# Analysis And Design of High-Rise Building

Harshad Suryawanshi[1], Chinmay Sawantdesai[2], Arjun Omase[3], Shantanu Chavan[4], Rohini Khandelwal[5]
[1,2,3,4,5]*Civil Engineering, D. Y. Patil College of Engineering, Akurdi, Pune, India*

***Abstract*—The project focuses on the structural design and analysis of a high-rise building, emphasizing safety, stability, and economy. With rapid urbanization and limited land availability, vertical construction has become an essential solution to meet growing residential and commercial demands. The design involves the selection of an appropriate structural system, load estimation, and detailed analysis of components such as beams, columns, slabs, and shear walls using relevant IS codes. Both gravity and lateral loads, including wind and seismic forces, are considered to ensure structural integrity and serviceability. The design is carried out using advanced software tools like ETABS And RCDC for structural analysis and Design. The project demonstrates the application of modern design principles, code compliance, and optimization techniques to achieve a safe, functional, and aesthetically appealing high-rise structure.**

**The project involves the complete structural design of a G+40 storey residential building.**

**The structure is analyzed for seismic Load as per IS 1893 (Part 1): 2016. The structure is analyzed for various load combinations as per IS 875 (Part 1, 2, and 3): and IS 456: 2000. Both gravity loads (dead and live) and lateral loads (wind and earthquake) are considered to ensure overall stability, strength, and serviceability.**

***Index Terms*—ETABS And RCDC, Structural design, Structural Analysis, High-Rise Building, Earthquake Analysis, Wind Analysis**

## I. INTRODUCTION

The rapid pace of urbanization and the ever-increasing demand for space in cities have led to the emergence of high-rise buildings as a practical and efficient solution for accommodating residential, commercial, and mixed-use developments. High-rise buildings, typically defined as structures with multiple storeys exceeding conventional building heights, utilize vertical expansion to overcome the limitations of scarce urban land. These structures symbolize modern engineering excellence, architectural innovation, and sustainable urban growth.

The design of a high-rise building presents significant challenges due to the complex nature of the loads and forces acting on it. Unlike low-rise structures, high-rise buildings are subjected not only to gravity loads but also to considerable lateral forces induced by wind and earthquakes. Therefore, the design process must ensure adequate strength, stiffness, and stability against both vertical and horizontal load effects. The structure must also satisfy serviceability criteria such as deflection, drift, and vibration limits to ensure occupant comfort and structural safety throughout its life span.

The project involves the structural analysis and design of a reinforced concrete (RC) high-rise building using relevant Indian Standard codes such as IS 456: 2000 for design of concrete structures, IS 875 (Part 1, 2 & 3): 1987 for load calculations, IS 1893 (Part 1): 2016 for seismic design, The analysis is carried out using software using ETABS which enable accurate 3-D modeling, load application, and automated design of structural members.

The primary objective of this study is to achieve a safe, economical, and efficient structural system that can effectively resist both gravity and lateral loads. The project also emphasizes optimization of member sizes, proper load distribution, and design detailing that complies with code provisions and practical constructability.

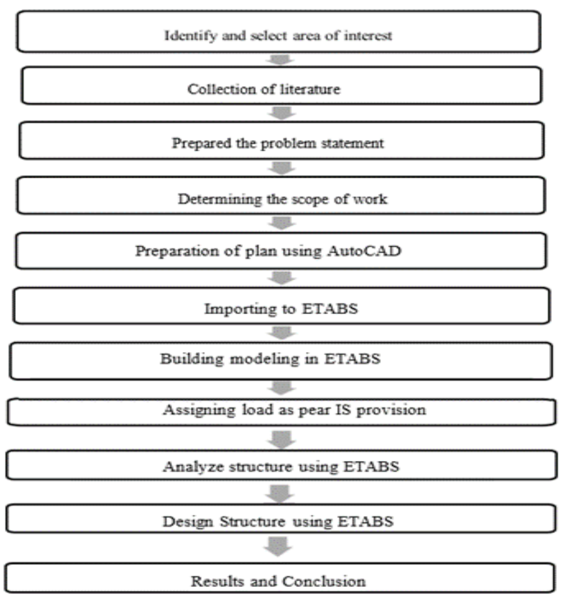
Aim:

The main aim of this project is to design and analyze a safe, stable, and economical high-rise reinforced concrete building by considering all possible loads and forces acting on the structure in accordance with relevant Indian Standard codes.

## II. OBJECTIVES

- To analyse and design structural members (columns and beams) of a high-rise building using both manual calculation and ETAB's software.
- To compare the results of Percentage of steel
- obtained from software to manual outputs.
- To understand the accuracy and efficiency of ETAB'S in analyzing and Design complex high-rise structures.
- To achieve an economical and safe design that fulfills functional, durability requirements.

