

Structural Analysis and Design of A G+2 RCC Residential Building Using STAAD Pro as Per IS Codes

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Abstract: *This study presents the structural analysis and design of a G+2 reinforced concrete residential building using STAAD Pro in accordance with Indian Standard codes. The building, planned on a 7.62 m × 14.32 m plot in Hyderabad, was modeled and analyzed considering dead loads, live loads, and relevant design parameters as per IS 456:2000 and IS 875. Structural responses such as bending moments, shear forces, and displacements were evaluated to ensure safety and serviceability. Reinforced concrete members including beams, columns, and slabs were designed based on code provisions. Foundation design was carried out using STAAD Foundation assuming medium soil conditions. Quantity estimation and cost analysis were performed using the Centre Line Method. The study demonstrates the effectiveness of STAAD Pro in optimizing structural design, improving accuracy, and reducing manual effort in analysis and estimation.*

Keywords: Structural Analysis of RCC Buildings, STAAD Pro Modeling, IS 456:2000 & IS 875, Reinforced Concrete Design

I. INTRODUCTION

Building construction is a key indicator of socio-economic development, requiring safe, efficient, and economical structural design. With increasing urbanization, the demand for well-designed multi-storey residential buildings has grown significantly. Structural analysis plays a critical role in ensuring stability and serviceability under various loading conditions.

This study focuses on the analysis and design of a G+2 reinforced concrete residential building planned on a 7.62 m × 14.32 m plot. The structure consists of a framed system with 14 columns, designed to resist both vertical loads (dead and live loads) and horizontal loads (wind loads) in accordance with IS 875 provisions. The design of structural elements such as beams, columns, and slabs is carried out as per IS 456:2000.

The building is modeled and analyzed using STAAD Pro to evaluate key parameters including bending moments, shear forces, and displacements. The study aims to demonstrate the effectiveness of software-based structural analysis in improving design accuracy, reducing manual effort, and ensuring compliance with Indian Standard codes.

II. PROJECT SPECIFICATIONS

Salient features

Utility of building	: Residential Building
No of stories	: G+2
No of staircases	: 3
No. of flats	: 3
Type of construction	: R.C.C. Framed structure
Types of walls	: Brick wall



Geometric details

Ground floor	: 3M floor to floor height
Height of plinth	: 0.38M
Depth of foundation	: 1.5m

Materials Used

Concrete grade	: M20
All steel grades	: FE415

III. OBJECTIVES OF PROJECT

- To model a G+2 RCC residential building using STAAD Pro software.
- To analyze the structure under Dead, Live, Wind, and Seismic loads as per IS 875 and IS 1893.
- To design beams, columns, slabs, and footings as per IS 456:2000 using Limit State Method.
- To evaluate structural safety based on bending moments, shear forces, axial forces, and deflections.
- To prepare quantity estimation and cost analysis for an economical design.

IV. SOFTWARE USED

STAAD Pro V8i: Used for 3D modeling, structural analysis, and design of the RCC building under dead, live, and wind loads as per IS 875 and IS 456:2000. Key outputs include bending moments, shear forces, axial forces, and displacements.

STAAD Foundation Advanced V8i: Utilized for the design of isolated footings based on column reactions, considering soil bearing capacity and load combinations.

AutoCAD: Employed for preparation of plan layouts and structural drawings, forming the basis for accurate modeling and detailing.

Microsoft Excel: Used for load calculations, result tabulation, and quantity estimation using the Centre Line Method.

V. ARCHITECTURAL PLANING AND DRAWINGS

The architectural drawings of the proposed G+2 residential building were prepared using AutoCAD, including floor plans, elevation, and cross-sectional views. The building is planned on a 7.62 m × 14.32 m plot with a uniform layout across all floors. Each floor consists of a 2-bedroom residential unit with functional spaces such as living room, kitchen, and sanitary areas, designed for efficient space utilization. A centrally located staircase provides vertical connectivity between floors.

The drawings include detailed room dimensions, layout, and structural configuration, which serve as the basis for accurate modeling and analysis in STAAD Pro.



