An investigational study of commercial building- case study

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Abstract - In our project we have analyzed and designed various components of commercial building(Basement+G+3) using Etabs which is compressive analysis, design and detailing software for superstructure (Beams, Columns) of any building, Substructure of the building(Footing) and slab is designed using SAFE software which can be directly integrated with Etabs for load and reaction transfer. For the design of commercial building we have considered dead load, live load and earthquake load along with their combination on each structural element of the building. Although software is capable of doing linear-static, linear-dynamic, nonlinear-static, nonlinear-dynamic analysis. We limited our scope of study to only linear static analysis. Software is even capable of detailing each structural element in substructure and superstructure but we have attempted to do detailing using AUTOCAD. Furthermore, manual design was done for critical structural element and the results were compared with Etabs and SAFE.

Key Words: **ETABS, Manual design, Safe.**

1. INTRODUCTION

A structure is the one which consists of various components which are interconnected to one another in order to carry the overcoming loads[1]. As per civil engineering examples for structures includes bridges, culverts, dams etc[4]. Structures are designed to withstand forces and moments due to different causes while some structures like aircraft structures, machine foundation etc[2]. necessarily have to be designed for forces due to motion, many are designed considering them to be equilibrium or at rest[3]. These structures have to be designed and analysed before the structure has been put in use so has to with stand the oncoming loads on the structure without any failure during its design life. Several software packages are available these days for analysis and design of the structure like STAADPRO, ETABS, SAP, RAM etc[5]. ETABS is one such software which is being widely used for the purpose of analysis and design of a high-raised buildings[6].

2. LITERATURE REVIEW

The present investigation deals with the analysis and design of commercial building using ETABS. The relevant literature available in this area has been critically studied and discussed.

Ragy Jose etal (2017)(1): In this paper, analysis and design of commercial building(G+3) was carried using ETABS.The various structural elements such as beams, columns etc. were designed manually as per IS 456:2000 guidelines. The calculation results which are obtained from both manual and software gives almost the result.

Puneet Mittal; Nishant Kad (2016) (2): Analysis and design of a structure is a very tedious job and it is also time consuming when it is carried out manually. This problem can be solved by the use of software which are meant for this work.

This paper mainly deals with the comparison of the results obtained from STAADPRO and ETABS which are the most widely used software for analysis and design of multi-storey building. On comparison between the softwares it was found that ETABS provides lesser forces as when compared to that of STAADPRO.

Mahesh N. Patil, Yogesh N. Sonawane (2015) (3): In this paper, Seismic analysis was done by using ETABS software. There was an increase in lateral forces from bottom to top floor in both manual and software analysis. The seismic analysis results obtained from ETABS software were manually verified as per IS 1893:2002. The seismic weight which were obtained from manual and software analysis almost gave the same result. The slight variation in base shear results were noticed in both manual and software analysis.

S. Vijaya Bhaskar Reddy etal (2015) (4): This paper deals with the effect of wind forces on a high raised building. When the structures block the flow of wind, the wind's kinetic energy is converted into potential energy of pressure, which causes wind loading. The effect of wind on the structure depends upon the density and velocity of the air, the angle of incidence of the wind, the shape and stiffness of the structure etc. It is found that the effect of the wind load increases as the height of the structure increases.

V. Varalakshmi1, G. Shiva Kumar,R. Sunil Sarma (2014) (5): In this paper a G+5 residential building is drafted with the help of Auto CAD software. The reinforcement details for beams, columns and slabs are designed as per IS-456-2000and footing were designed as per IS-786-1995.The loads that are acting on the building such as dead load – which is caused due to the weight of the materials that are used for the construction of the building and the live load which is due to the weight of the object temporarily placed on the structure, moving vehicle or the natural forces. Live load for residential building is taken as per IS-875(part-2). The loads from the slab get distributed to the beams which is further distributed to the columns. From column this load gets distributed to the footing.