## III. METHODOLOGY




### 3.1. Building Details

Table no. 1- Details of Building

| Parameter | Value |
|---|---|
| Building Type | RCC Residential building |
| Number of Floors | G+40 |
| Floor Height | 3 m |
| Total Height | 120 m |
| Beam Size | 300 mm × 450 mm |
| Column Size | 600 mm × 600 mm |
| Slab Thickness | 150 mm |
| Concrete Grade | M30 |
| Steel Grade | Fe500 |

### 3.2. Preliminary design data and architectural layout.

Preliminary design data is the basic information collected before starting the structural analysis and design of a high-rise building. This data helps engineers understand the building requirements, loading conditions, material strength, and environmental effects.

The building selected for the project is a G+20 high-rise RCC structure. "G+20" means one ground floor and twenty upper floors. High-rise buildings are designed vertically to accommodate more people in limited land areas.

Fig.1 - Architectural layout

### 3.3. Create 3D ETABS model Define materials, section properties

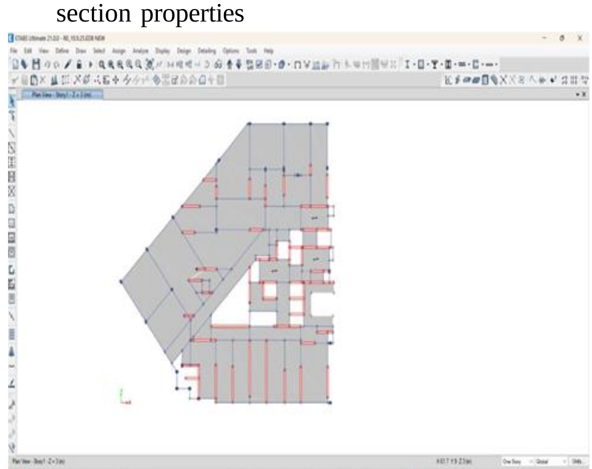


Fig.2 - Top view Plan of the building

© June 2026 | IJIRT | Volume 13 Issue 1 | ISSN: 2349-6002

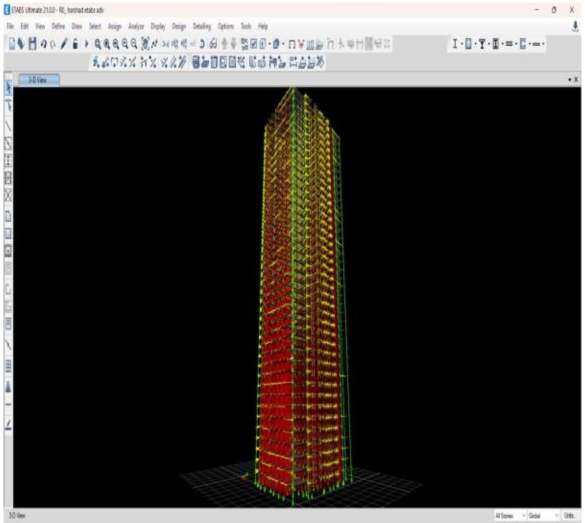


Fig.3- 3D view Of Building

3.4. Data for Modeling
Concrete grades = M40
Steel = FE550

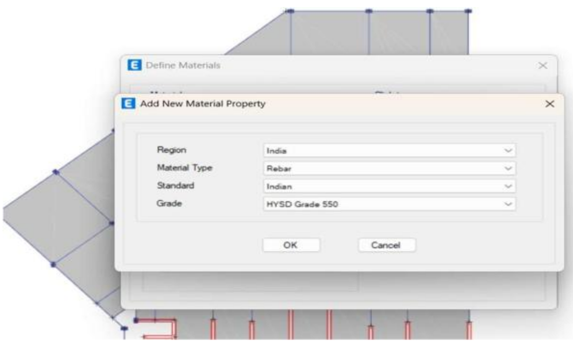



Fig.4 - Grade of Steel

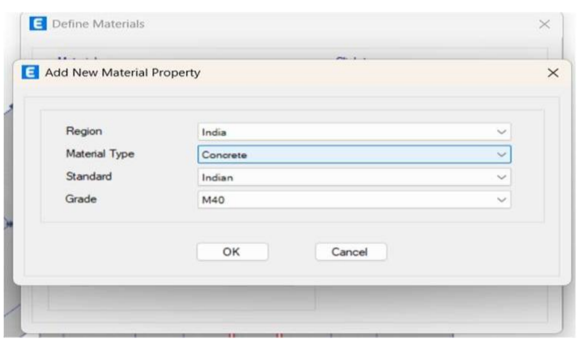



Fig.5 - Grade of Concrete

3.5. Loading Details
Dead Load
Includes:
Self-weight of structure
Wall load
Floor finish load

Live Load
Applied as per IS 875 Part 2.

