Design And Analysis of G+10 College Building

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Abstract — This project aims to develop and study a G+10 college building. Extended three- dimensional analysis of building systems (ETABS) software and IS-2017 code manual calculations were used to design the reinforced concrete slabs, beams, columns, piles, wind load, seismic load, and water tank in this project. Creative thinking, conceptual thinking, structural engineering knowledge, current design regulations and bylaws, experience, intuition, and judgement are needed for structural planning and design. Understanding column and beam moments while designing them ensures and improves safety while balancing economy and safety. The design depends on end circumstances, loading, and one-way or two-way slabs. Slab loads are transferred to beam. Beam loads are transferred to columns.

Keywords: ETABS, Concrete, G+10, Steel Fibre-Reinforced Concrete

I. Introduction

The design and analysis of a G+10 (Ground plus 10 floors) college building involves a comprehensive process of structural planning, load analysis, and component design to ensure a safe, durable, and functional structure. This process includes determining the structural form, considering material properties, and applying relevant design codes and regulations. The analysis focuses on understanding the effects of gravity and lateral loads, particularly seismic forces, on the building's behavior. Landslides, floods, and other secondary consequences can compound the initial damage from an earthquake's vibrations. Buildings must be designed to withstand earthquakes of varying severity, depending on their location and significance. The building's inertia creates seismic forces as it fights against the tremors of the earth. The building's foundations move with the ground, but the rest of the structure remains still because to inertia. When a building's components move relative to one another, they generate a force proportional to the mass times the ground acceleration. Each floor's CM is where this inertial force acts because that's where the mass is concentrated. This action counteracts that force with one of equal or greater magnitude. The building exerts a countervailing inertial force, which acts at the floor's center of rigidity (CR)

II. Objective of the Study

- Create a 10-story academic college building based on IS 2017.
- Develop an accurate 3D model of the G+10 college building in ETABS.
- Define material properties (concrete, steel) and structural elements (beams, columns, slabs, shear walls, etc.).
- Simulate real-world loading conditions (dead load, live load, wind load, and seismic load as per IS codes).
- To use software to examine building design and analysis in its entirety.
- To research how the structure is affected by seismic loads.

III. Methodology

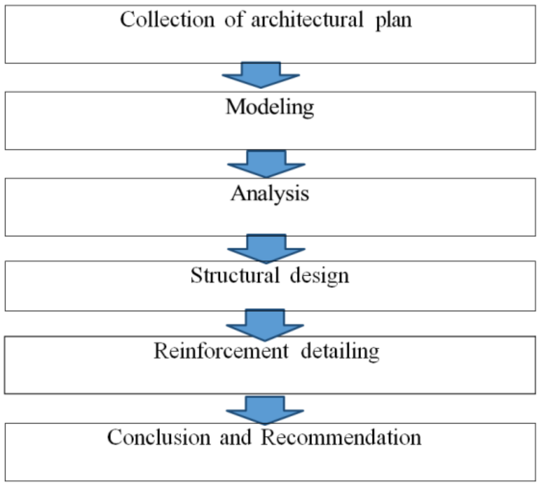

Fig. 1: working flow chart

A. *Codes and Specifications*

A building must adhere to a code that details the requirements for structural integrity, fire protection, plumbing, ventilation, and accessibility for those with physical disabilities. The "ACI Code," also known as the American Concrete Institute issued Reinforced Concrete Building Code. Legal criteria for RCC structure design often include this. After reviewing the "ACI Code," the Indian government released its own set of construction regulations. The responsibility for the building's failure does not rest with the structural designer if they adhere to these guidelines.

B. *Basic Combinations of Load*

This section applies to all building materials used to proportion structural elements using the permitted stress design approach. When designing structural members using this method, all loads must be considered and function in the following combinations. Design must use the worst combo.

Sl. No.	Basic Combination
1	1.4 DL
2	1.2 DL+1.6 WY+LL
3	1.2 DL+1.6 WX+LL
4	1.2 DL+1.6 LL
5	1.2 DL+ 1.0EQY + 1.0LL
6	1.2 DL+ 1.0EQX + 1.0LL
7	1.2 DL-1.6 WY+LL
8	1.2 DL-1.6 WX+LL
9	1.2 DL-1.0EQY + 1.0LL
10	1.2 DL- 1.0EQX + 1.0LL
11	0.9DL + 1.6WY