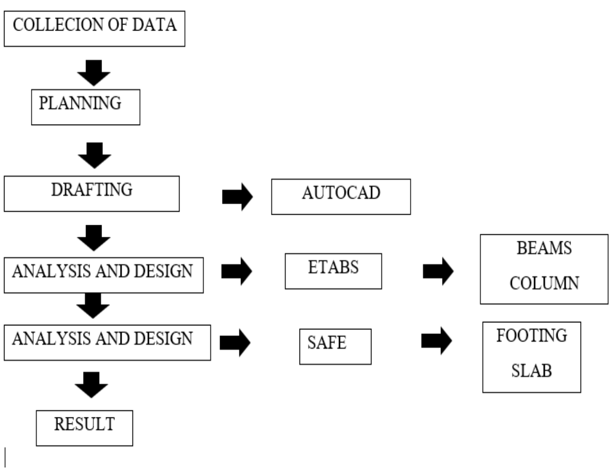
2.1. Present Study

In this paper a Basement+G+3 commercial building which is of about 9400sq.ft located at Basaveshwara Nagar, Bangalore.

2.2. Objectives

- To analyze and design with an aid of Extended3D Analysis of building System (ETABS) and SAFE.
- To highlight the advantages of using ETABS and SAFE over manual method in practical or live project.
- To understand the limitations of ETABS and SAFE (if any) and methods to overcome that limitation.
- To compare results obtained from Etabs and SAFE with manual method.

3. METHODOLOGY



4. BUILDING DATA

Features

- Type of building: Commercial building
- Size of the site:100*94[ft]
- Building height:
- Number of storey: Basement +G+3
- Type of construction: R.C.C framed structure
- No. of stairs: one
- No. of lift: Two
- Type of wall: Brick wall

• Dimension of Beams	B_1=230*600mm B_2=230*450mm
• Dimension of columns	C_1=230*450mm C_2=230*600m
• Thickness of slab	150mm
• Live load • Floor finish • Wall load	4KN/m² 1KN/m² 13KN/m