Wind Load
Calculated according to IS 875 Part 3.

Earthquake Load
Applied according to IS 1893:2016.

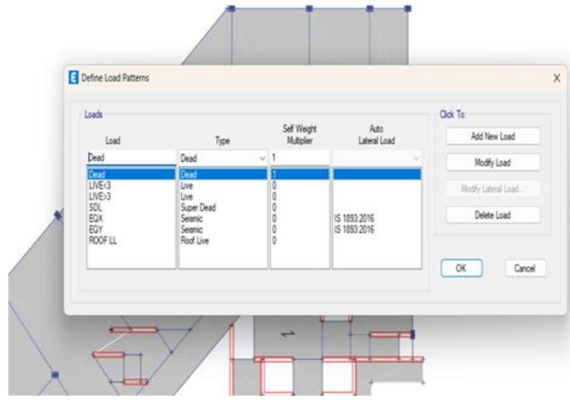



Fig.6 – Load Patterns

## IV. RESULTS AND DISCUSSION

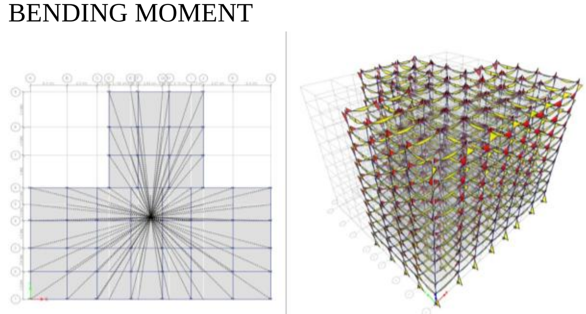
4.1. Storey Displacement
The maximum displacement occurs at the top storey due to lateral loading. The values remain within permissible limits specified by IS codes.

4.2. Storey Drift
Storey drift increases gradually with building height. Proper stiffness distribution reduces excessive drift.

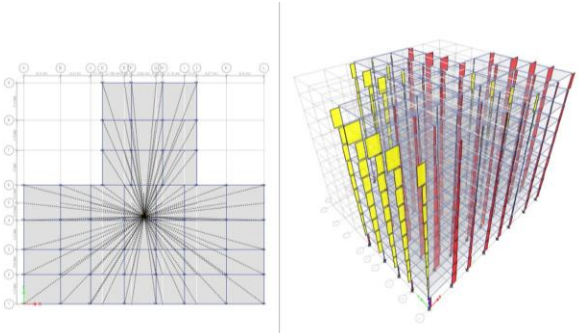
4.3. Base Shear
Base shear is observed to increase with seismic zone intensity.

4.4. Bending Moment and Shear Force
Critical values are observed in lower floors due to higher load accumulation.

BENDING MOMENT



SHEAR FORCE DIAGRAM



## V. CONCLUSION

The structure is based on the E-TABS design, which provides acceptable serviceability, strength, and economic work. Working time is saved by using E-TABS software, and it also assists us in precisely developing structures. The structural components were designed both manually and using software. There is not much land available in urban areas so buildings are constructed in story's to utilize the vertical space. Rather than destroying forests and swamps to build houses, shopping centers and factories, they can be placed in a vertical tower to serving to preserve the environment. The displacements, story shears increase as the wind speed increases. The high-rise stories are more effected by the wind forces and the wind influence increases if the height of the structure increases further. It is observed that the lateral force excited on the structure have shown increasing severity with increase in the wind speed.

## REFERENCES

[1] U. H. Varyani, *Structural Design of Multi-storeyed Buildings*, 2nd ed. New Delhi, India: South Asian Publishers.

[2] J. Ambrose and D. Vergun, *Simplified Building Design for Wind and Earthquake Forces*, 3rd ed. New York, NY, USA: Wiley-Interscience Publication.

[3] M. N. Patil and Y. N. Sonawane, "Seismic analysis of multi-storeyed building," *Int. J. Eng. Innov. Technol. (IJEIT)*, vol. 4, no. 9, Mar. 2015.

[4] *IS 875 (Part 1 and Part 2): 1987*, "Indian Standard Code of Practice for Design Loads," Bureau of Indian Standards, New Delhi, India, 1987.

[5] *IS 875 (Part 3): 1987*, "Indian Standard Code of Practice for Design Wind Loads," Bureau of Indian Standards, New Delhi, India, 1987.