
- **click >>>ok**
- **Define shear wall**



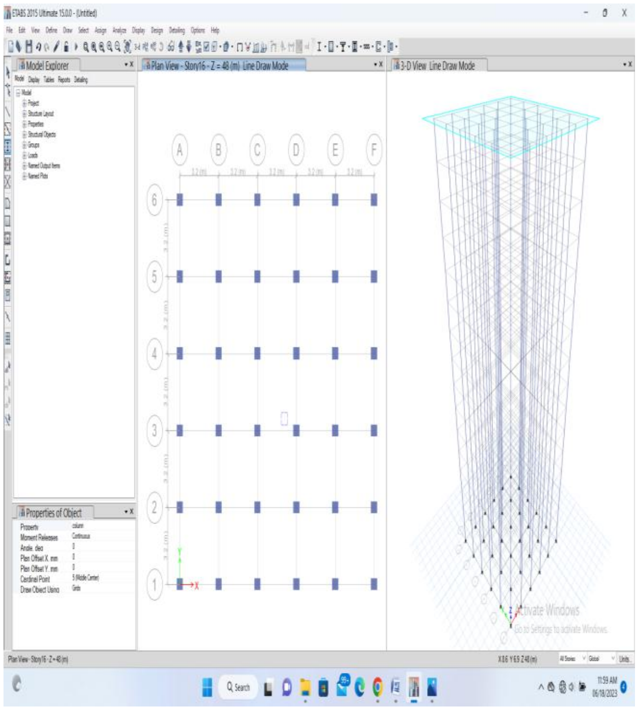
- **Define shear wall**



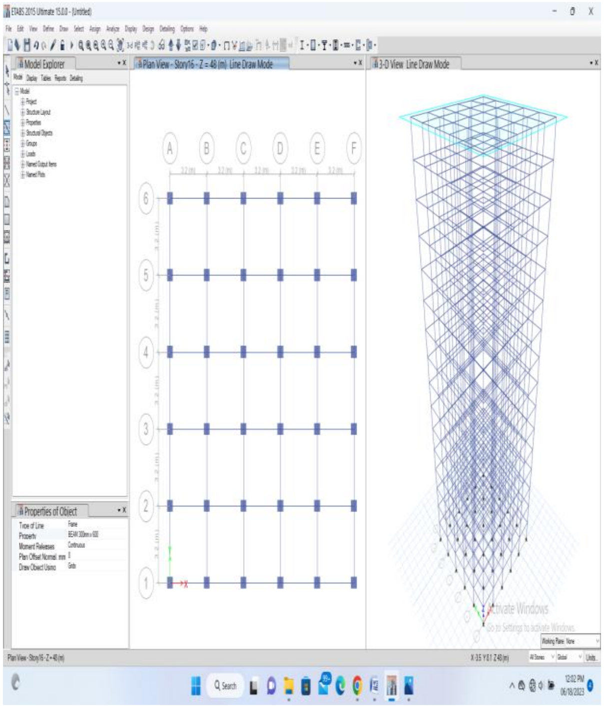
- **Draw Quick column**



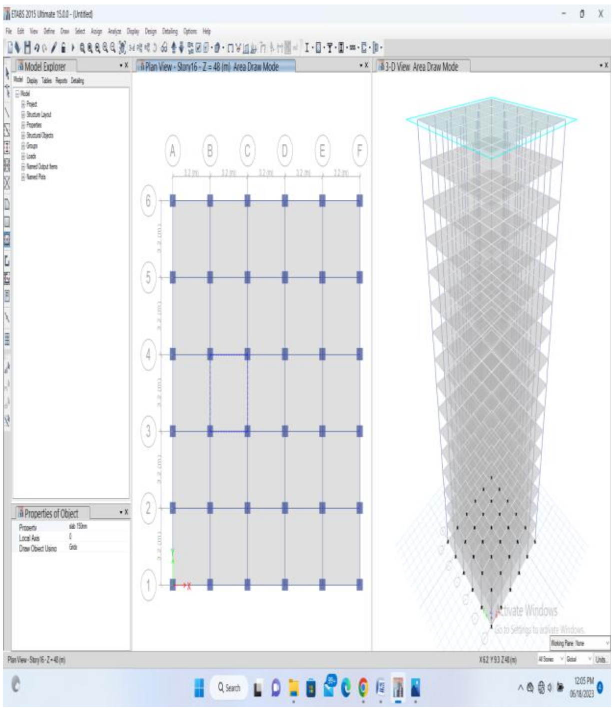
- **Applying all materials**
- **Click quick draw column**



