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Comparative Study of Design of a Multi-Storey Residential Building by Manual and STAAD.PRO Software

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***Abstract*: In this technological world, many application software is available to do complex and large structural work more easily by saving time and manpower. In the Civil Engineering field, the analysis and design of the structure are subjected to multiple types of loading which is calculated by some application software. For this purpose of civil engineering, STAAD Pro software is selected for analysis and design of the multi-story building as well as to find out how the values obtained from STAAD Pro software differs from manually calculated values. For analysis and design of a multi-story building (G+3), proper techniques are used for creating geometry, cross-sections for column, beam, slab, and footing.**

***Keywords*: analysis, design, multi-storey building, manual, STAAD Pro software.**

1. Introduction

Structural design is an art and science of designing, with the economy and elegance, a safe, serviceable, and durable structure.

The entire process of structural planning and design requires not only imagination and conceptual thinking (which form the art of designing) but also sound knowledge of the science of structural engineering besides knowledge of practical aspects, such as relevant design codes and by-laws, backed up by ample experience, institution, and judgment.

In this paper, we have studied, analyzed, and design the Residential building using a manual method with IS code 456:2000 and the most popular structural design products of model generation, analysis, and design of various structures "STAAD.PRO".

2. Methodology

A. *Statement of Project*

1. Type of building: (G+3) RC Frame Structure
2. Use of Building: Residential Building
3. Floor to floor height: 3.6 meter
4. Loads: Dead load - Calculate as per the self-weight of
5. elements
6. Live load - 2 KN/m^2
7. Floor Finish - 1 KN/m^2
8. Material specification: Concrete grade- M20
9. Steel Grade- Fe415
10. Wall thickness – Outer Wall: 200mm
11. Partition Wall: 100mm
12. Assumptions for design: Slab simply supported over beams
13. & beam simply supported over columns.
14. Design philosophy: Limit state design as per IS:456-2000
15. The density of Concrete: 25 kN/m^3
16. The density of brick: 19 kN/m^3

1) Load Condition

The concepts presented in this project provide an overview of building loads and their effect on the structure. Building loads can be divided into two types based on the orientation of structural action: vertical and horizontal loads.

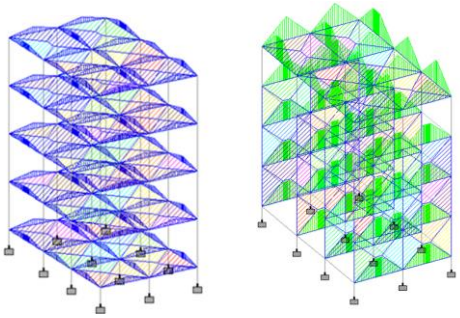

Fig. 1. Load condition

Design loads for commercial building are as follows,

- Dead Load: In STAAD Pro assignment of the dead load is automatically done by giving the property of the member. In load case, we have an option called self-weight which automatically calculates weights using the properties of material Bullet points.
- Live Load: In STAAD, we assign live load in terms of U.D.L. we have to create a load case for live load and select all the beams to carry such load. After the assignment of live load, the structure appears. For our

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structure, live load for all floors is taken as 2kN/m^2 and for terrace level, it is taken as 1.5 kN/m

- Floor Load: Floor load is calculated based on the load on the slabs. Assignment of floor load is done by creating a load case for floor load. The intensity of the floor load is taken as 1 kN/m^2

2) Design of Beam

Design of beam is done by using moment distribution method End moment and moment shear are calculated by using MDM Span moments for each span is calculated. Span moments are the maximum moment in span. Then design for each span and support have been done.

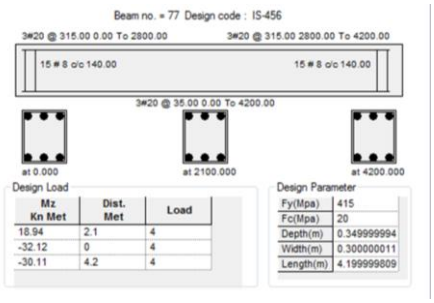

Fig. 2.

3) Design of Column

Design of bi-axially loaded column

Steps

1. Assume percentage of reinforcement (P)
2. Assume effective cover and calculate d'/D and d'/e3) Calculate
3. Calculate Puz
4. Find permissible
5. Check permissible
6. Calculate Asc and provide main and lateral reinforcement of the column.

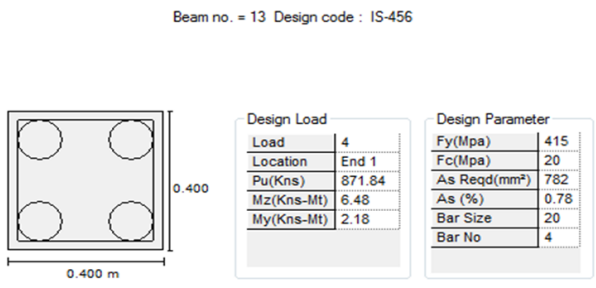

Fig. 3.

4) Design of Footing

Isolated square footing

Data

Size of column = 400mm* 400 mm

Fck = 20 N/mm^2

Fy = 415 N/mm^2

Sbc = 250

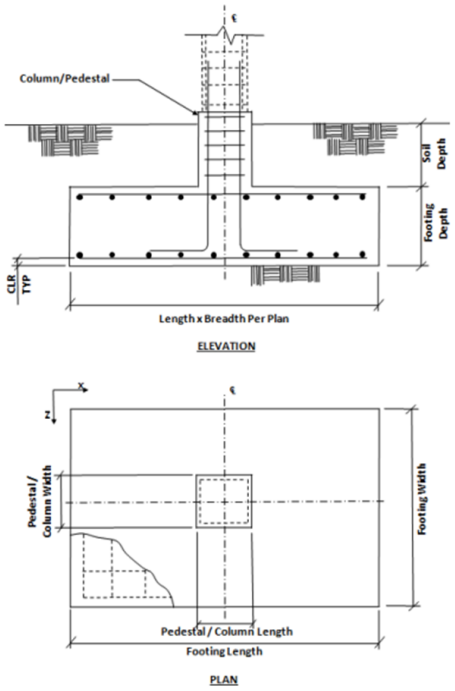

Fig. 3.

3. Result

Table 1
Comparative result

Section	Staad Pro		Manual	
	Concrete (Cu.m)	Steel (Kg)	Concrete (Cu.m)	Steel (Kg)
Slab	62.06	4533.74	58.192	3702.72
Beam	24.39	4105.22	23.71	3080.14
Column	32.04	4838.64	47.216	4268.4
Footing	53.02	2055.14	27	1886.4

4. Conclusion

- Using STADD Pro., the analysis and design of the multistorey building has completed much quicker and easier than the manual calculation.
- Steel requires by software is more than manually.
- Time required for calculation is more in manual method than software.
- Skilled supervisor required for STAAD Pro.
- Details of every member can be obtained using STAAD Pro.
- All the List of failed beams can be obtained and also Better
- The section is given by the software.
- The design of R.C.C. structured building done by Limit State Theory.
- All the slabs are designed as two-way Slabs, by the method
- provided by IS 456: 2000.
- Load in a residential building is so less than slab was safe in all aspects with the minimum reinforcement as per IS 456: 2000.

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