Design and Comparative Study of G+6 Residential Building with Different Loads Using Etabs

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Abstract - *The two most popular design software programs available now are Staad and Etabs. This ultimate encoding program is used by many design companies. As a result, this project's venture development primarily focuses on the virtual analysis of the outcomes achieved when designing a multi-story concrete frame structure utilizing STAAD and ETAB software independently. Calculating loads and examining the entire structure are part of the design process. Limit State Design, in accordance with the Indian Standard Code of Practice, is the design methodology employed in STAAD.Pro and ETABS analysis. The primary goal of a structural engineer is to use technology to create a safe and cost-effective structure so that they can take on the design of larger, more complicated buildings. STAAD.pro boasts a cutting-edge user interface, robust analysis and design engines with dynamic analytical capabilities, and visualization tools. STAAD.Pro is the professional's choice for everything from model creation, analysis, and design to visualization and result validation. Nowadays, many structural designers use ETABS, another top design program. Here, we also used ETABS program to analyze a regular structure for the design.*

Key Words: **Staadpro, Etabs, Structural Elements, Frame, Load Combinations.**

1. INTRODUCTION

STRUCTURAL AIDED ANALYSIS AND DESIGN is what STAAD stands for. It was created in Yorba Linda, California, by Research Engineers International, and in late 2005, it was acquired by Bentley Systems. A structural engineering software program called STAAD.Pro is used to analyze and design a wide range of different kinds of structures. Its advanced features, fluid data collaboration, and flexible modeling environment enable structural engineers to analyze and design almost any kind of structure. Almost any kind of structure, including buildings, bridges, towers, transportation, industrial, and utility structures, can be analyzed and designed using STAAD.Pro.

The software called ETABS, which stands for EXTENDED 3D ANALYSIS OF BUILDING SYSTEMS, was created by Computers and Structures, Inc. (CSI), an engineering software business based in Berkeley, California, that was established in 1975. An engineering software program called ETABS can be used to evaluate and design multi-story buildings by taking into account different load combinations, grid-like geometry, and different analysis and solution strategies.

An architect is involved in the minutiae of aesthetics, while a structural engineer is primarily responsible for the overall structural design. Dead, live, wind, and seismic loads must all be taken into account while designing structures. All external forces operating on the structure will be counterbalanced by high-quality reinforcing for the beams and columns. In order to disperse the intensity of the load on the foundation, the soil beneath the structure should be sufficiently firm. We use staad.pro for accuracy as well because manual calculations become more complicated, time-consuming, and prone to error as the number of floors increases. IS 456-2000 is in compliance with the design.

OBJECTIVE OF THE STUDY

To carry out the modelling and analysis of R C Framed structure using StaadPro & Etabs

- To design a regular plan multi storey structure as per IS-456 & IS-875,(1,2,3)
- To find out shear force, bending moments and deflection of structural members.
- To compare the results obtained from staadpro and etabs.
- To observe the software gives more accurate and economical result.

1.1 OVERVIEW OF SOFTWARE'S

1.1.1 STAAD PRO

STAAD.Pro 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, STAAD.Pro is the professional's choice for steel, concrete, timber, aluminium and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles and much more.

- Easy user interface,
- Confirmation with the Indian Standard Codes,
- Versatile nature of solving any type of problem,
- Accuracy of the solution.

1.1.2 ETABS

ETABS can be effectively used in the analysis and design of building structures which might consists of structural members like beams, columns, slabs, shear walls etc, With ETABS you can easily apply various construction materials to your structural members like concrete, structural steel, Reinforced Concrete etc. ETABS automatically generates the self-weights and the resultant gravity and lateral loads. ETABS also have much of the features.

- User interface is model, simple and easy to use.
- Modelling is quite easy and quick.
- Easy application of loads in structures.
- Advanced analysis tools.

2. LITERATURE REVIEW

D.Ramya, A.V.S.Sai Kumar (2015): A comparative study on design of G+10 building by staadpro and etabs. The paper focuses to conclude the effectiveness of use of a structure software between these two. They found that sometimes staadpro is good for use but many times etabs.

Isha Bedi, Girish Sharma, Abhishek Gupta (2017): They proposed a Comparative study of RCC Frame Structures using Staad.Pro, ETABS, and SAP. From the proposed research analysis, we conclude that Staad.Pro is much more efficient. The values of force derivative are low as Compared to ETABS and SAP. The maximum the value of Force derivative will result in the maximum difference between the values of Staad.Pro, ETABS, and SAP.