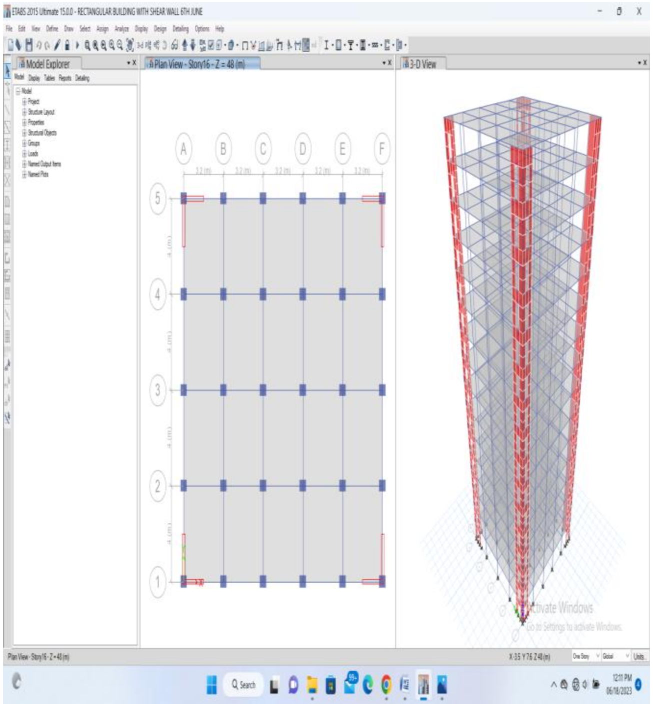
- **Click quick beam**



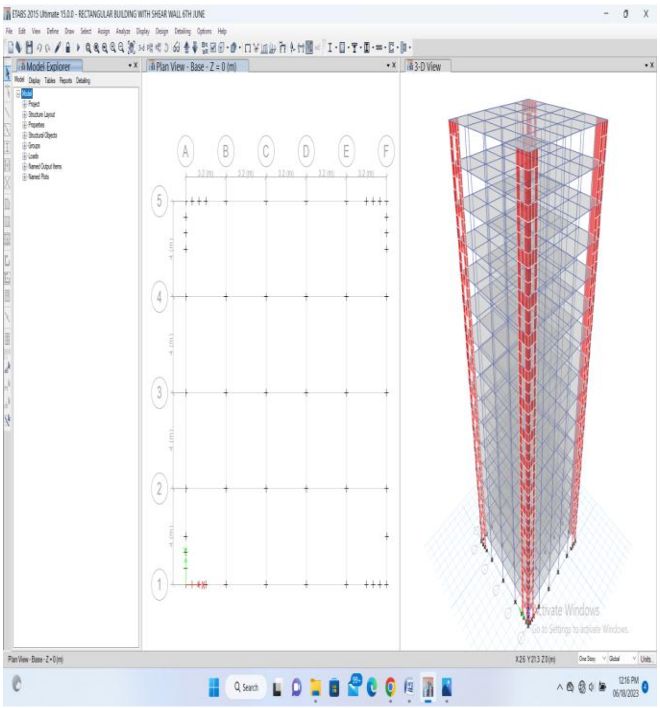
- **Click on quick slab and draw slab**



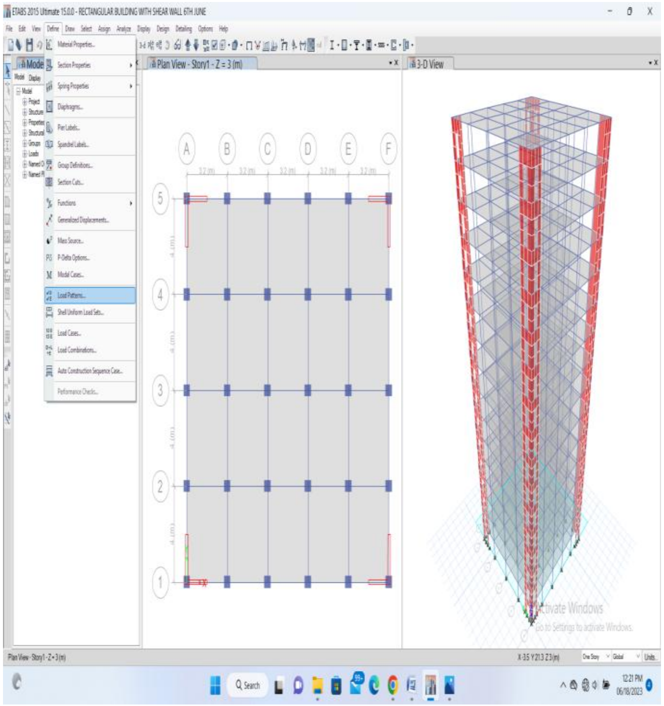
- **Click on shear wall and draw shear wall with openings**

