

Comparison between Manual and Software Approach towards Design of Structural Elements

Dr. P. D. Hiwase¹ Miss. Aditi Joshi² Mr. Aakash Keshariya³

Assistant Professor Civil Engg. Department RCOEM Nagpur

4th Year Student Civil Engg. Department RCOEM Nagpur

4th Year Student Civil Engg. Department RCOEM Nagpur

ABSTRACT : Emerging from the olden times when the use of manual calculations was predominant, the use of various software's and learning of the same has become much easier and important. Big construction firms and ventures have switched their approach and have started using them for design purposes. This paper mainly ponders upon the comparison of analysis procured from the design of regular multi-storeyed structures using these user friendly software's. In this paper, comparison of software's results with the manual calculations of a sample beam and column of the same structure designed as per IS 456 has been made.

KEYWORDS: Analysis of Structure, Design of structure, ETABS, Indian Standard Code, STAADPro.

I. INTRODUCTION

The construction market has been blessed with two efficient softwares namely STAADPro and ETABS. Huge business firms and construction ventures have started using these softwares for designing purposes. This paper focuses basically on the comparison between the results procured from the design of a multi storeyed structure calculated with the help of STAADPro and ETABS Softwares. We have considered the height of each storey as 3m. The total height of the whole structure thereby becomes----- A conclusion is drawn at the end comparing the results drawn from their analysis and design. The results from the softwares are then compared to the manual calculations.

1.1. NEED AND ADVANTAGES OF SOFTWARES

Being a totally practical and site based study, the use of the softwares like STAADPro and ETABS becomes questionable. But the civil engineering softwares comprise of a wide range of tools to help the civil engineers in all construction works. In all the stages of work namely drafting & documenting, designing, visualizing & analyzing, these tools can be helpful.

STAADPro is a software which is used for data analysis and design. It is popular due to its flexible modelling environment and wide range of design codes. The design of petrochemical plants, tunnels and bridges can be easily done using it. It contains a wide range of features of civil engineering and is also easy to operate. STAADPro has made it easy for the civil engineers to pan the structures according to the demands of their clients.

ETABS is used in the design of beams, slabs, columns, shear walls and bracings. The graphic input output and the numerical solutions are very easy. We also obtain precision and accuracy in Accuracy in dimensions by using Snaps (end, perpendicular, middle etc.). There are multiple viewing windows present in the software.

1.2. ANALYSIS AND DESIGN OF A STRUCTURE

All the structures which have to withstand the loads such as buildings, bridges, vehicles, machinery, furniture etc. The results of the analysis tell us about the fitness of the structure for use. It is a key part of all the civil engineering works. The structure is nothing but a body or a system of connected parts. To design and analyse the structures, one must consider the aesthetics and serviceability of the structures.

The Design of a structure in civil engineering deals with the ability to understand, predict and calculate the stability and strength of a structural element. Through designing of a structure, one can easily know how economically stable a structure is. The grade if material, its reinforcement is calculated in a design.

II. DESIGN PROBLEM

The study of 16mx16m 8 storey multi storeyed regular structure is done. All the steps including modelling, analysis and design of the whole structure is done on STAADPro.

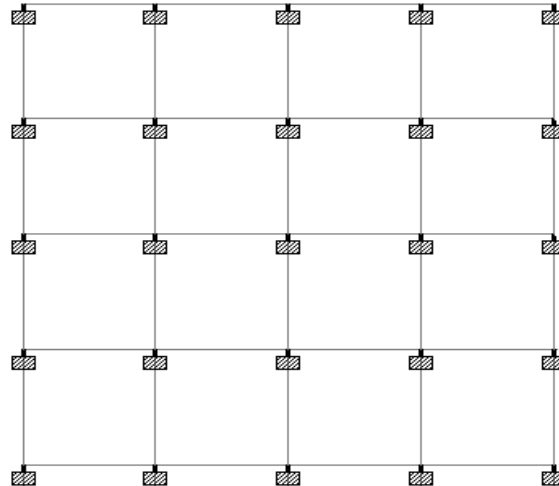


Figure 1 : Plan of the structure to be analyzed

2.1.1. PRIMARY DATA

Length x Breadth = 16mx16m, No. of Storey = 8, Storey Height = 3m, Beam = 450mmx450mm, Column 1-4 storeys = 750mmx750mm, Column 6-8 storeys = 600mmx600mm, Slab thickness = 120mm, Support conditions = Fixed, Beam Releases = Axial force

2.1.2. LOADING PATTERN CONSIDERATION:

Different types of loads which are acting on this structure are Dead Load (DL), Live Load (LL) and earthquake Load (EL).

Here, DL=Self weight of the structure+ Floor finish+ Wall loads

Live load considered is 2.8KN/sq.m .The soil type on site is of type II.The response reduction factor is 4. The importance factor consideration is 1.daming percentage is 5% and the time period determined is 0.55sec.

2.1.3. RESULTS AND DISCUSSION

Given below are there results obtained from vertical reactions of a sample node for different loads

Table 2: Results using STAADPro and ETABS

Maximum Deflection at the roof without shear wall

Loading	STAADPro	ETABS
DL	1025.23KN	1024.65.KN
LL	170.45KN	169.98KN
EQ(Along Length)	153.676KN	145.87KN
EQ(Along Breadth)	153.676KN	145.87KN

Table 2: Results using STAADPro and ETABS

TABLE 3: BENDING MOMENT AND SHEAR FORCE OF A SAMPLE COLUMN

Loading		Fx	Fy	Fz	Mx	My	Mz
Dead load	STAADPro	195.23	15.789	15.789	0	24.56	24.56
	ETABS	193.65	14.31	14.31	0	24.235	24.235
Live Load	STAADPro	26.432	2.92	2.92	0	4.78	4.78
	ETABS	26.22	3.88	3.88	0	5.55	5.55
EQ (Along Length)	STAADPro	10.452	6.45	0	0	0	7.245
	ETABS	11.76	7.43	0	0	0	7.123
EQ (Along Breadth)	STAADPro	10.452	6.45	0	0	0	7.245
	ETABS	11.76	7.43	0	0	0	7.123

2.1.5 TABLE 4: RESULTS OF DESIGN OF A SAMPLE

Total Reinforcement (sq.mm) Column and Beam section

Section	Beam	Column
STAADPro	814	2660
ETABS	760	2660
Manual Calculation	715	2660

III. CONCLUSION

The design of a multi-storeyed structure using ETABS and STAADPro was done. These results give conservative results of the design. In the ETABS, it was found that the area which was calculated was less than STAADPro. But the design of the structure was much more easy using both the softwares. It was also concluded that there was a minor difference in the results of the manually done experiment and those done by softwares, the results of latter being more accurate.(All the results shown in table 4)

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Dr. P.D. HIWASE is currently working as an Assistant Professor in Shri Ramdeobaba College of engineering and management. He has a specialization in structural engineering. He has been in the teaching sector since 9 years along with an industrial experience of 4 years in the field of structural engineering. He has published about 10 international journals till date.



Miss ADITI JOSHI is a student of final year of the academic year 2014-2018. of Shri Ramdeobaba College of Engineering and Management. She has been a part of various technical and non-technical organizations in and outside the college.



Mr. AAKASH KESHARIYA is a student of Shri Ramdeobaba College of Engineering and Management of Final Year academic year 2014-2018,Civil branch. He has been a part of various technical conferences in the past and is a GATE aspirant.