Tejashree Kulkarni, Sachin Kulkarni, Anjum Algur, M. H. Kolhar (2016): Aimed to present study "Analysis and design of high rise building by staad pro 2008" is to define proper technique for creating Geometry, cross sections for column and beam etc, developing specification and supports conditions, types of Loads and load combinations. In this study a 30- storey high rise structure is analyzed for seismic and wind load combination using staad pro 2008 and comparison is drawn.

Aman, Manjunath Nalwadgi, Vishal T, Gajendra (2016): aimed an Analysis and design of multistorey building by using STAAD Pro for the G+5 commercial building and shows short term deflection, structure is safe in shear and flexure, amount steel provided is economic and so on.

Arunkumar N pattar, Sunil kumar chavan, Muralidhar Raje, Prof.Vishwanath B Patil (2015): They proposed a research on the Analysis and Design of Multi Storied Structural System with Wind Load Effects Using Staad Pro.

This project was briefly analysed for the G+21 building. It includes the designing and analysis of the structure by staadpro and Etabs both. The analysis values in both software's Staad Pro and ETABS are almost similar but design values are differ and uneconomical, so it's better to adopt the analysis values for manual design to have a economical design.

3. METHODOLOGY

A research presents the main features and organization of STAADPRO and ETABS, a computer programs that has been developed for the static and seismic stability evaluations of different civil engineering structures and concrete gravity dams. Our project involves analysis and design of multi-storied building using a very popular designing software STAAD Pro and ETABs against all possible loading conditions. In this chapter a multistory building has been modelled and analyze with considering all loads like Dead load, Live load, Wind load, Seismic loads as per as IS standard.

- Calculation of loads as per Indian Standards.
- Step by Step process of Methodology.
- Analysis using Staad pro on multi-storied framed structure
- Design using Staad. Pro on multi-storied framed structure.

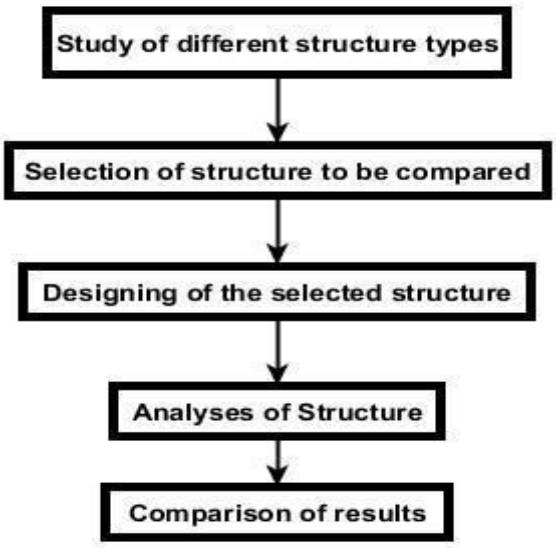

Fig 1. Methodology flow chart

Following data has been used in design as:

- RC moment resisting frame fixed at base.
- Seismic Zone II
- No of storey 14
- Density of concrete : 25kN/m^2
- Density of infill : 20kN/m^2

- Live load on floor level : 3kN/m²
- Live load on roof level : 1.5kN/m²
- Floor finish : 1.0kN/m²
- Plan (regular) : 25m*25m
- Beam dimension : (300mm*650mm)
- Column dimension : (600mm*600mm)
- Slab thickness : (160mm)
- Concrete grade used : (M30)
- Steel grade used : (Fe500)
- Bearing capacity of soil : (>180kn/m2)
- Floor to floor height : 3m
- C/c distance : 5m
- Depth of foundation : 600mm