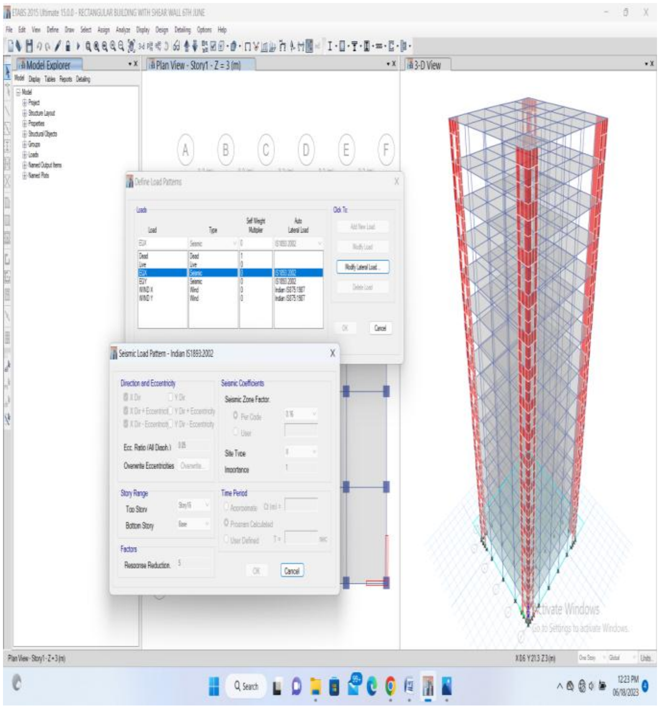


- **Define supports,**
- **Click on >>>Assign >>>joint>restraints>>fixed>>>ok**

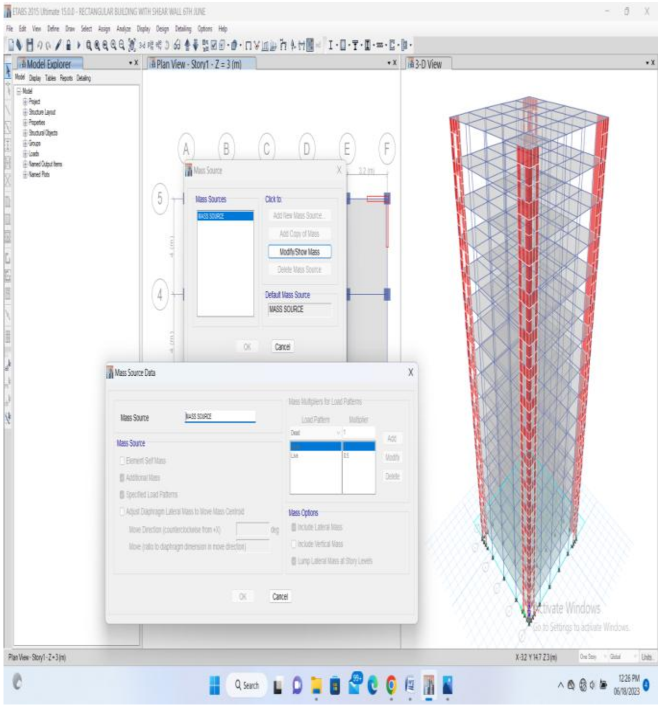


- **Define load patterns**





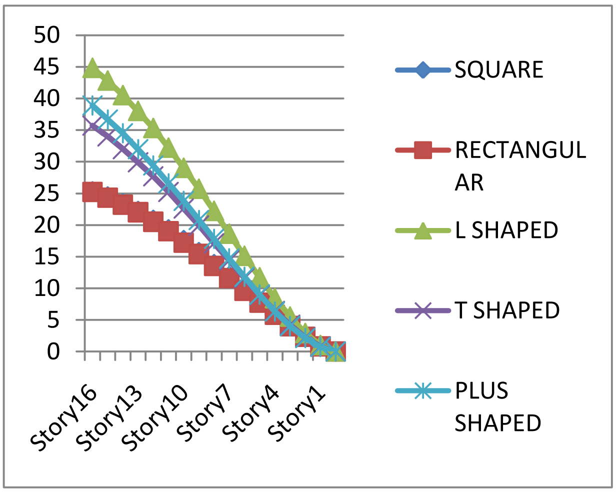
- **Define mass source**



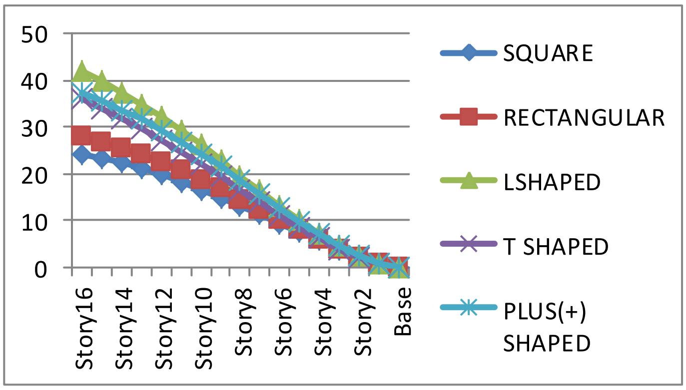
- **Define load combination**
- **Run analysis(f5)**
- **Model check**
- **Results**