12	0.9DL + 1.6WX
13	0.9DL + 1.0EQY
14	0.9DL + 1.0EQX
15	0.9DL - 1.6WY
16	0.9DL - 1.6WX
17	0.9DL - 1.0EQY
18	0.9DL - 1.0EQX

Table I: Load Combination

IV. DESIGN CONSIDERATION

A. *Architectural Plan*

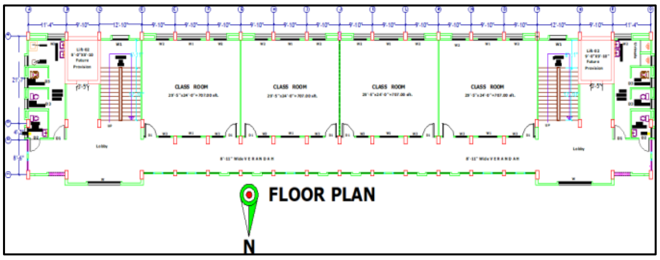

Fig. 2: Typical Floor Plan

Building Type: College Academic Building, 10 Stories.
Zone: Surat.
Land area: 9899.79 ft^2

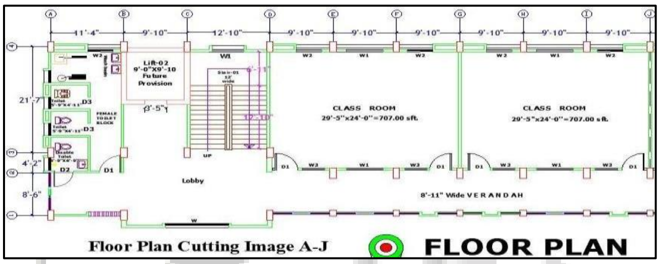

Fig. 3: Regular Floor (Cutting Image A-J)

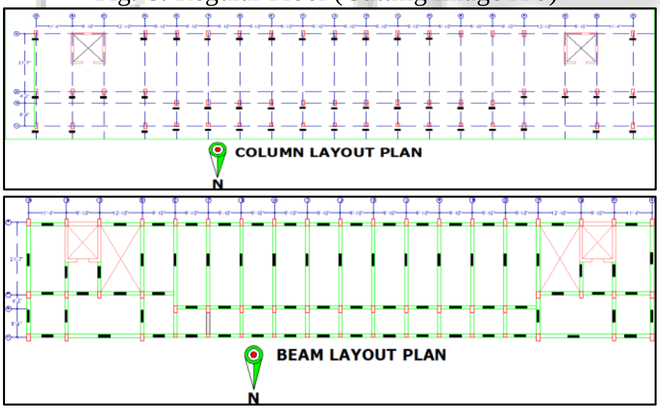

Fig. 4: Column and beam approximation

B. *Model detailing*

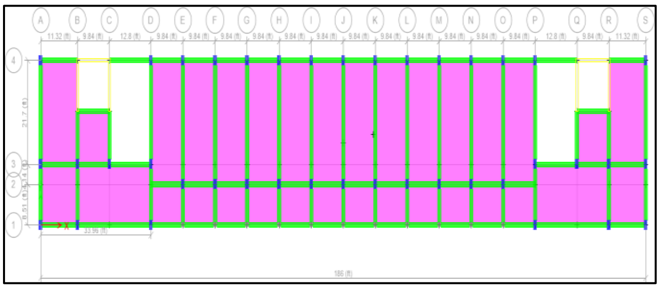

Fig. 5: column and beams (2D View)

