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Original Article

A Review of Structural Design of G+1 Residential Building

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ABSTRACT

This project focuses on the comprehensive analysis and design of a G+1 residential building using STAAD.Pro software in accordance with Indian Standard Codes (IS:456-2000, IS:875-1987) [1]. The design process encompasses structural planning, load estimation, and the analysis and design of primary structural members such as beams, columns, slabs and foundations[2][5]. The report emphasizes structural safety, serviceability, and economy while achieving the intended functional and aesthetic requirements. Each component of the building has been analysed under various load conditions including dead loads, live loads, and wind loads[7]. The software-based approach ensures precise and efficient analysis and results in a design that is both structurally sound and cost-effective[3]. The project serves as a practical application of theoretical knowledge and offers insight into real-world construction practices.

Keywords: Footing Design, Slab Reinforcement, Column Detailing, Beam Design, Structural Planning, Drawing and Scheduling

INTRODUCTION

This project focuses on the analysis and design of a residentail building using STAAD.Pro, a widely used structural design software [6]. STAAD.Pro was selected due to its:

- User-friendly interface
- Compliance with Indian Standard Codes
- Versatile and accurate design capabilities

Structural Design Overview: Structural design combines art and science to create safe, economical, serviceable, and durable structures [4]. It requires creativity, sound engineering knowledge, familiarity with design codes, and practical experience. While architects typically handle aesthetics and functionality, structural engineers ensure safety, serviceability, and economy.

Stages of Structural Design:

1. Structural Planning
2. Load Computation
3. Structural Analysis
4. Member Design and Detailing
5. Drawing and Scheduling

STAAD.Pro: STAAD.Pro is a powerful tool developed for structural analysis and design. It supports various materials including concrete, steel, timber, and aluminum. Key components include:

- Graphical User Interface (GUI): Used for model creation, analysis setup, and result visualization.
- Design Engine: Performs structural calculations and checks against various codes.
- Documentation: Includes manuals for setup, commands, tutorials, technical theory, and release updates.

Key Manuals Provided:

- Getting Started Manual: Installation guide and basic program use.
- GUI Manual: Covers modeling, analysis, design, result verification, and reporting.
- Technical Reference: Explains underlying engineering theories and STAAD commands.
- Release Report: Highlights latest features and updates for user reference

DRAWING AND DETAILING

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

After the planning and detailed design of all the building's structural members, drawings of the necessary elements are prepared based on the analysis conducted during the design phase [8]. In the development of this project, priority will be given to the preparation of detailed drawings and documentation for all elements [10]. The following drawings and details of the building are provided below.

Fig 1: Ground Floor Plan

Fig 2: First Floor Plan

Table 1 Plinth Beam Reinforcement

Plinth Beam							
Beam Name	Beam Size	Top Reinforcement			Bottom Reinforcement		Stirrups
		Through	Left	Right	Through	Mid	
PB 1	300 X 400	3-12@	3-16@	3-16@	3-12@	3-12@	8@150mm c/c
PB 2	300 X 300	4-16@	4-16@	4-12@	4-10@	4-12@	8@120mm c/c
PB 3	200 X 400	5-12@	4-16@	4-16@	4-10@	4-10@	8@110mmc/c

Table 2 Ground Floor Beam Reinforcement

Ground Floor Beam							
Beam Name	Beam Size	Top Reinforcement			Bottom Reinforcement		Stirrups
		Through	Left	Right	Through	Mid	
GB 1	300 X 300	5-12@	3-16@	3-16@	4-10@	4-10@	8@150mmc/c
GB 2	300 X 300	4-12@	4-12@	4-10@	4-10@	4-12@	8@120mmc/c
GB 3	200 X 400	4-10@	3-16@	3-16@	3-12@	3-12@	8@110mmc/c

Table 3 First Floor Beam Reinforcement

First Floor Beam							
Beam Name	Beam Size	Top Reinforcement			Bottom Reinforcement		
		Through	Left	Right	Through	Mid	Stirrups
FB 1	300 X 300	3-12@	3-16@	3-16@	4-10@	4-10@	8@150mmc/c
FB 2	300 X 300	4-12@	4-12@	4-10@	4-10@	4-12@	8@120mmc/c
FB 3	200 X 400	5-12@	4-16@	4-16@	4-10@	4-10@	8@110mmc/c
FB 4	300 X 300	4-10@	3-12@	3-12@	3-12@	3-12@	8@150mmc/c