## 3 RESULTS & CONCLUSION.

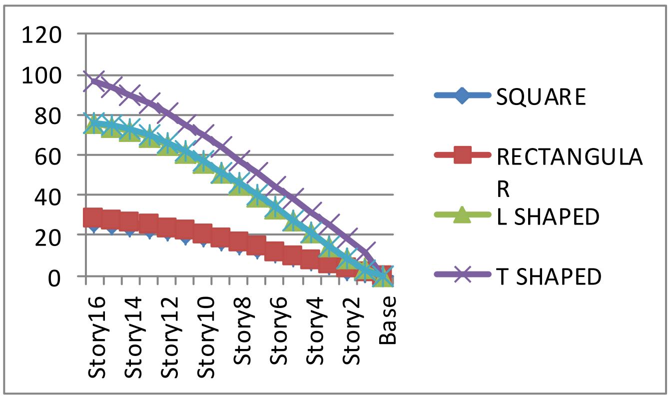
### 1. MAXIMUM STOREY DISPLACEMENT IN X DIRECTION (WITH SHEARWALL) EQX



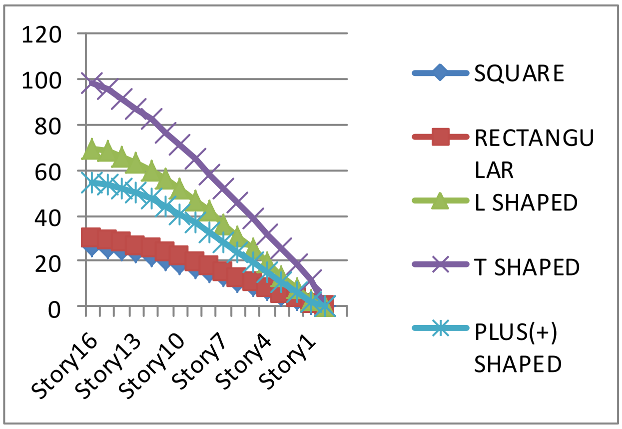
2. **MAXIMUM STOREY DISPLACEMENT IN Y DIRECTION (WITH SHEARWALL) EQY**



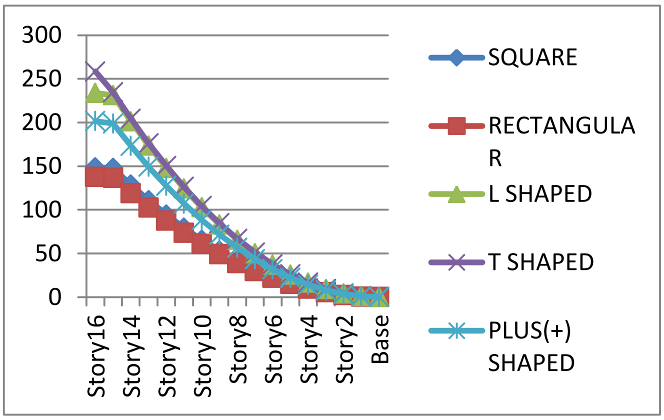

3. **MAXIMUM STOREY DISPLACEMENT IN X DIRECTION (WITHOUT SHEARWALL) EQX**



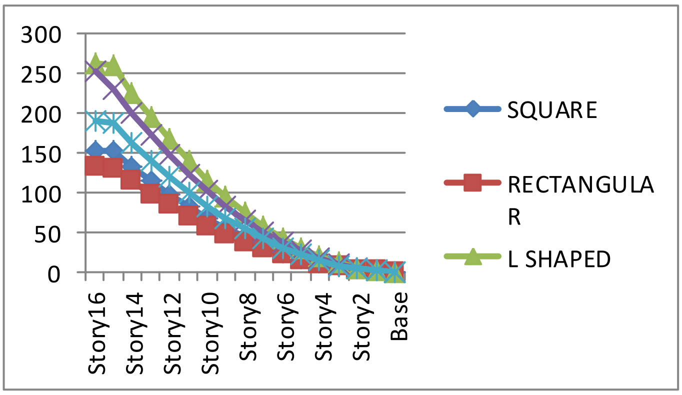

4. **MAXIMUM STOREY DISPLACEMENT IN Y DIRECTION (WITHOUT SHEARWALL) EQY**



