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Design & Analysis of G + 5 Residential Building with Comparison of Conventional Slab and Flat Slab using ETABS

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Abstract: ***In the conventional method, a beam with a large beam depth and a small slab thickness supports the slab. The weight is transferred from beams to columns.***
The flat slab is method in which the slab is resting directly on columns .The flat slab allows architects to provide partition wall wherever it is needed.
To supports heavy loads and thickness of slab near the support with the column is increased and these are called drops ,or columns are provided with enlarged heads are called column heads .As the beam is not there in flat slab it gives the plain ceiling consequently giving better architectural appearance.
The flat slab building is used these days because these structures offers many benefits which a normal slab structure does not provide .The objectives of this project is to compare multi-storey residential building having flat slab with conventional slab . The design and analysis is done by using ETABS software. This present work provides reasonable information about the stability of flat slab.
Keywords: Flat Slab, Conventional Slab, Normal Slab, Comparison, Drop Panel, ETABS

I. INTRODUCTION

The normal conventional slab consist of columns slab and beams. However it may be possible to undertake construction without providing beams in that case. The flat slab is a system of construction in which slab is directly resting on the columns. The load is directly transferred to the column and then to the foundation. The flat slab includes column drops, column head and middle strip. It is used in the places like malls, restaurants, residential places, car parking etc. The thickness of slab is taken 150mm which is taken from the standard IS Code. The minimum thickness can be considered as 125mm.In fact in area where height limit are critical, the use of flat slab is advantageous and create more space. The advantageous of having flat slab are consumes lesser construction time, reduce floor to floor height, it looks good from architectural point of view.
Column drops: - To carry heavy loads, the thickness of the slab over the column is increased, the thickened part of the slab is known as the column drops or droop panel.
Columns drops are provided are rectangular in shape. The height on each side should not be less than 1/3 of the panel on the side.
The structure is design by using the software named as ETABS is the abbreviation of "Extended 3D Analysis of Building System.

A. Scope And Study

The scope of the study is to produce good structural work which is economical and for performing analysis and design for a building.

B. Objectives

1) To understand the basic principles of structures by using Indian Standard Codes.
2) The objective is to analysis of forces, stress, strain, deflection and bending moment for structural system.
3) The objective is to design the G+5 building (structural system) by using ETABS.
4) To gain understanding of the parameters for structural design elements such beams, columns, and slabs.
5) To prepare the 3D model of the structure by using the E-TABS Software for detailed analysis and design.

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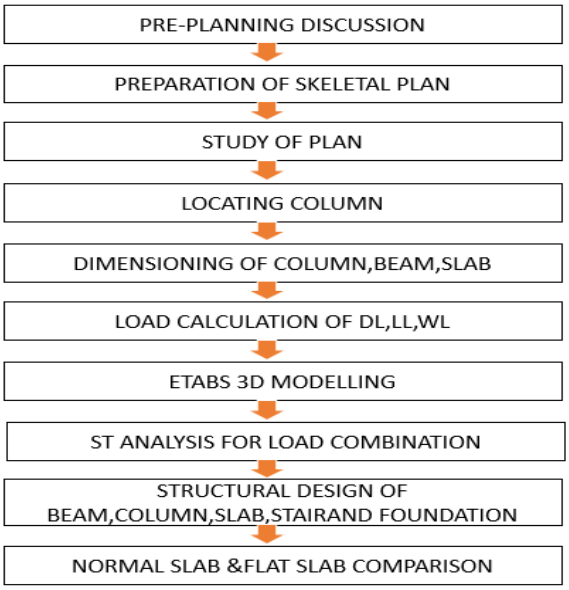
II. METHODOLOGY

ETABS software was used to analyze both flat and traditional slab structures. The structure's necessary components, such as its material properties, loads, load combinations, member sizes, response spectrum, etc., must all be established in advance of analysis. We can use the findings of the analysis, such as displacement, storey shear, bending moment, drift ratio, and axial pressures, to compare the performance of flat and traditional slab buildings. The process that ETABS used to conduct their analysis is depicted in the flow chart below.