4.1. Plan of the building

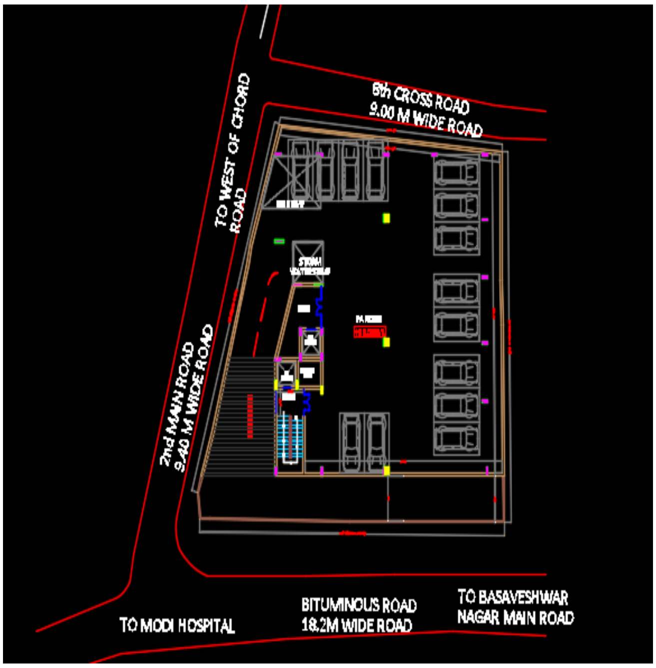


Fig 1:Basement floor plan

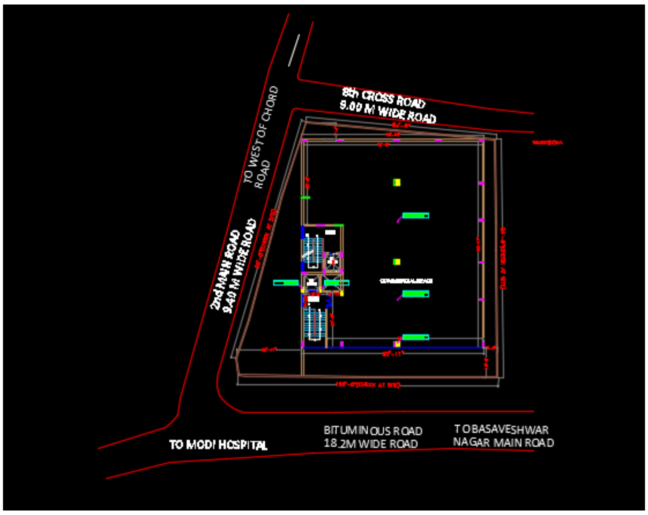


Fig 2:First floor plan

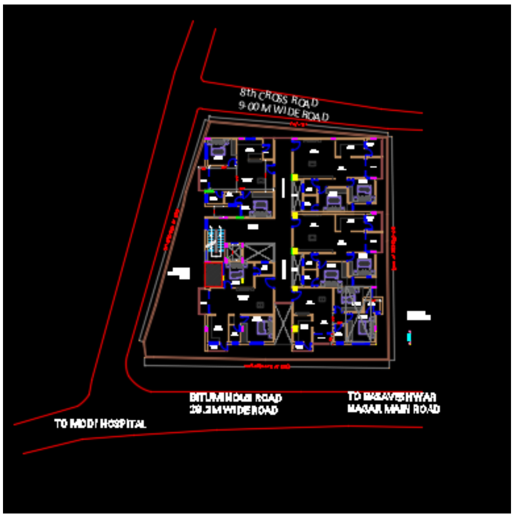


Fig 3: Second and Third floor plan

5. ETABS MODELING AND ANALYSIS

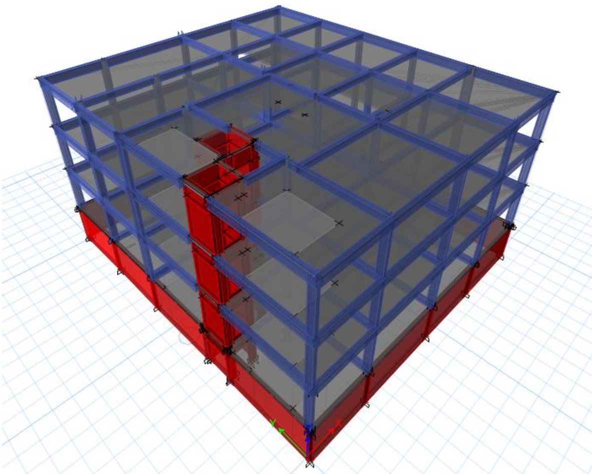


Fig 4: Modeling of the structure

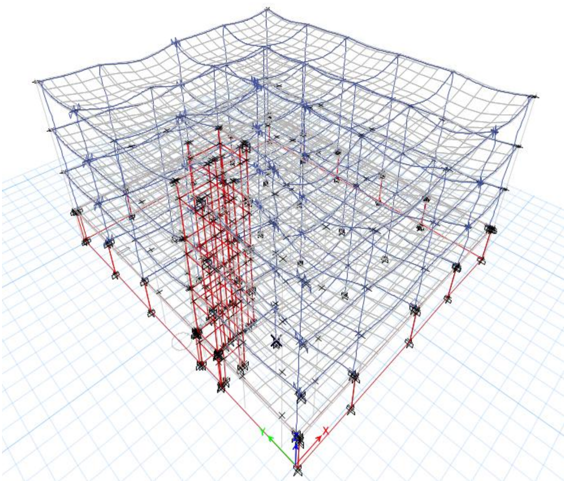


Fig 5: Analysis of the structure

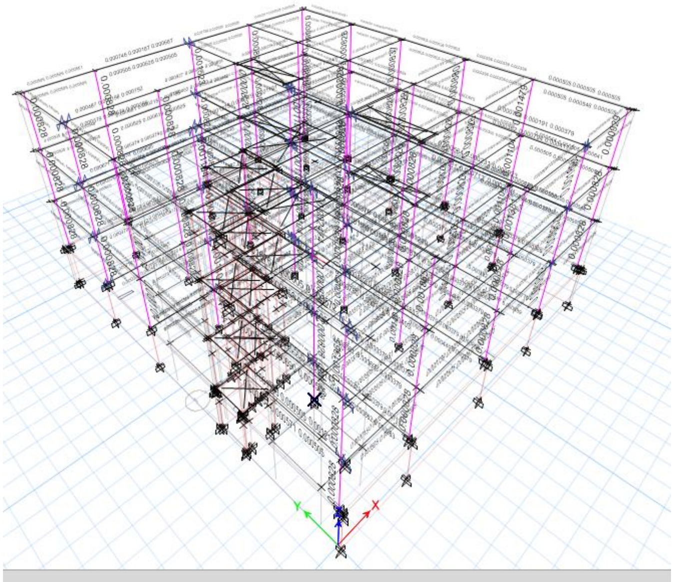