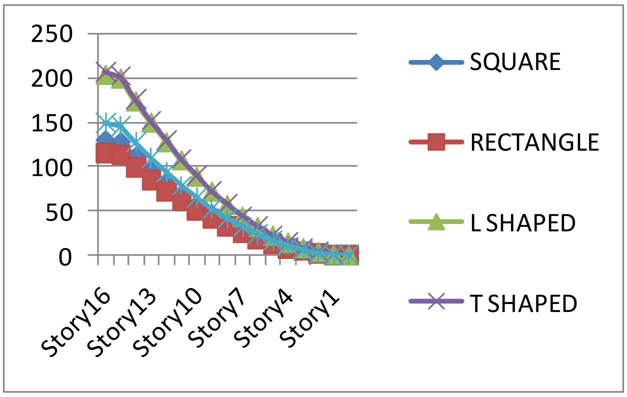

5. **AUTOLATERAL LOAD SEISMIC STOREY TO STOREY EQX IN X DIRECTION (WITH SHEAR WALL)**



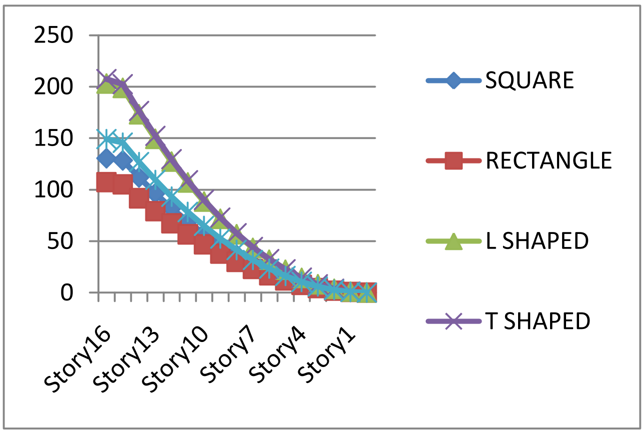

6. **AUTOLATERAL LOAD SEISMIC STOREY TO STOREY EQY IN Y DIRECTION (WITH SHEAR WALL)**



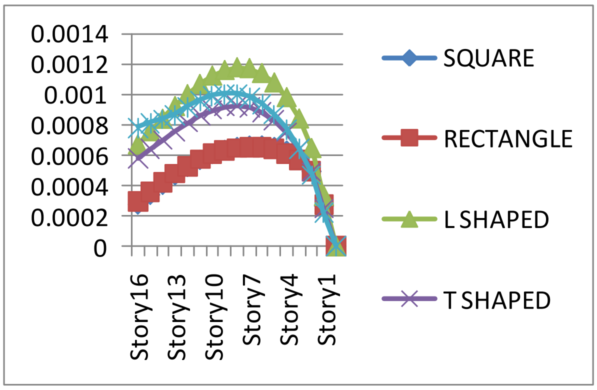

7. **AUTOLATERAL LOAD SEISMIC STOREY TO STOREY EQX IN X DIRECTION (WITHOUT SHEAR WALL)**



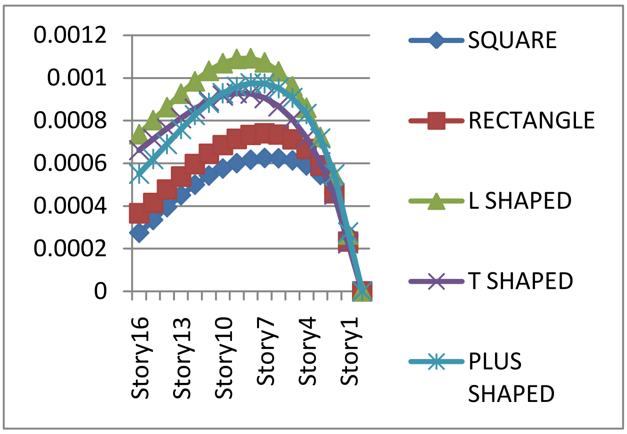
**8. AUTOLATERAL LOAD SEISMIC STOREY TO STOREY EQY IN Y DIRECTION (WITHOUT SHEAR WALL)**