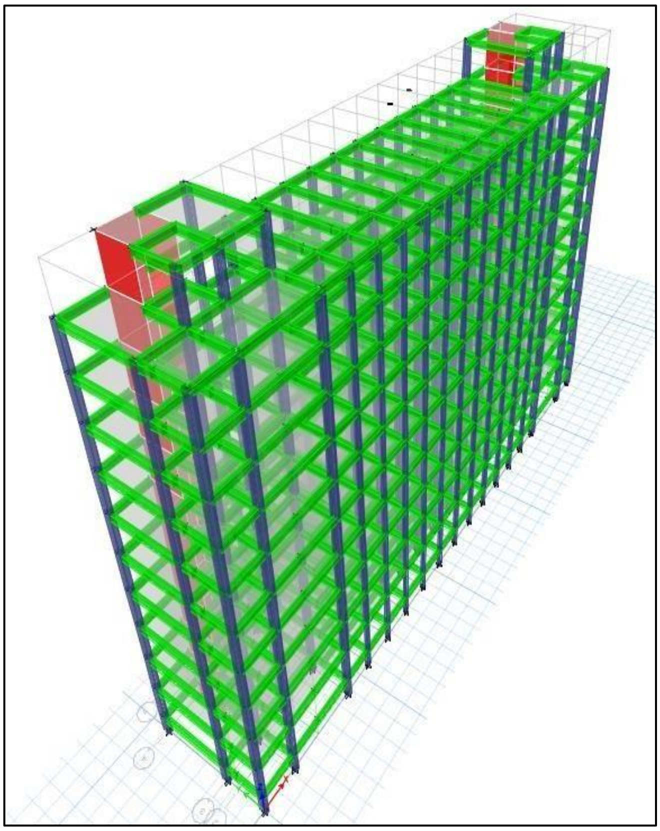

Fig. 6: Ten stories in 3D

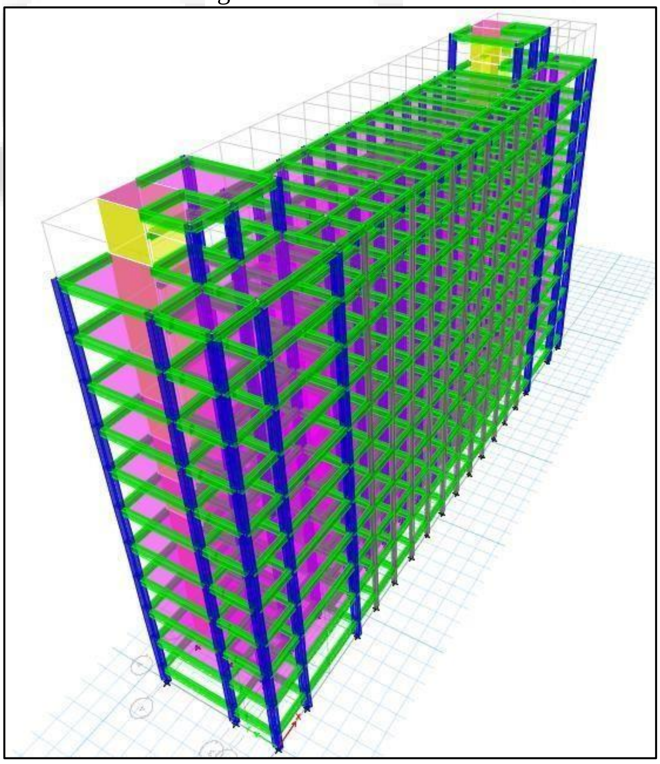

Fig. 7: Ten stories in 3D

V. STRUCTURAL ANALYSIS & RESULTS

In this chapter, ETABS software and manual calculations are used to examine the eight- story building. Due to a lack of space, only the analysis's results for moments, shears, axial forces, overturning moments, and displacements are shown here.