Fig 6: Design of the structure

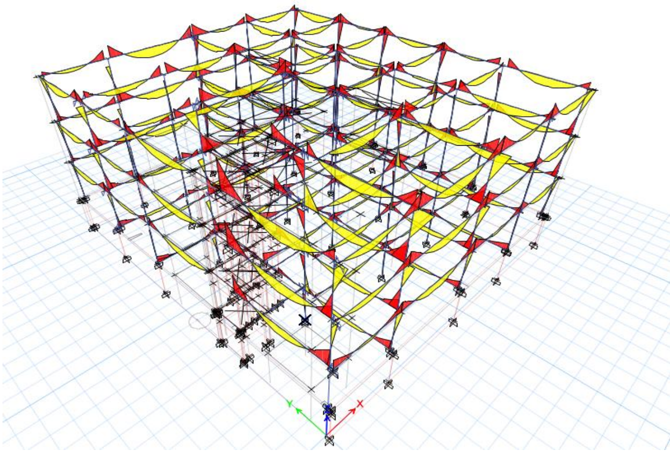


Fig 7: Bending Moment diagram of the structure

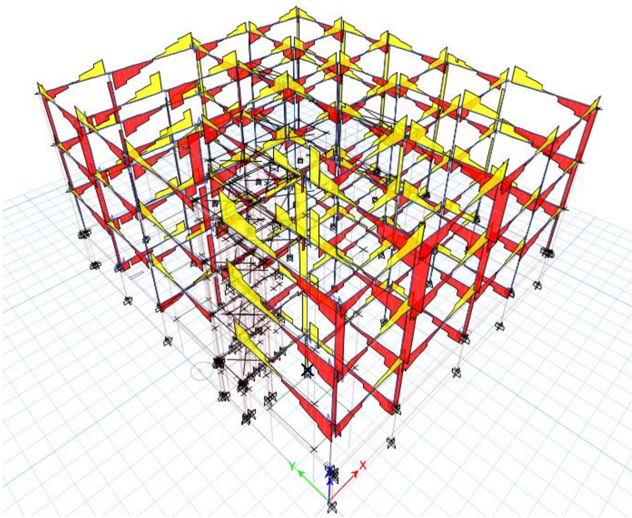


Fig 8: Shear force diagram of the strucutre

SBC of soil	339KN/m^2	
Column size	0.23x0.6m	
Column load	1340.372KN	
Footing size	3.38x1.3m	
Depth of footing	700mm	
Area of steel required:	Manual method	Software
(a) Along longer direction	3141.59mm^2	2611mm^2
(b) Along shorter direction	377.107mm^2	348mm^2