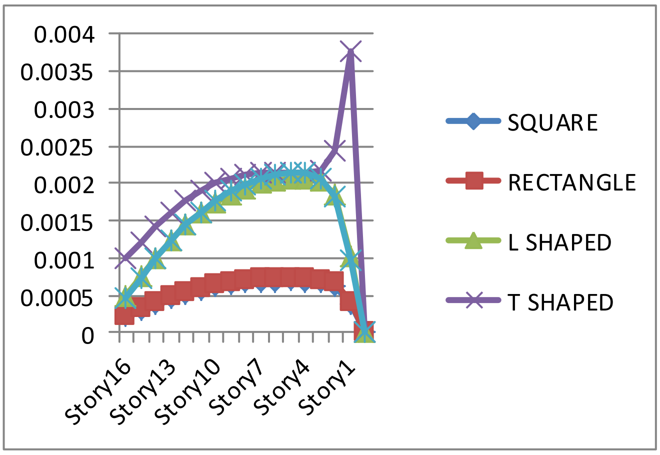

**9. MAXIMUM STOREY DRIFT EQX IN X DIRECTION (WITH SHEAR WALL)**



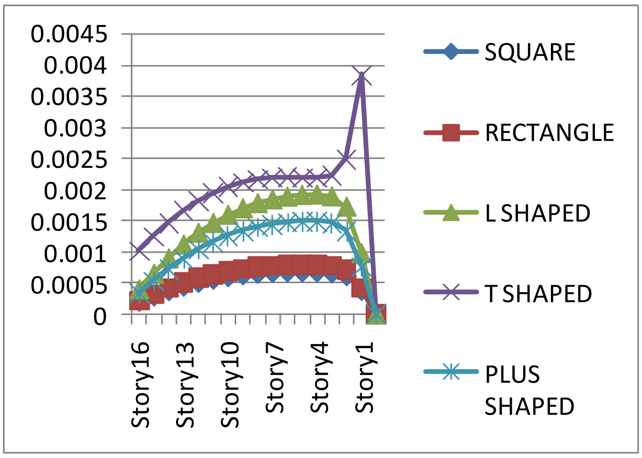

**10. MAXIMUM STOREY DRIFT EQY IN Y DIRECTION (WITH SHEAR WALL)**



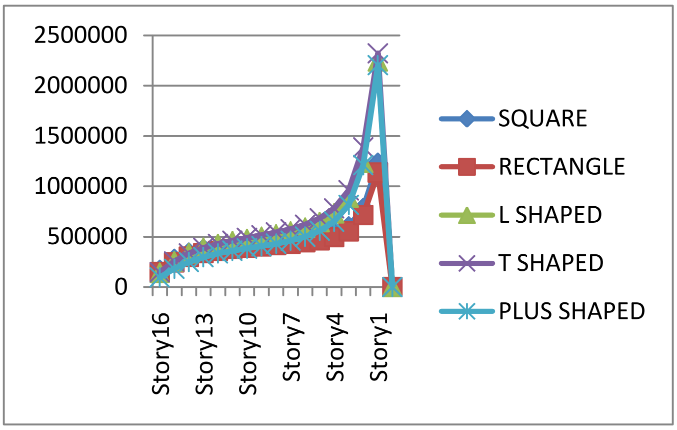

11. MAXIMUM STOREY DRIFT EQX IN X DIRECTION (WITHOUT SHEAR WALL)



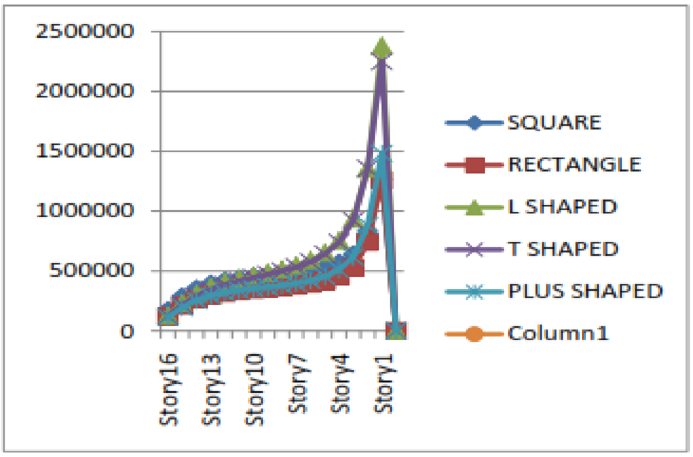

**12. MAXIMUM STOREY DRIFT EQY IN Y DIRECTION (WITHOUT SHEAR WALL)**



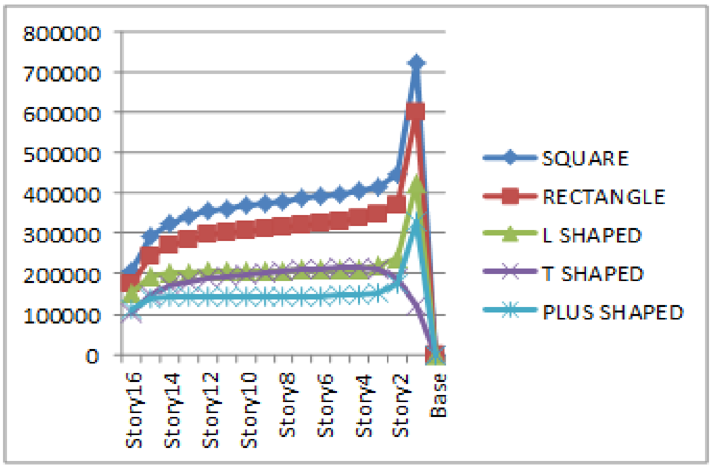

**13. STOREY STIFFNESS EQX IN X DIRECTION**



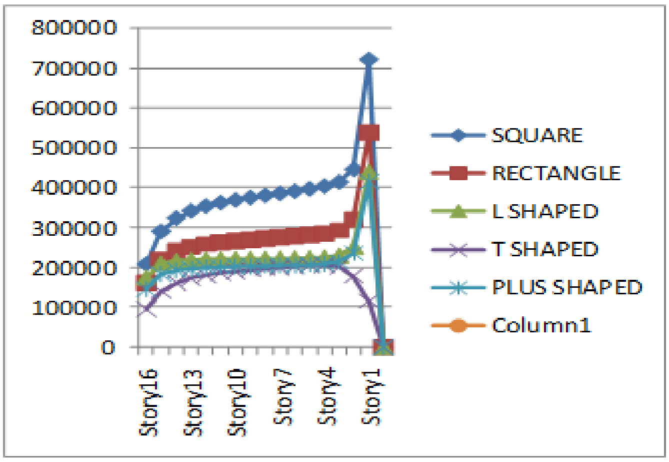
**14. STOREY STIFFNESS EQY IN Y DIRECTION**




**15. STOREY STIFFNESS EQX IN X DIRECTION(WITHOUT SHEARWALL)**




**16. STOREY STIFFNESS EQY IN Y DIRECTION(WITHOUT SHEARWALL)**




## 4. LITERATURE REVIEW

1. **IS 456:2000 [22]**, This standard is typically applied to both basic and reinforced building forms. The focus here is on tailoring the structure's layout to the needs of the client. Cement concrete work is to be executed under the leadership of a qualified and experienced supervisor, and the design of the plan and reinforced cement concrete work is to be entrusted to a qualified engineer.

2. **Bruce R.Ellingwood (2001) [7]**earthquake resistance and design process based on the more reasonable probability-based treatment of uncertainty are researched for their potential and future improvement.

3. **IS 1893(part1):2002 [21]** Buildings, elevated structures, industrial and stack-like structures, bridges, concrete masonry and earth dams, embankments and retaining walls, and other structures are all covered by the standard's basic provisions, which address seismic load assessment and earthquake resistant design.

4. **S.K. Ahirwar, S.K.Jain and M.M.Pande(2008)**: Possible effects of an earthquake on multi-story R.C. Construction of framed structures in accordance with IS:1893-1984 and IS:1893-2002. They looked at structures of 3, 5, 7, and 9 stories and studied them separately. Five distinct sequences were determined for each structure. Analysis techniques such the Seismic Coefficient, Response Spectrum, and Modal Analysis were used. Earthquake reactions, such as ground shaking and building shaking.