III. PROJECT INFORMATION CONSIDERATION

Height – 21.9 m; Type – Residential; Floors - G+5 Storeys; Structural floors – 8

IV. PROPERTIES OF MEMBERS

1) Materials used:
- Grade of concrete = M25 for all member.
- Grade of steel = Fe500 for all member

Conventional Slab Structure:-

2) Frame sections provided:
- B230x500 M25 – primary beams (230x500 mm)
- B150x300 M25 – secondary beams (150x300 mm)
- C300x600 M25 – column (300x600 mm)

3) Slab sections provided:
- S125 M25 – general slab & wc slab
- St200 M25 – staircase

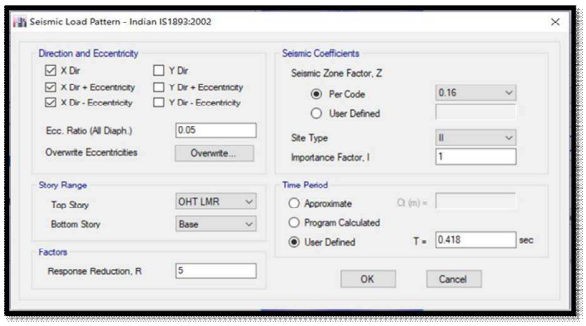
Flat Slab Structure:-

4) Frame sections provided:
- C650x650 M25 – column (650x650 mm)

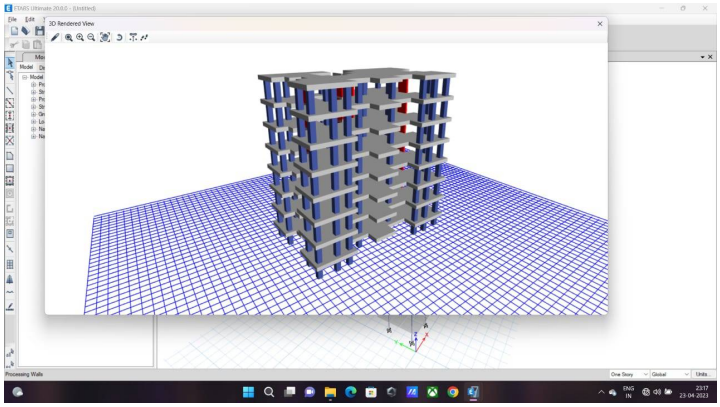
5) Slab sections provided:
- S300 M25 – general slab & wc slab
- St200 M25 – staircase

6) Drop panel provided:
- Thickness = 550mm

7) Earthquake load data:
{IS: 1893 (part-1): 2016}



1. Zone = III. …. Clause Annex E (pg. no.36)
2. Zone Factor = 0.16. ….. Clause 6.4.2
3. Importance Factor = 1 …. Clause 7.2.3
4. Response Reduction Factor = 5. ….. Clause 6.4.2
5. Soil Type = II …. Clause 6.4.2.1
6. Time Period … Clause 7.6.2.c



V. LOAD CALCULATIONS

Load name	Load type	Dead load (D.L) for conventional slab	Dead load (D.L) for flat slab	Live load (L.L)	Reference
General load	General load	1.5 kN/m²	2.876 kN/m²	2 kN/m²	Is:875(p2)-1987, t1
St load	Stair case load	3 kN/m²	2.5 kN/m²	4 kN/m²	From prob. Statement
Wc & bath	Water closet & bath load	2 kN/m²	2 kN/m²	2 kN/m²	Is:875 (p2)-1987, t1