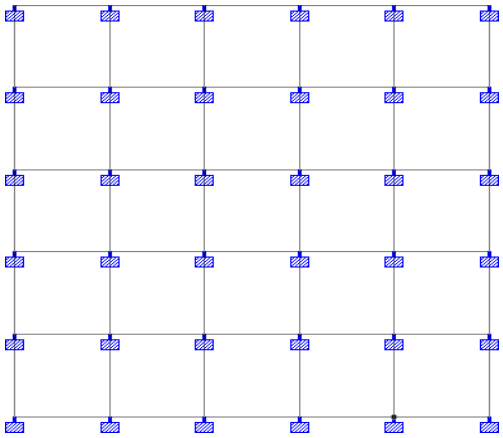

Fig 2. Top view staadpro plan

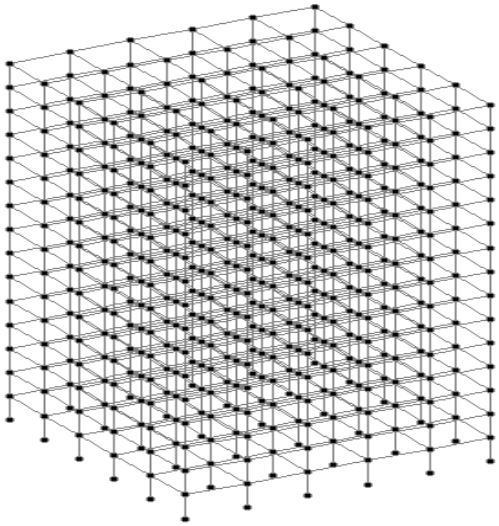

Fig 3. Geometric model of structure (staadpro)

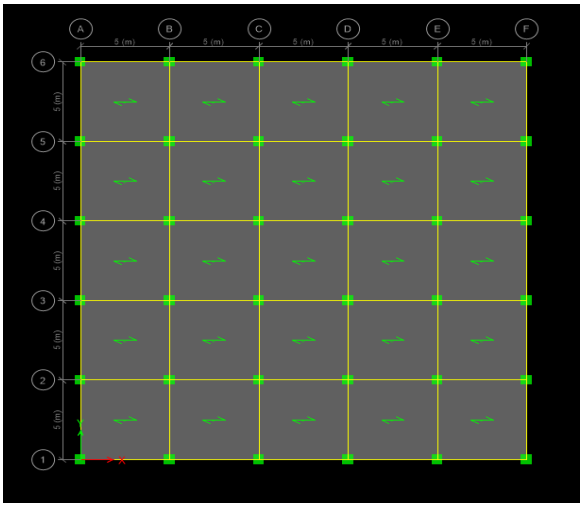

Fig 4. Top view etab plan

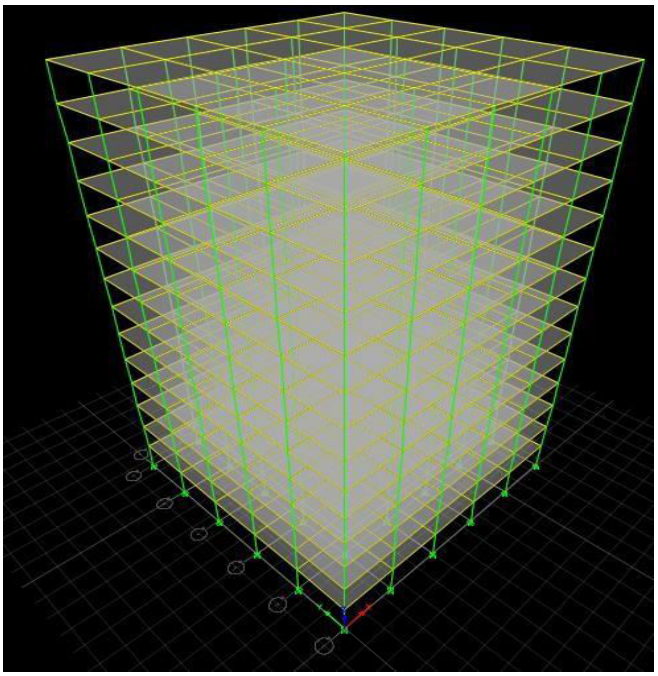

Fig 5. Geometric model of structure (Etab)

4. RESULT AND DISCUSSION

It has observed that when a G+14 Multi storied high rise structure with same beam and column cross sections analyzed and designed for loads using both the software's, there are many similarities and flexibility occurs in one another. The structure analysis of all the frames models that includes different loading conditions on beams, columns and slabs has been done by using software's STAAD.Pro and ETABs. The parameters which are to be studied are shear forces, bending moments and deflections as shown below in figures. And the points resulted are as follows:

- Usage of ETABS software minimizes the time required for analysis and design.

- ETABS gave lesser area of required steel as compared to STAAD PRO.
- STAAD.Pro software is more flexible to work compared to the ETABS software.
- The quantity of steel requirement is *9.25%* less for the design of G+10 multi-storied building using ETABS compared with the STAAD analysis.
- By the intensive study of "Comparative study on Analysis and Design of G+10 multi-storied building by both STAAD and ETABS software's" the "economical sections" was developed by ETABS software.