5. **Geotechnical Earthquake Engineering (Steven L. Kramer), (2013)** Introduces earthquake engineering, geotechnical engineering, seismology, and structural engineering. The author discusses earthquake damage types, ground motion measurements, earthquake hazards, and earthquake response techniques.

6. **Anil K. Chopra (2015) [17]**This book covers earthquake analysis, structural response, and building design from the perspective of structural dynamics. This text is dedicated to the dynamic analysis and design of multi-story buildings in the face of earthquakes.

7. **Inchara K P, Ashwini G (2016):**This research aimed to examine the behavior of R.C framed irregular buildings under gravity loads and in varying seismic zones, as well as to determine the effect of varying percentages of steel and volumes of

concrete. And to learn how the proportion of steel reinforcement and the amount of concrete differ depending on whether the structure was constructed according to IS 456:2000 for gravity loads or IS 1893(Part 1): 2002.for earthquake tremors in various regions. Five (G+4) different models were investigated in this analysis. The effects of gravity and earthquake forces in a variety of seismic zones were simulated and investigated for all four models. The models were analyzed with ETABS program. Their findings suggest that the volume of concrete and the weight of steel reinforcement needed for footings increased from zone II to zone V, and that the same trend held true for beams, with the percentage of steel reinforcement increasing as the zone number increased from II to V.

8. **Aniket A. Kale et al. (2017) [4]**performed wind and seismic study on four distinct building designs in the same location (15, 30, and 45 stories) using state-of-the-art software (CSI ETABS). The method of response spectra was utilized to identify the dynamic effects. Story displacement, story drift, base shear, overturning moments Mz, acceleration, and time period have all been taken into account in the comparison. It has been determined that a 15-story building is the safest design for withstanding strong winds and a 15-story triangular building is the safest design for withstanding strong earthquakes. Maximum earthquake and wind effect are minimized in a 45-story circular or rectangular building. Both wind and seismic effects must be carefully considered for buildings over 15 and 30 stories in height, respectively. An earthquake is less of a concern than wind.