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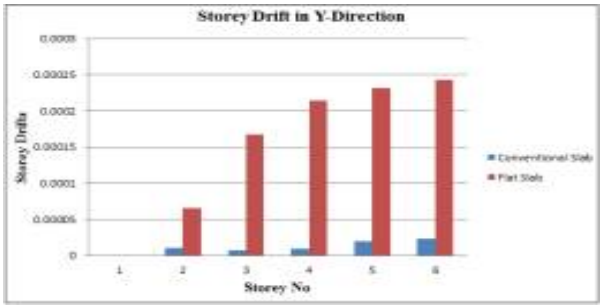
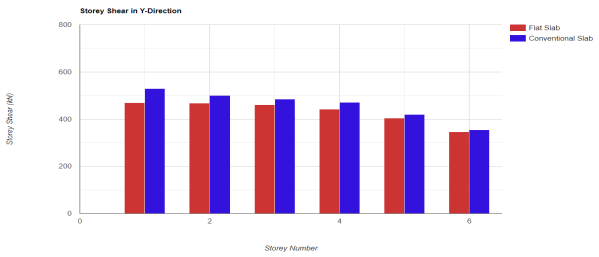
VI. COMPARISON





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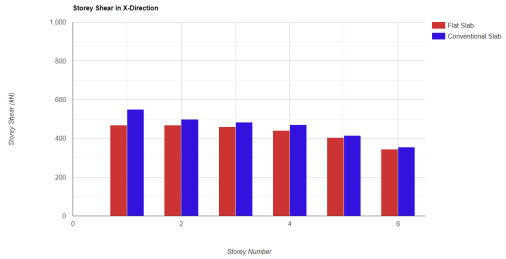

VII. RECOMMANDATION AND CONCLUSION

A. Recommendations

Following the conclusion of this major project, the following suggestions are offered based on our experience. After completing this main project, based on our experience the following recommendations are made.

1) The significance of the geotechnical engineering report, which provides an estimate of soil carrying capacity, cannot be understated.
2) The following technical backgrounds are necessary for the engineers involved in the study and design of multistory buildings.
    - Engineering mechanics
    - Engineering drawing
    - Strength of materials
    - Structural analysis
    - Structural design of RCC and steel
3) In addition to the technical skill one should have the following basic skills.
    - Communication skills
    - Report writing skills
    - Microsoft office
    - AUTOCAD
    - Structural engineering software
    - Architectural software
    - ETABS
4) The design engineer should also have a foundational understanding of electrical and plumbing engineering.
5) Our main project report can be used as a reference by a less experienced design engineer.

B. Scope of Future Work

By adopting a flat slab to limit the building's overall height, additional floors can be fit inside the designated height.
In this project, the key materials required and advised in accordance with the design are used to compare normal slabs, conventional slabs, and flat slabs.

C. Conclusion

Following the conclusion of this major project suggestions are offered based on our experience.

1) In India, flat plate/slab construction is a growing industry. Because flat slabs have numerous advantages over traditional slabs, they might be a great choice for contemporary buildings that demand structural soundness as well as cutting-edge aesthetic qualities and prospects.
2) The weight of flat slab constructions is comparatively greater than that of normal slab structures.
3) Reinforced concrete of the usual variety. India's flat plate/slab, which uses Indian codes, has several flaws that need to be fixed very away.
4) Whereas the conventional slab is more suitable for residential and small span structures, while flat is more suitable for bigger span structure.
5) The highest displacement of storeys occurs at roof level as compared to ground level. Comparatively speaking, the flat slab construction displaces less space than a normal slab building. Because of this, the flat slab building in this research has a higher story displacement than a typical slab.

6) Additionally, the structures of flat slab buildings and traditional slab buildings are compared with storey drift. When compared to a conventional slab building, the flat slab here also has the greatest amount of storey drift for all number of storeys.

VIII.ACKNOWLEDGMENT

We're highly thankful to all my teachers and friends who helped me in framing this research paper. I am obliged to my guide Prof. RVRK Prasad and to Head of department of Civil Engineering at KDKCE University for helping and guiding during the course of research. I am also thankful to my parents who always supported me morally as well as financially.