GROUND FLOOR

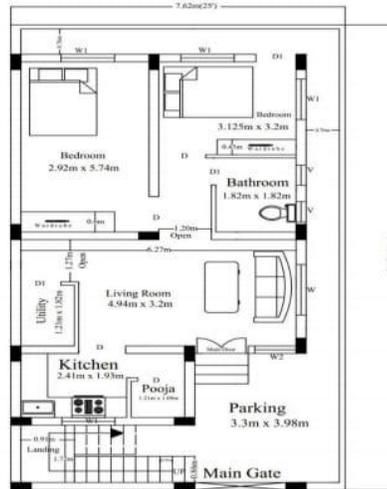


Fig 1 Ground floor plan

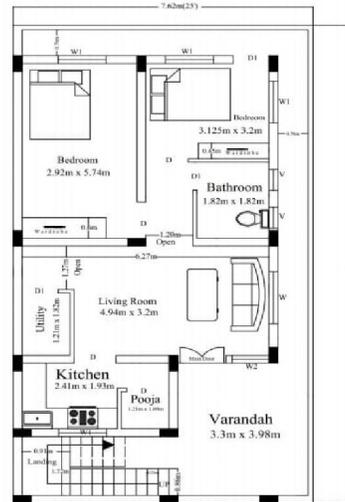


Fig 2: 1st & 2nd Floor plan

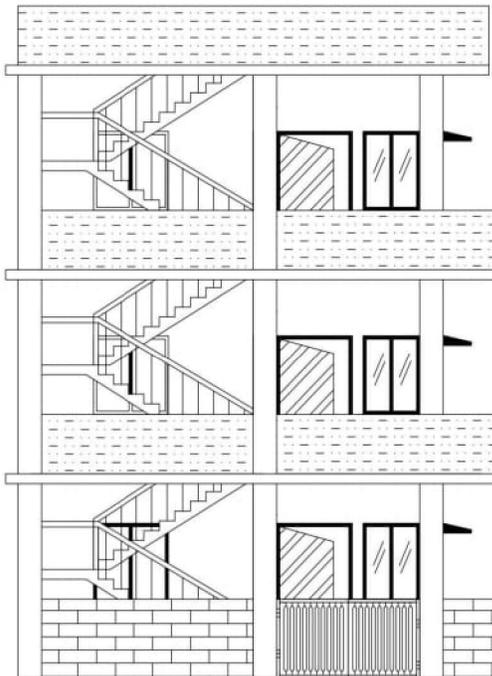


Fig 3: Cross section

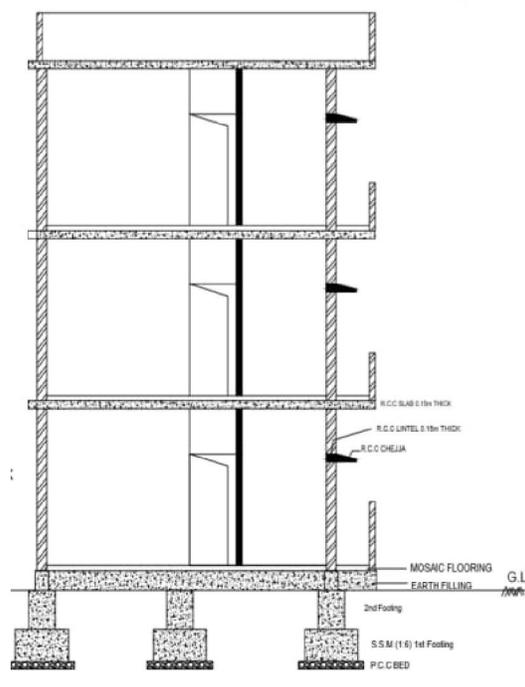


Fig 4: Elevation



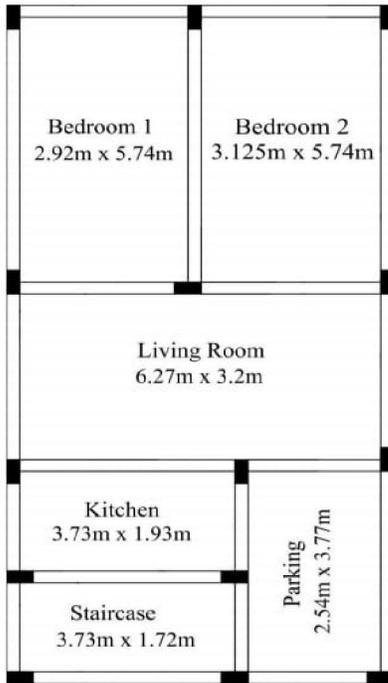


Fig 5: Beam layout plan

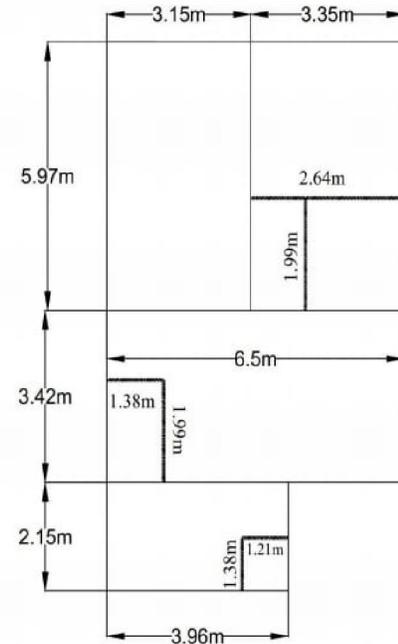


Fig 6: Center line

VI. TYPES OF LOADINGS AND COMBINATIONS

Structural loads can be broadly categorized into dead loads, live loads, environmental loads (like wind and earthquake), and special loads (like snow, impact, and thermal loads). Load combinations are used in structural design to analyze how these different loads might act together to determine the worst-case scenarios and ensure the structure's safety.

1. Dead Load + Live Load: A basic combination for everyday conditions.
2. Dead Load + Wind Load: For structures exposed to wind forces.
3. Dead Load + Live Load + Wind Load: For structures subjected to all three load types.
4. Dead Load + Earthquake Load: For structures in seismic zones.
5. Dead Load + Live Load + Snow Load: For structures in areas with heavy snowfall.

Table 1: Load factors as per IS 456:2000

Live load(KN)	Dead load(KN)	Wind load(KN)
1.5	1.5	0
1.2	1.2	1.2
0.9	0.9	0.9

Discussion about Results

The structural analysis of the G+2 RCC building was performed using STAAD Pro considering dead, live, and wind loads as per IS 875. The results indicate that maximum bending moments and shear forces occur in beams at lower storeys, while columns at the base carry higher axial loads due to cumulative load transfer.

Lateral displacements under wind loads are found to be within permissible limits, confirming adequate stiffness and stability of the structure. All structural members were designed based on critical load combinations and satisfy strength and serviceability requirements as per IS 456:2000.



The foundation design using STAAD Foundation shows that isolated footings are safe against bearing capacity failure and settlement. Overall, the analysis confirms that the structure is safe, stable, and efficiently designed, and demonstrates the effectiveness of STAAD Pro in structural analysis and design.

VII. CONCLUSION