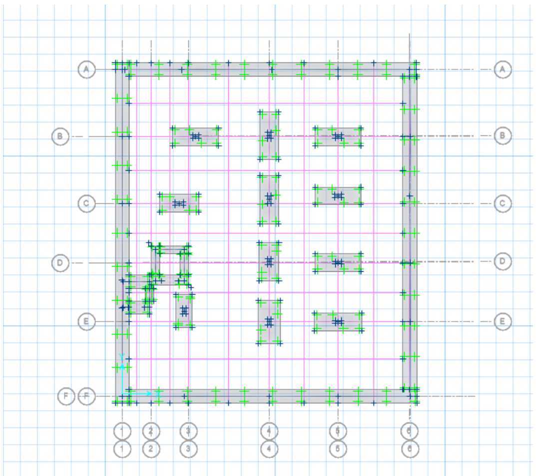


Fig 9:Foundation Layout

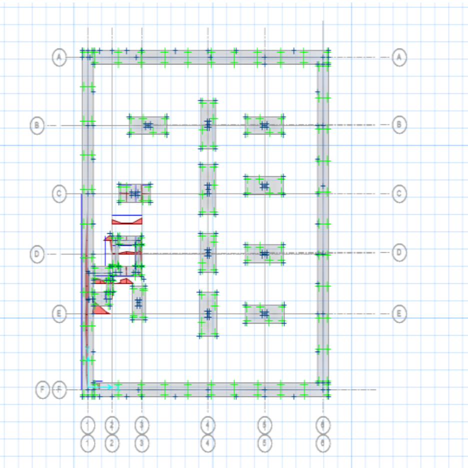


Fig 10: Analysis and Design of Foundation

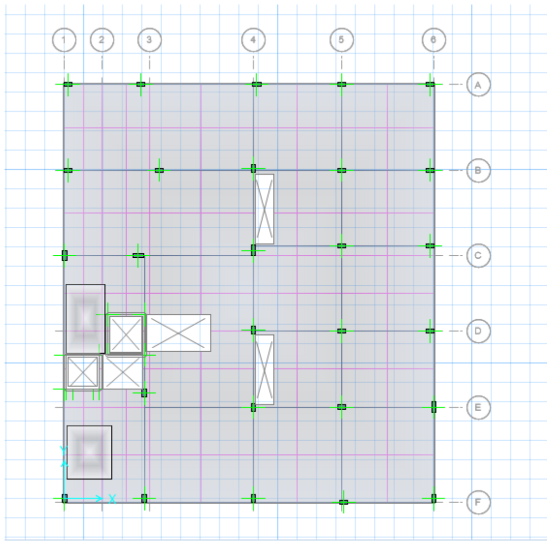


Fig 11:Slab Layout

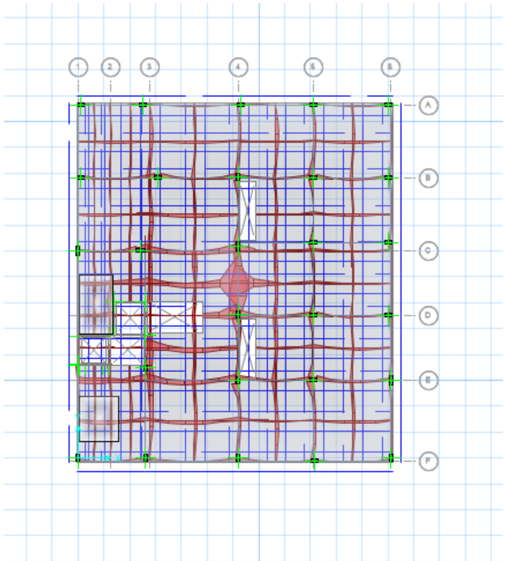


Fig 12: Analysis and design of slab

6.Comparison of Reinforcement details of Software and manual method

Footing Reinforcement details

Column Reinforcement details

Area of the steel required	Manual method	Software
	1407.43mm^2	1104mm^2

Beam details

Area of the steel required	Manual method	Software
	402mm^2	505mm^2

Slab details

Area of the steel required: (a)Along longer direction (b) Along shorter direction	Manual method 261.799mm^2 393.01mm^2	Software 250mm^2 310mm^2

7. CONCLUSIONS

- It takes less time to design a building accurately in ETABS and SAFE.
- Revision of loads and redesigning of structural elements is easier in ETABS compared to manual design.
- Documentation of result is systematic, effective and in a proper sequence which lags in case of manual design
- Creating and saving of reports in ETABS in digital format is much more safe and efficient way.

8. REFERENCES

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