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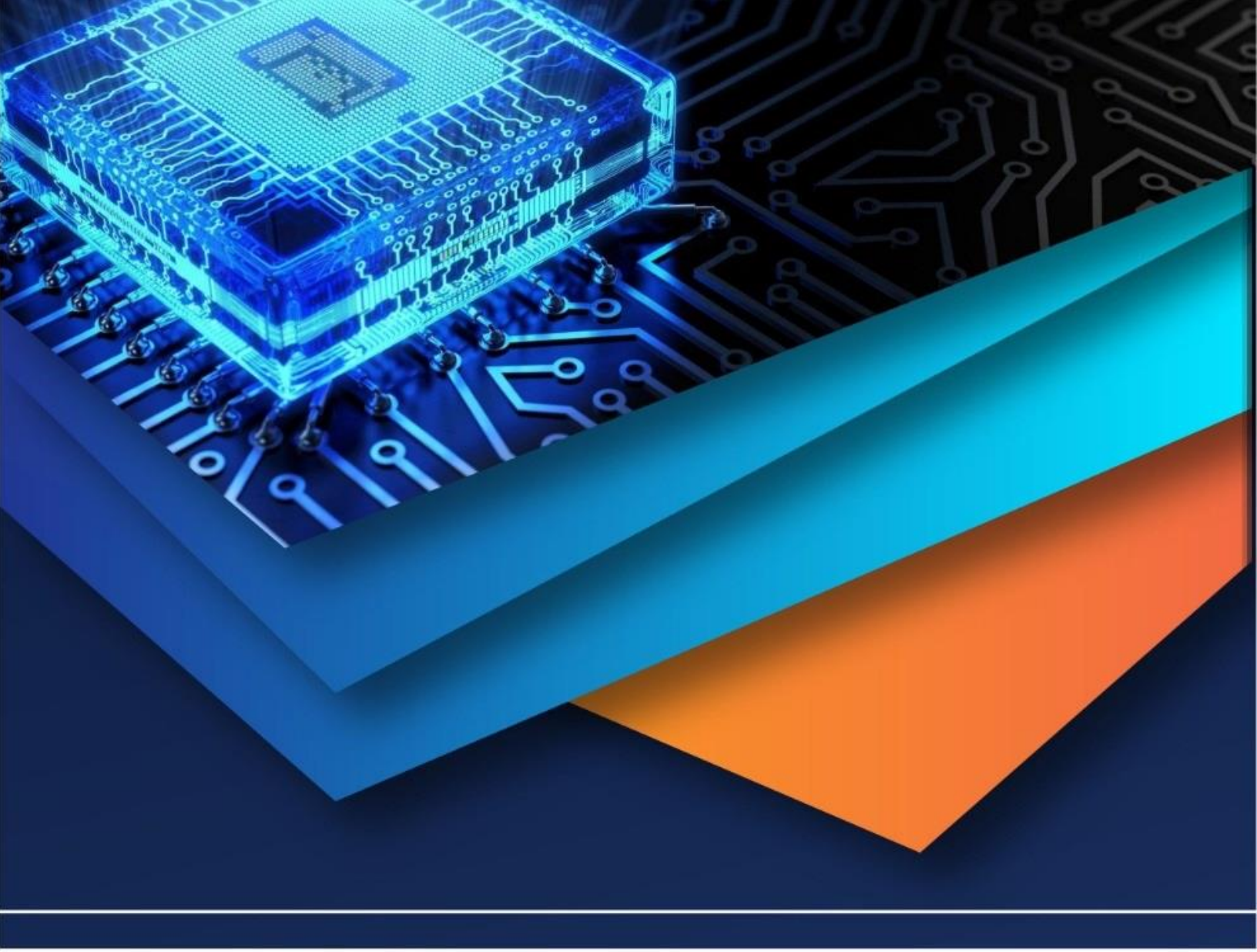

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