The present study demonstrates the effectiveness of computer-aided tools in the structural analysis and design of a G+2 RCC residential building. The use of STAAD Pro significantly reduced computational effort and improved the accuracy of analysis compared to conventional manual methods. The structure was analyzed under dead, live, and wind loads as per IS 875, and all structural components were designed in accordance with IS 456:2000.

The results confirm that the building satisfies both Ultimate Limit State and Serviceability Limit State requirements, ensuring safety and structural stability. The use of STAAD Foundation further validated the adequacy of isolated footing design under given soil conditions. Architectural planning was carried out as per standard guidelines, ensuring efficient space utilization and functional design.

Overall, the study highlights that integration of software tools such as STAAD Pro, AutoCAD, and Excel provides a reliable, efficient, and accurate approach for the analysis, design, and estimation of residential buildings in compliance with Indian Standard codes.

REFERENCES

- [1]. K. Rama Raju, M.I. Shereef, Nagesh R Iyer and S. Gopalakrishnan;2013. "Analysis and Design of RC Tall Building Subjected to Wind and Earthquake Loads", The Eighth AsiaPacific Conference on Wind Engineering. 10(14): pp103-111.
- [2]. Borugadda Raju and Mr. R. Rattaiah; 2015. "Analysis and Design of High-Rise Building (G+30) Using STAAD.PRO", International Journal of Research Sciences and Advanced Engineering. 2(12): pp.50-54.
- [3]. Sreeshna K.S; 2016. "Analysis and Design of an Apartment building", International Journal of Innovative Science, Engineering & Technology.3(3): pp.456-479.
- [4]. Amar Hugar, Sharanabasappa M Pujari, Beerappa G Pujari, Anaveerappa N Biradar and Gajendra;2016. "Analysis and Design of a Commercial cum Residential Building by Using STAAD Pro", International Research Journal of Engineering and Technology. 3(6): pp.2797-2801.
- [5]. Bandipati Anup and Dr. Dumpa Venkateswarlu; 2016. "Comparison Between Manual Analysis and STAAD PRO. Analysis of Multi Storey Building", International Journal of Research Sciences and Advanced Engineering. 2(15): pp.216 – 224.
- [6]. Aman, Manjunath Nalwadgi, Vishal T and Gajendra; 2016. "Analysis and design of multistorey building by using STAAD Pro", International Research Journal of Engineering and Technology. 3(6): pp.1-7.

Code Books References

1. IS456-2000 code book for design of beams and columns and slabs.
2. IS 875-2000 part1-5 code book for different load calculations.
3. SP-16 For design of column