Table 4 Column Reinforcement

Column				
Column Nam	Column Size	Reinforcement		Stirrup
		Through	Mid	
C 1	300 X 300	4-16@	4-12@	8@150mmc/c
C 2	300 X 300	8-12@	8-10@	8@150mmc/c
C 3	300 X 300	4-20@	6-16@	8@150mmc/c
C 4	230 X 230	4-12@	4-10@	8@150mmc/c
C 5	450 X 300	8-16@	6-12@	8@150mmc/c

Table 5 Footing Reinforcement

Footing				
Footing Nam	Footing Dep	Footing Length	Reinforcement along Depth	Reinforcement along Length
F 1	1.43m	1.43m	φ 10 @110mm c/c	φ10 @110mm c/c
F 2	1.70m	1.70m	φ12 @130mm c/c	φ 12 @140mm c/c
F 3	2.00m	2.00m	φ16 @185mm c/c	φ 16 @170mm c/c

Table 6 Slab Reinforcement

Slab				
Slab	Type of slab	Depth	Reinforcement	
			Along shorter span	Along longer span
S1	Two way	120mm	10mm@150mmc/c	8mm@150mmc/c
S2	One way	110mm	8mm@150mmc/c	8mm@150mmc/c
S3	Catilever	120mm	8mm@150mmc/c	8mm@150mmc/c
S4	Cantilever	150mm	10mm@150mmc/c	8mm@150mmc/c

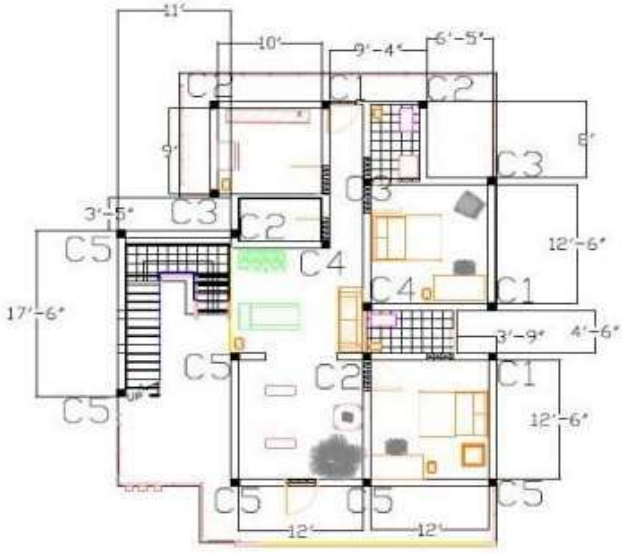

Fig 3: Column Detail Map

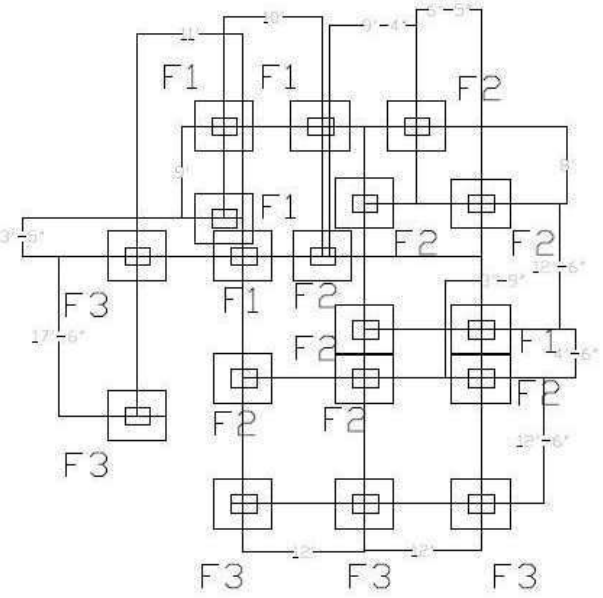

Fig 4: Footing Detail Map

CONCLUSION

The objective of this project was to plan and design a G+1 residential building using ETABS software. The project involved key structural design stages such as

load computation, member design, reinforcement detailing, and drawing preparation [12]. Structural planning included decisions on column placement, beam and slab layout, staircase design, and foundation selection. ETABS was chosen for its user-friendly interface, accuracy, versatility, and compliance with Indian Standard Codes. The design approach combined both engineering science and creativity to ensure a structure that is safe, durable, serviceable, and economical.

The methodology followed included:

- Structural Planning
- Load Calculations
- Structural Analysis
- Member Design and Detailing
- Drawing and Schedule Preparation

All steps were executed in accordance with relevant codes, standards, and expert guidance. The planning phase emphasized efficient structural layout to meet both functional and aesthetic requirements [11]. Overall, the project aimed to deliver a structurally sound and well-designed residential building.

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