9. **Albert Philip et al. (2017) [5**I] Analyzed the seismic properties of a G+12 reinforced concrete building with both a regular and irregular floor layout in earthquake zone III in India using the CSI ETABS program. The analysis was conducted using a technique called response spectrum analysis. Parameters including torso displacements, torso drifts, torso shear, and torso stiffness were used to make the comparison. A linear relationship between story displacement and building height has been established. For an irregular building, the maximum storey drift happened on the second level, while for a regular building, it occurred on the fourth story. The greatest shear between stories was recorded between the first and second floors of a regular building, and on the first level of an irregular building. Both buildings have non-linear changes in stiffness across their storeys.

10. **G. Guru rasad et al. (2017) [1]**Using ETABS, we ran a dynamic analysis of a six-story, reinforced concrete (RC) building with a C and rectangular layout. Parameters including sway, shear, support reactions, style of construction, and section cut force have been compared.

11. **Conclusion:**It was determined that the L-shaped plan had the highest value of story shear compared to the square and circular plans. In all three scenarios, values in the stories drift from left to right in the X direction, while rising in the Y direction from top to bottom. It was discovered that irregular plan structures may withstand higher foundation shear when earthquake loads are applied in the Y direction than rectangular plan structures. Results were better for regular and L-shaped buildings than for C-shaped structures.

12. **AthulyaUllas et al. (2017) [2]:**conducted wind studies on structures with complex geometries, including the Y, Plus, and V. Modeling and analysis of buildings with the Y, Plus, and V floor plans are performed in ETABS 2016. The story force is found to be constant across all building types, indicating that it is independent of building form. A V-shaped structure is shown to have the most lateral displacement. The Y-shaped building is the most structurally unstable of the selected shapes, with the most storey drift compared to the other shapes. On the other hand, the Plus-shaped building is the most stable, with the least lateral displacement and the least storey drift.

13. **Pradeep Pujar et al. (2017) [3]**investigated the seismic effectiveness of irregular buildings with a height of up to nine stories (G+9) with and without shear walls. The I, L, and C shapes of floor plans were taken into account. During the research, researchers investigated both bare frame and shear wall models. The models have been examined with the help of E-tabs V 15.0.0 software and the Equivalent static method. Parameters like vertical movement, vertical drift, and horizontal shear have been used to draw comparisons. Great results in base shear, story drift, and displacement have been observed in L- and C-shaped structures with Shear walls. While the base shear in the X and Y directions is greatest for the I-shaped building with the shear wall, it is only slightly greater for the L-shaped building. When compared to a bare frame building, a structure with a shear wall is more effective at withstanding seismic waves.

## 5. CONCLUSION:

- Maximum storey displacement is higher value of L shaped structural building and lower value of structure is rectangular shape of structure in x direction of displacement. And storey displacement in y direction of higher value is L shaped

And square shape of building is lower value of displacement.

- Irregular types of buildings are maximum displacement than regular type of buildings.
- Maximum storey drift is higher value in irregular type of buildings and lower value in regular type of building.
- Irregular type of building storey stiffness is higher than regular type of building.
- zDisplacement diaphragm is higher value of plus shaped irregular type of building and lower value of square shaped regular type of building with shear wall.
- Displacement diaphragm is higher value of T shaped irregular type of building and lower value of square shaped regular type of building without shear wall.
- Drifts diaphragm is maximum for irregular type building and minimum value of regular type of buildings with or without shear wall.
- Rectangular & square shaped buildings are safer for earthquakes as compared irregular buildings are more un safe structures.
- irregular type of buildings are having some problems wind loads and seismic loads
- Overcome the problems of lateral forces by adding of the shear wall.
- Regular type of buildings are having less displacement & drifts and irregular type of buildings are having more displacement & drifts as compared to regular buildings.

## 6. REFERENCES:

1. Geeta Mehta, Bidhan Sharma and anuj Kumar (2016) optimization of Member size and Materials for Multi storied RCC buildings using ETABS in India. International journal of science and technology.
2. Hatim saleem, LP shrivastava (2019) comparative study of different types of shapes of building and design for wind loads by using ETABS in India. Published by (IRJET).
3. Pushkar rathod , rahul chandrashekar (2017) earthquake analyzing of high raised structures for various type of shapes by using ETABS (IRJET).
4. M Pavani, G Nagesh Kumar, Dr. Sandeep pingale (2015) design and analysis of multi storied buildings with shear wall by using ETABS. International journal of scientific & engineering research (ISSN).
5. Plain and reinforced concrete code of practice fourth revision (IS456-2000) BUREAU OF INDIAN STANDARDS manak bhavan, 9 bahadur shah zafar margi NEW DELHI.
6. INDIAN STANDARD CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES fifth revision (IS 1893 part 1 – 2002)
7. Indian standard (IS 1987: part-1 to 3)

## BIOGRAPHIES

HARISH BABU. ALURI
M.TECH STRUCTURAL ENGINEERING