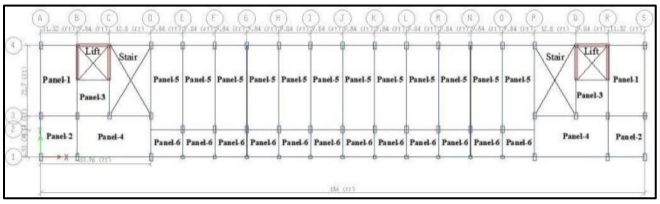

Fig. 8: Layout in slabs

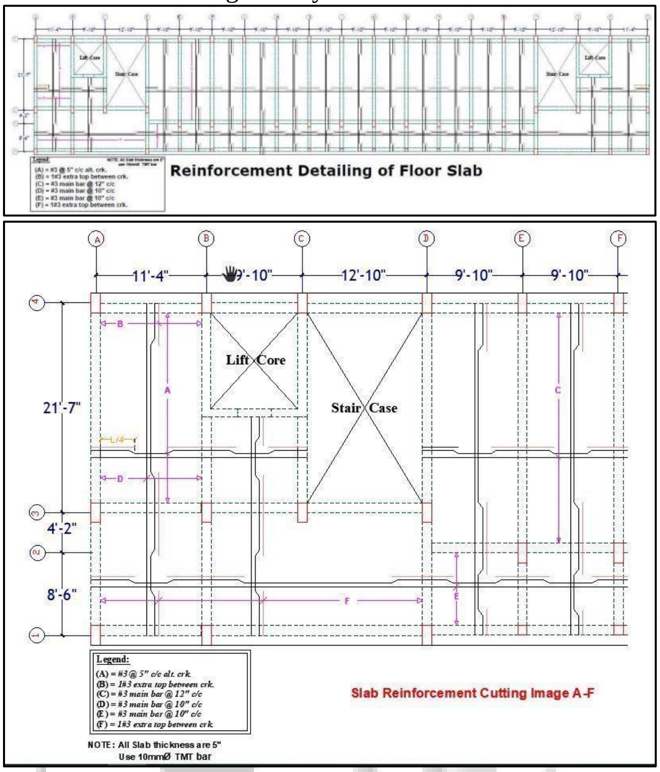

Fig. 9: Detailing Slab Reinforcement

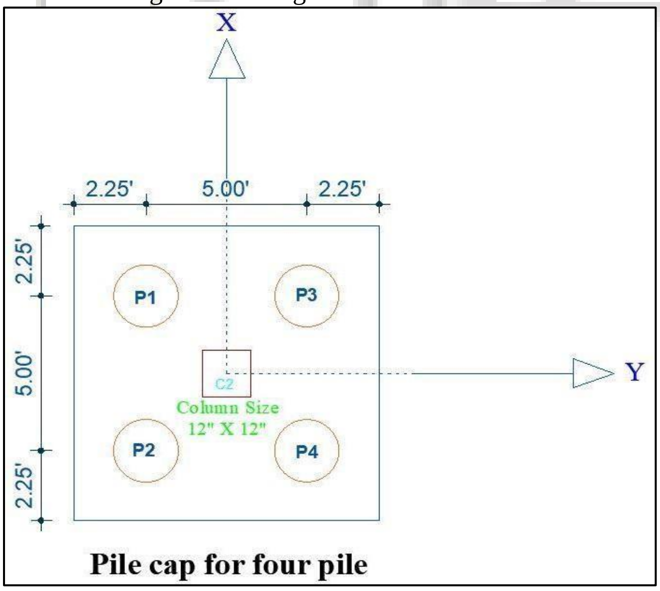

Fig. 10: For four piles, a pile cap

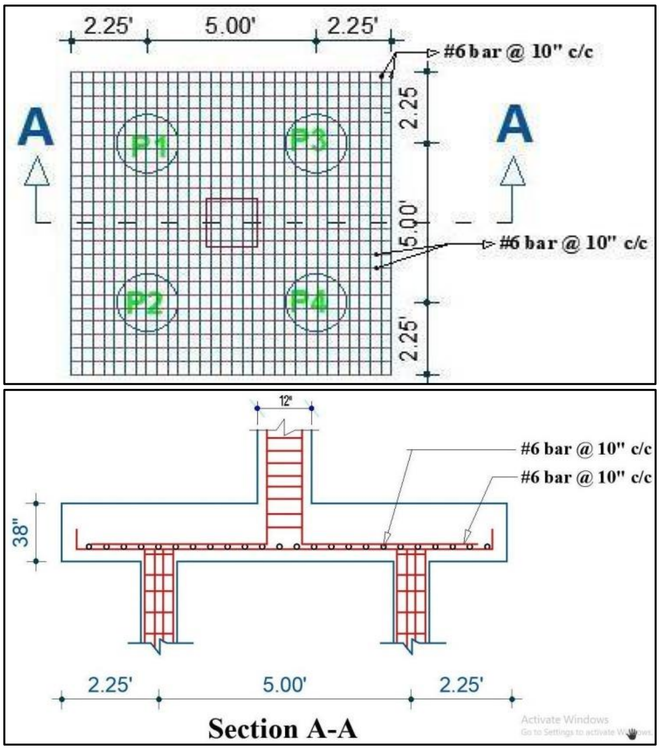

Fig. 11: The four pile cap reinforcements are detailed

VI. CONCLUSION

Wind and earthquake loads in one direction are substantially higher than in the other because of the building's enormous width to length ratio. The majority of the column is rectangular as a result. All ETABS values are close to those obtained by manual calculation. The analyses' findings are so confirmed.

VII. SCOPE FOR FUTURE STUDY

1) The thin building tends to deflect in the short direction, with a higher short- direction deflection than long-direction deflection. Therefore, further study should be done to determine how shear walls along short directions might be used to lessen the direction's deflection.
2) Column-beam joints, which were crucial to the design of a multistory educational structure but weren't taken into account in this study, are strongly recommended for further research.
3) To check the software's dependability, this project's work may also be analyzed using another widely used program called STAD Pro, and the results could be compared to those from ETABS.

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