International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

Planning, Analyzing and Design of High Rise Building Using Etabs

Bilal Shaikh[1], Mohammed Sawood[2], Farasha[3], Sarfraj Ahmed[4], Haneef[5]

[1]*Assistant Professor, Department of Civil Engineering, Anjuman Institute of Technology and Management. Bhatkal, Karnataka, India*

[2,3,4,5] *U.G. Student, Department of Civil Engineering, Anjuman Institute of Technology and Management. Bhatkal, Karnataka, India*

Abstract - *The principle objective of this project is to Plan, analyse and design a multi-storeyed building [B + G + 15(3 dimensional frame)] using ETABS. The design involves analysing the whole structure by ETABS. The design methods used in ETABS analysis are Limit State Design conforming to Indian Standard Code of Practice. ETABS features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification, ETABS is the professional's choice. Initially it started with the analysis of simple 2 dimensional frames and manually checked the accuracy of the software with the results. The results proved to be very accurate for all possible load combinations [dead, live, wind and seismic loads].*

Key Words: **Gravity load, High rise, Etabs, Design**.

1. INTRODUCTION

A building is a permanent or temporary structure enclosed within exterior walls and a roof or consisting of a R.C. frame structure and including all attached apparatus, equipment, and fixtures that cannot be removed without cutting into ceiling, floors, or walls. Buildings come in a variety of sizes, shapes and functions, and have been adapted throughout history for a wide number of factors, from building materials available, to weather conditions, to land prices, ground conditions, specific uses and aesthetic reasons. Multi storey buildings aim to increase the floor area of the building without increasing the area of the land the building is built on, hence saving land and, in most cases, money (depending on material used and land prices in the area). The design process of multi stored building requires not only imagination and conceptual thinking but also sound knowledge of science of structural engineering besides the knowledge of practical aspects, such as recent design codes, bye laws, backed up by ample experience, intuition and judgment. The purpose of standards is to ensure and enhance the safety, keeping careful balance between economy and safety.

2. LOADS AND LOAD COMBINATIONS

Loads and properties of materials constitute the basic parameters affecting the design of a RCC Structure. Both of them are basically of varying nature. The correct assessment of loads/forces on a structure is a very important step and serviceable design of structure.

2.1 TYPES OF LOADS

The loads are broadly classified as vertical loads, horizontal loads, and longitudinal loads. The vertical loads consist of dead load, live load, impact load. The horizontal loads comprises of wind load and earth quake load.

3. CODE-BASED PROCEDURE FOR SEISMIC ANALYSIS

Main features of seismic method of analysis based on Indian standard 1893(Part 1):2002 are described as follows

Table -1: features of seismic method of analysis

Sl. No.	Particulars	Load	Analysis
1.	Equivalent static load method	Static	Static
2.	Response spectrum method	Dynamic	Dynamic
3.	Time history analysis	Dynamic	Static
4.	P – Delta analysis	Static	Dynamic

3. EQUIVALENT STATIC ANALYSIS

All design against seismic loads must consider the dynamic nature of the load. However, for simple regular structures, analysis by equivalent linear static methods is often sufficient. This is permitted in most codes of practise for regular, low-to medium-rise buildings. It begins with an estimation of base shear load and its distribution on each story calculated by using formulas given in the code. Equivalent static analysis can therefore work well for low to medium-rise buildings without significant coupled lateral-torsional effects, are much less suitable for the method, and require more complex methods to be used in these circumstances.

4. OBJECTIVES

- To study the existing literatures for the preparation of plan, analysis, design and reinforcement detailing of a regular structure.
- To prepare the model using ETABS and check the adequacy of the structural component size of the regular framed structures.
- To obtain the structural parameters of the regular framed structure such as lateral forces, story drift, floor displacements, moments and shear force.
- To design, detail and to provide the adequate member sizes, reinforcement and connection details so that to enable the structure to withstand safely against the calculated loads.

4. MODELLING AND ANALYSIS

For the analysis of multi storied building, following data is considered as described below.

Table -2: Modelling details

Sl. No.	Particulars	Dimension/Size/Value
1.	Model	B+G+15
2.	Seismic Zone	II
3.	Floor height	3m
4.	Plan Size	94mx44m
5.	Size of Columns	1200mmX230mm & 1050mmX230mm
6.	Size of Beams	230mmX750mm & 230mmX600mm
7.	Walls	230mm thick
8.	Thickness of Slab	150mm thick
9.	Type of Soil	Type-II, Medium soil as per IS-1893
10.	Material Used	Concrete- M20 (columns), M20 (Beams & Slabs) Reinforcement- Fe 500

4.1 GRAVITY LOADS

Table -3: Loads Considerations

Type of Loads	Value
Wall Load (Dead Load)	14.904 KN/m^2
Floor Finish (Dead Load)	1.0 KN/m^2
Live Load	2.0 KN/m^2

The structure is analysed and designed for live load and dead load consisting of self-weight of beams, columns and slabs.

