ANALYSIS AND DESIGN OF G+30 MULTISTOREYBUILDING BY USING ETABS

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Abstract: ETABS stands for Extended Three-Dimensional Analysis of Building Systems. Themain purpose of this software is to design multistorey building in a systematic process. The project is designed in accordance with Indian codes, considering various loads such as Reinforcedconcrete (IS 456-2000), dead load (IS875-1987 part1), live load (IS875-1987 part2), wind load (IS875-1987 part3), seismic load (IS1893-2016 part1) and load combinations are considered as per the (IS875-1987 part-5) code books. The analysis considers seismic zone III and ensures safety by considering dead load, live load, seismic and wind forces, and balancing economy andsafety. Structural design is crucial for Civil Engineers, and proper analysis can prevent structure failure and loss of life. Engineers analyze structures considering constraints like serviceability and deformability, following IS codes. Our project focuses on analyzing and designing superstructures like slabs, beams, and columns, considering dead load, live load, seismic and wind forces. The analysis parameters such as shear force, bending moment, and displacements are compared and presented in a comparative manner.

Keywords: ETABS, Seismic load and Wind load.

I. INTRODUCTION

The G+30 Multistorey building a high-rise structure, is being analyzed and designed using ETABS software. This software is used to model complex structures and perform rigorous analysis, ensuring structural integrity, safety, and efficiency. The G+30 structure faces unique challenges in terms of structural stability, lateral load resistance, and overall design complexity. ETABS software offers advanced features for modeling, analysis, and design optimization, allowing engineers to simulate real-world behavior and make accurate predictions of structural performance. Design considerations include ensuring adequate strength, stiffness, and stability to resist gravity and lateral loads. ETABS software provides comprehensive seismic zone is crucial for calculating probabilistic ground motions and determining the destruction of structures. The map prominently displays the diverse seismic zones of the nation. Earthquake resistant buildings are designed to withstand seismic activity of reasonable magnitude, minimizing loss of life and functionality. As the population grows, more integrated tools are used for multistory buildings, absorbing surface phenomena. Dynamic analysis methods like time history and responsespectrum method are used for seismic analysis. Structural design is crucial for earthquake resistance, considering height and lateral forces like seismic and wind. ETABS software offers a comprehensive solution for both simple and complex structures, focusing on analyzing and designing structural elements to ensure resilience against seismic events and facilitate safe evacuation for occupants. ETABS software is used to analyze and design a G+30 multistorey structure, producing a complete 3D model, applying loads, and modifying member sizes, einforcing details, and layout configurations to fulfill safety and performancerequirements.

I. CODES

These are the applicable codes and standards for the analysis and design of G+30 residential building.

- IS 456-2000 code of Practice for Plain and Reinforced Concrete - For design of any structural member (slab, beam, column,footing, staircase).
- IS 800-2007 code for design of steel - This code is generally used to design steel structures (Towers, bridges, chimneys).
- IS 875 codes of Practice for design of loads - This code is generally used to design the loads (dead load, live load, wind load) acting on thestructure.
- IS 875 part 1 refers detailed design about dead load.
- IS 875 part 2 refers detailed design about live load.
- IS 875 part 3 refers detailed design about wind load.
- IS 1893-2002 refers detailed design aboutseismic load.
- IS 875 part 5 refers detailed design about load combinations.

III. SEISMIC ZONES

identifying four distinct seismic zones.The map, color-coded in red, shows the seismic activity of different regions of India, ranging from Zone II to Zone V. The seismic zone is crucial for calculating probabilistic ground motions and determining the destruction of structures. The map prominently displays the diverse seismic zones of the nation.

Zone - II: Seismic Intensity Low.
Zone- III: Seismic Intensity Moderate.
Zone - IV: Seismic Intensity Severe.
Zone - V: Seismic Intensity Very Severe.

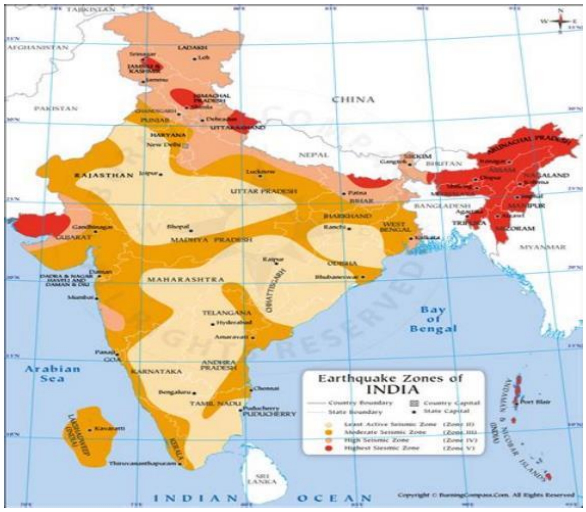

Fig-1: Map of India Showing Seismic Zones of India

IV. PROBLEM IDENTIFICATION

1. From the Past records of earthquakes have sparked a demand for earthquake- resistant buildings, requiring thorough analysis and design to ensure their resilience.