And some resultive discussion points comes out as shown in the table:

S.No	Point of Comparison	Software		Remarks
		STAAD.Pro	ETABS	
1.	Time	It takes less time	It takes slightly more time.	STAAD is very easy to learn& work.
2.	Accuracy	Less accurate.	More accurate	STAAD is accurate for both analysis and design
3.	Flexibility	User friendly	Learners choice	***
4.	Present day status	Most of the designers are using this software	Not preferred like STAAD	STAAD is more preferred because of its flexibility and ease of workability
5.	Steel	122.58 tons	111.24 tons	***
6.	Concrete	1086 cum	1086 cum	***

Table 1. Comparative result table

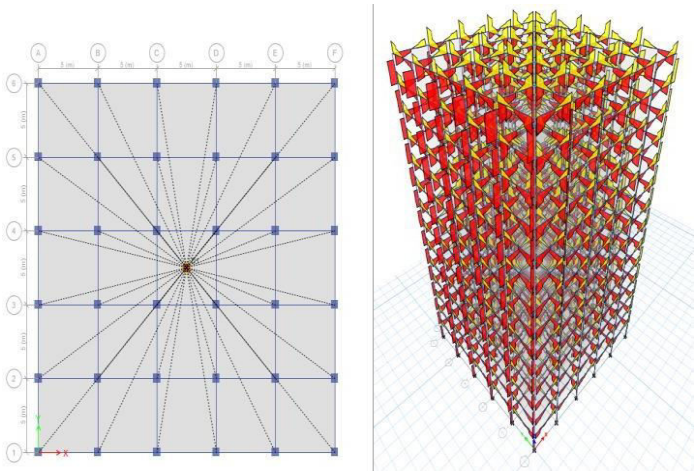

Fig 6. Shear Force Diagram on structure

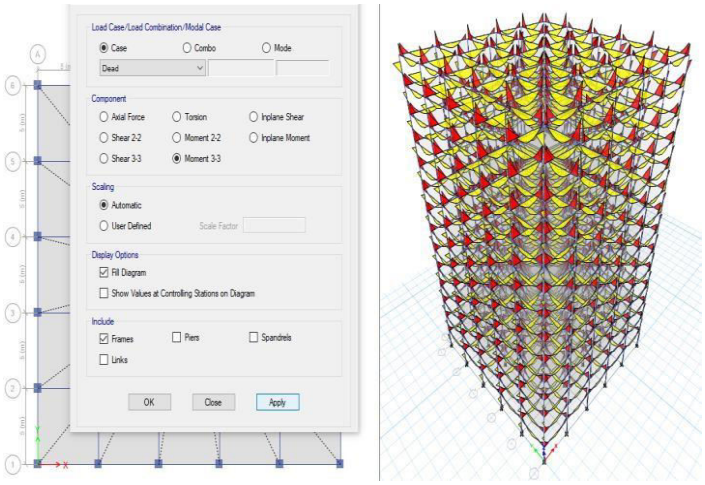

Fig 7. Bending Moment Diagram

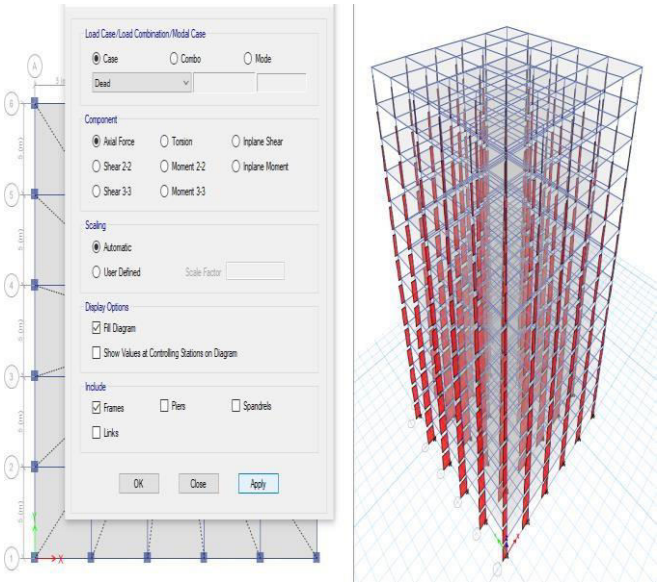

Fig 8. Axial Load Diagram on whole structure

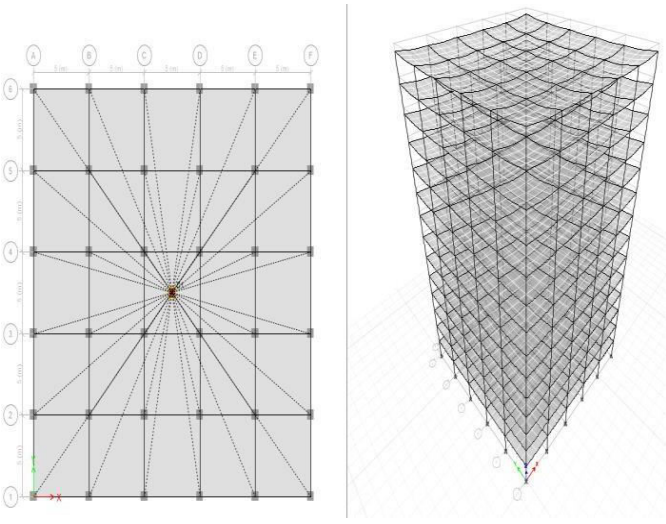

Fig 9. Deflected Shape of Structure

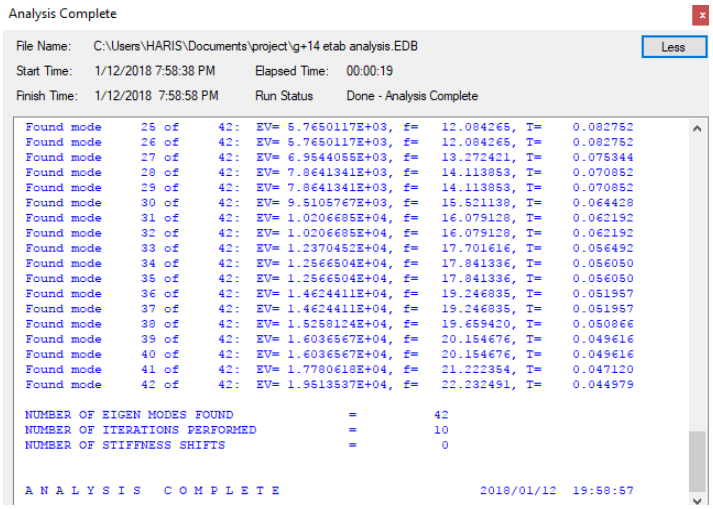

Fig 10. Analysis on Etabs

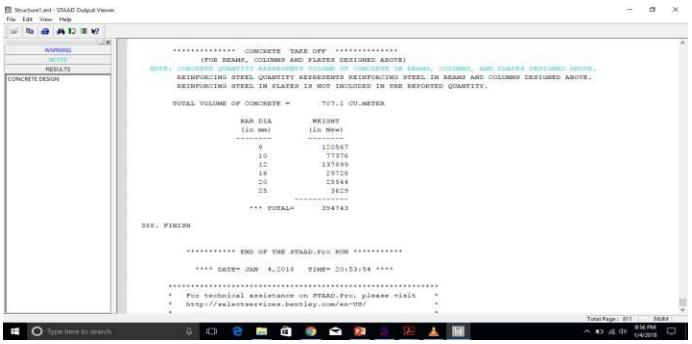

Fig 11. Result of Steel Requirement

5. CONCLUSIONS

Based on the behaviour of RCC frames on STAADPro. and ETABS some important conclusions are drawn:-

- ETABS gave lesser area of required steel as compared to STAAD PRO.
- Form the design results of columns, comparison of results for this case is not possible because of same Ast.
- Axial forces calculated by Staad Pro are almost similar to the axial forces calculated by etabs, so may adopt the analysis values for the design purposes.
- The analysis values in both software's Staad Pro and ETABS are almost similar but design values are little differ and uneconomical, so it's better to adopt the analysis values for manual design to have a economical design.
- Analysis was done by using ETABS and STAADPRO software successfully verified manually as per IS456.
- Usage of ETABS software minimizes the time required for analysis and design.
- STAAD.Pro software is more flexible to work compared to the ETABS software.
- The quantity of steel requirement is 9.25% less for the design of G+14 multi-storied building using ETABS compared with the STAAD analysis.
- The quantity of concrete requirement is same for the design of the multi-storied building using both STAAD and ETABS analysis.
- By the intensive study of "Comparative study on Analysis and Design of multi-storied building by both STAAD and ETABS software's" the "economical sections" was developed by ETABS software.

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