5. BUILDING PLANNING

It is very important to have idea about planning depending on the functions for which the building is planned. Initially the planning begins with site investigations and considerations of NBC. Later the drawings are prepared in AutoCAD 2014. Considering all the amenities and spaces and its architectural plan is prepared with a basic elevation. The drawings are as follows.

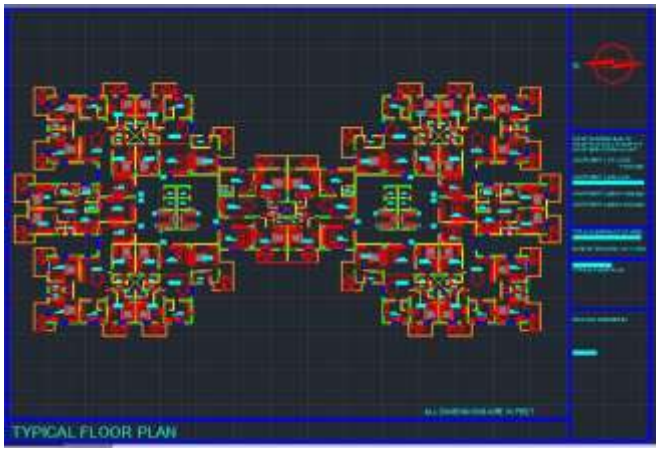

Fig 1 : Typical Floor Plan

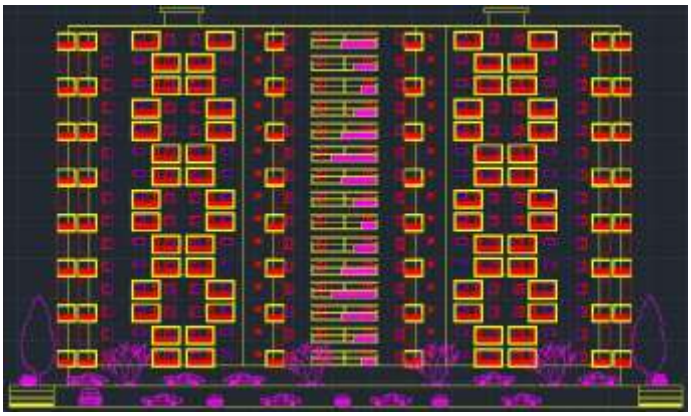

Fig 2 : Basic Elevation Of Building

Fig 3 : 3D Elevation Designed In 3ds Max

Fig 3.1 : 3D Elevation Designed In 3ds Max

Fig 4 : Apartment Type 1

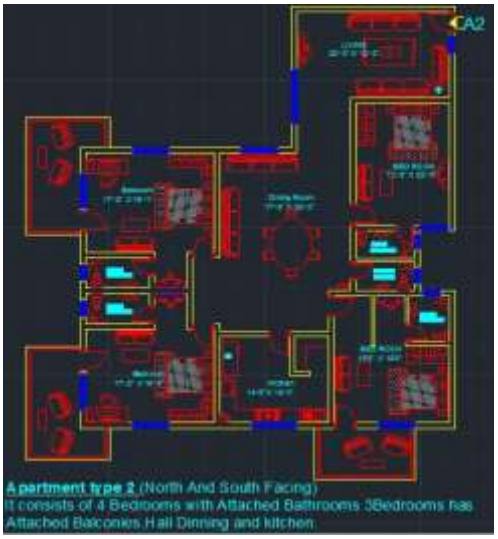

Fig 5 : Apartment Type 2

Fig 6 : Apartment Type 3

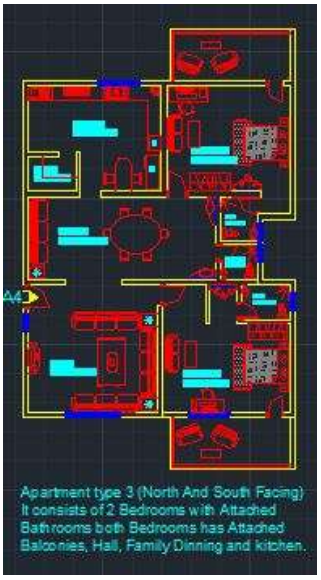

Fig 7 : Apartment type 4

5. STRUCTURAL ANALYSIS AND DESIGINING RESULTS

From the below fig. 8, it is shown that the multi storied frame structure has been designed for 15 stories. The slabs have been modelled on top of the beams using end to end beam connectivity. The beams dimensions being 230mm x 750mm & 230 x 600mm have been modelled throughout the structure. The column dimensions have been spliced suitably based on the requirement of the design considerations and so in as to reduce the load from the structure. The bottom ends of the columns have been assigned as fixed such that the end describes it to be fixed to the footing.