2. The construction of tall buildings is widely influenced by seismic and wind loads, requiring careful consideration for safety, strength, and stiffness.

V. OBJECTIVES

The goal is to conduct an effective analysis and design of the structure without any potential failure.

1. To Analyze the seismic load and wind load on the building.

2. To check and design of the seismic response of multistorey building.

VI. SCOPE OF STUDY

The study emphasizes the importanceof seismic and wind loads in earthquake resistance, enhancing the resilience multistorey buildings for occupant safety.

VIII. PROPERTIES OF THEMATERIALS

Grade of concrete for slab, beam,Column: M30
Column Sizes = 400X600mmBeam Size = 250X350mm
Slab thickness = 120mm Number of Stories = 30
Dead load = 6 kN/m2Live load = 3 kN/m2

IX. METHODOLOGY/PROCEDURE

Step 1: Setting Up the Indian StandardCodes

ETABS software initial step involves configuring units and design codes units and design codes to align with project requirements, ensuring consistency and compliance with standards, ensuring a reliable structural engineering workflow.

Step 2: Choosing the Template & Importing DXF File

Next, we'll start with a blank template to develop a structural model, then import a DXF file fromAutoCAD into ETABS to streamline the modeling process by combining existing designs.

Step 3: Defining Properties

We defined material properties by selecting the"define" menu, added new material for structural components like beams, columns, and slabs, and defined section size by selectingframe sections for beams and columns.

Step 4: Assigning Properties

After we define the property, we use the command menu to design the structural
to verify seismic resistance and building components. Assignment of beams and columns.

Step 5: Assigning Supports

Support conditions are critical in structural analysis, and we will apply appropriate conditions to our model to effectively imitate real-world behavior. Columns were selected at the structure's base, and supports were assigned through the joint\frame Restraints menu.

Step 6: Defining of loads

In ETABS defines loads, including dead, live, seismic, and wind, within a software environment, enabling engineers to accurately simulate and analyze structural response, aiding in building design and optimization.

Step 7: Assigning of Dead loads

To define load patterns, create a dead load pattern, assign self-weight or unit weightsto elements, apply the pattern to the model, and perform structural analysis to analyze the structure's behavior under dead loads.

Step 8: Assigning of Live loads

In ETABS live loads can be assigned using load patterns as per IS 875-1987part II.

Step 9: Assigning of Wind loads

Wind loads are allocated to model elements, such as beams, columns, walls,and floors, based on their wind exposure. This includes setting wind load parameters for every element.

Step 10: Assigning of Seismic loads

Seismic loads are specified and assigned in accordance with IS 1893: 2002 by providing a zone, generating seismic load combinations, assigning loads to structural model elements, and analyzingthe structure code compliance.

Step 11: Assigning of Load Combinations

Individual load cases should be defined for various types of structural loads, such as dead, live, wind, and seismic loads. In ETABS, generating load combinations involves combining different load cases with their corresponding load factors.

Step 12: Analysis & Check for errors

Before we begin analysis, we will thoroughly examine our model for flaws and warnings. Addressing any errors at this step helps to avoid mistakes in the analysis results.

Step 13: Design process

Following the completion of the analysis, we designed the structure in concrete inaccordance with IS 456:2000.

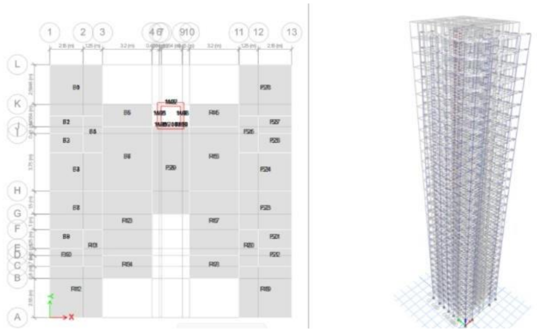

Fig-2: 3D view in ETABS

VII. LOAD COMBINATIONS

To ensure structural integrity in various conditions, structures must be constructed to sustain a variety of loads as determined by design codes, The following load combinationshas been taken:

1. 0.9D.L-1.5SESX
2. 0.9D.L-1.5SESY
3. 0.9D.L-1.5WLX
4. 0.9D.L-1.5WLY
5. 0.9D.L+1.5SESX
6. 0.9D.L+1.5SESY
7. 0.9D.L+1.5WLX
8. 0.9D.L+1.5WLY
9. 1.2(D.L+L.L+SESX)
10. 1.2(D.L+L.L+SESY)
11. 1.2(D.L+L.L+WLX)
12. 1.2(D.L+L.L+WLY)
13. 1.2(D.L+L.L-SESX)
14. 1.2(D.L+L.L-SESY)
15. 1.2(D.L+L.L-WLX)
16. 1.2(D.L+L.L-WLY)
17. 1.5(D.L+L.L)
18. 1.5(D.L+WLX)
19. 1.5(D.L+WLY)
20. 1.5(D.L-WLX)
21. 1.5(D.L-WLY)
22. 1.5(D.L-SESX)
23. 1.5(D.L-SESY)
24. 1.5(D.L+SESX)
25. 1.5(D.L+SESY)

X. RESULTS OF ANALYSIS

Shear and bending moment diagrams are important analytical techniques used in structural analysis to assist with structural design. They calculate the magnitude of shear force and bending moment at precise locations along structural elements such as beams. These diagrams provide critical insights into the internal forces operating on the structure, allowing engineers to design strong and safe constructioncomponents.
Shear force diagram:

Shear force diagrams provide importantinsights into the distribution of forces within a structure, assisting inunderstanding how loads are transferredthrough a building.

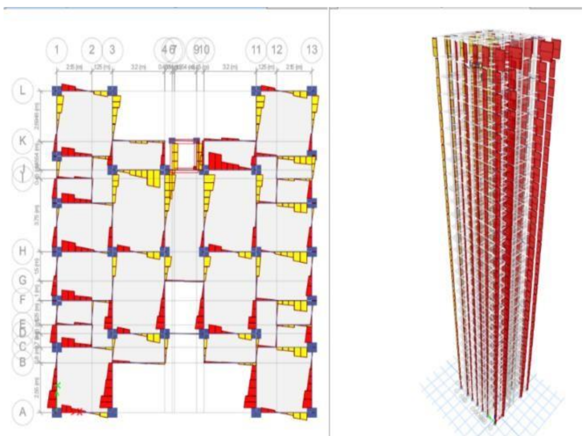

Fig-3: Shear force diagram for the structure

Bending moment diagram:

Bending moment diagrams help to evaluate the structural response to applied loads and detect potential concerns such as excessivebending or deflection.

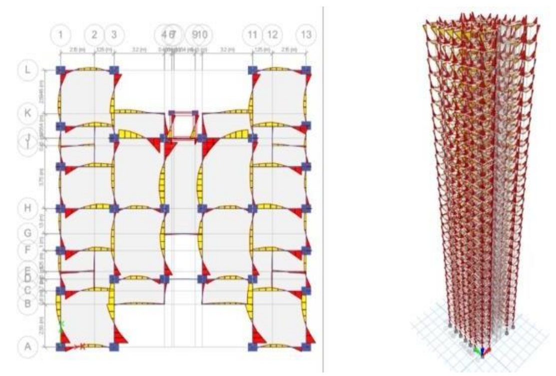

Fig-4: Bending moment diagram for the structure

Longitudinal reinforcement diagram:

To calculate the longitudinal reinforcement area, go to the design menu in ETABS, pick concrete frame design, and run the designcheck.

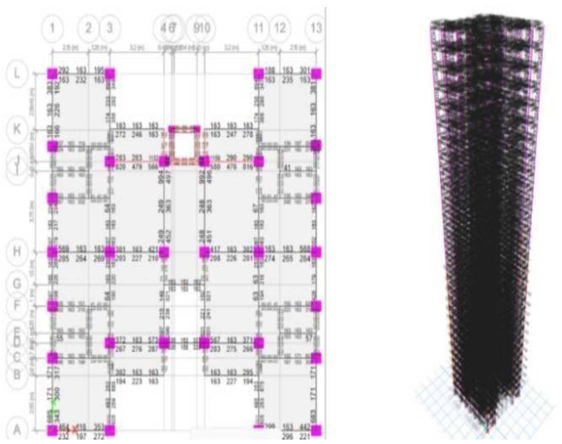

Fig-5: Longitudinal reinforcement of thestructure

XI. CONCLUSION

conclusion of the analysis and design process using ETABS software will evaluate a building's structural performance under seismic and wind loads, assuring adherence to rules and standards. It will discuss the building's energy dissipation and collapse prevention, as well as the efficiency of wind-resistant design features. There may be recommendations for designimprovements. The structure is designed using ETABS for strength, serviceability, and durability, with variations in displacement, shear force, and bending moment.

XII. REFERENCES

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