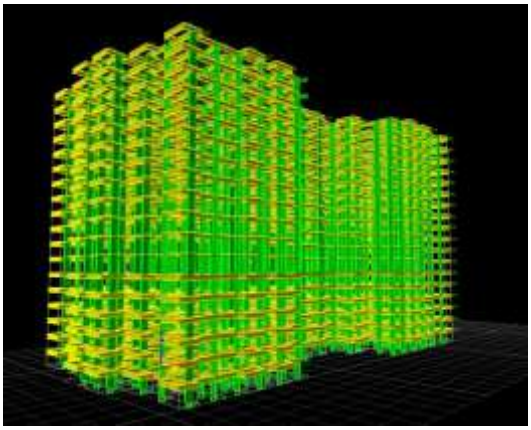

Fig. 8 Structural Model In Etabs

The building components such as beams, columns, slabs is as shown in the figure above. The detail representation of the frame components is as shown below.

- Beams (230 X 600mm) & (230 X 750 mm)
- Columns (1050X 230mm) & (1200 X 230 mm)
- Slab (150mm thick)

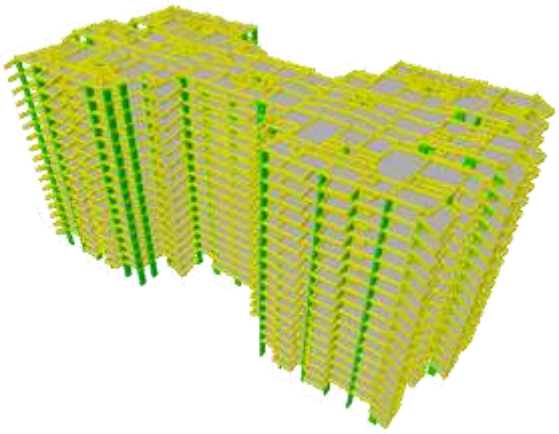

Fig. 9 Structural Model After Analysis

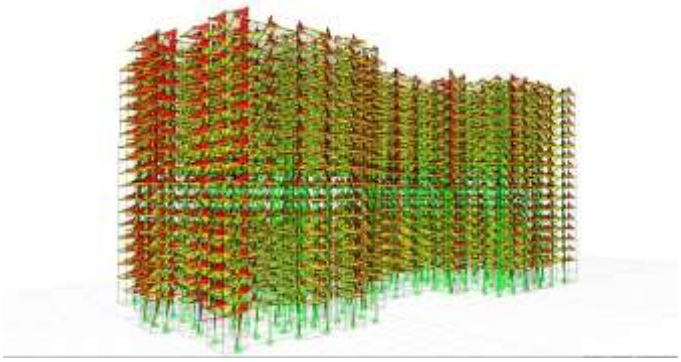

Fig. 10 Bending movement diagram of a building

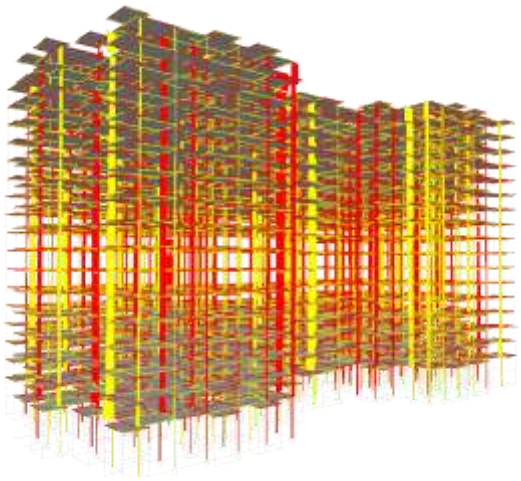

Fig. 11 Shear Force diagram of a building

3. CONCLUSIONS

1. The preparation of the project has provided an excellent opportunity ti engage ourselves in Planning and Designing of high rise building
2. The project has given an opportunity to recollect and coordinate the various Principles and methods used in designing
3. Using and understanding the practical use of software's like Autocad, 3ds max, Etabs was understood
4. By using ETABS the analysis and design work can be completed within the stipulated time.
5. The project gave the confidence to carry out design projects of high rise building.

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BIOGRAPHIES

Mohammed Sawood
U.G.Schalor, Deparment of Civil Engineering, Anjuman Institute of Technology And Management Bhatkal, Karnataka, India

Farasha Nudrath
U.G.Schalor, Deparment of Civil Engineering, Anjuman Institute of Technology And Management Bhatkal, Karnataka, India

Sarfraj Ahmed
U.G.Schalor, Deparment of Civil Engineering
Anjuman Institute of Technology And Management Bhatkal, Karnataka, India

Mohammed Hanif
U.G.Schalor, Deparment of Civil Engineering, Anjuman Institute of Technology And Management Bhatkal, Karnataka, India

Bilal Shaikh
Assistant Professor, Department of Civil Engineering, Anjuman Institute of Technology And Management Bhatkal, Karnataka, India