



# “BIM-Based Structural Analysis and Design Using AutoCAD, Revit & ETABS”

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## Abstract

This study explores the integration of Building Information Modelling (BIM) and ETABS for the structural analysis and design of a mixed-use G+4 building with a cellar floor. The structure, located at Kalaburagi of plot size 120' x 80', is designed to accommodate both commercial and residential, along with common amenities. The cellar floor is designated for parking, serving residents and visitors. The ground floor houses 31 commercial shops suitable for retail, office, or showroom use. The first to third floors consist of six well-ventilated two-bedroom apartments per floor, designed for efficient spatial planning. The fourth floor is reserved for amenities, including a conference room and a gym. The methodology involves creating a 3D BIM model of a multistorey structure, exporting it to ETABS for analysis and design, and re-integrating the results for documentation and further detailing. This integrated workflow not only reduces time and cost but also facilitates better decision-making throughout the project lifecycle. The study shows the potential of BIM-ETABS synergy to transform traditional design practices into smarter, more efficient processes, ultimately contributing to the advancement of sustainable and resilient infrastructure.

Key Words: Architectural Planning, Structural Design, Revit, ETAB, AutoCAD, Analysis and Design etc....

## Introduction

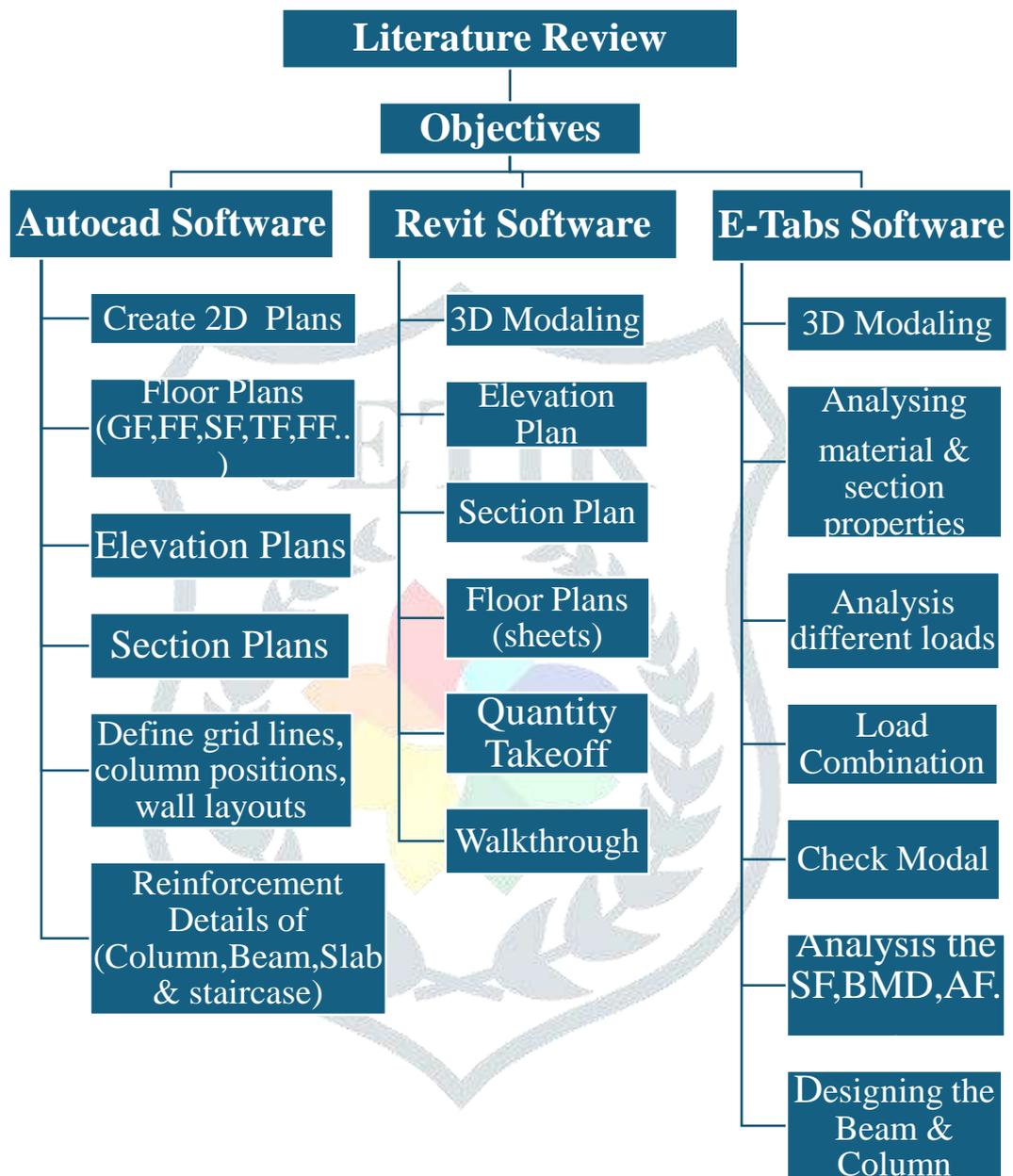
Due to rapid urbanization, overpopulation, and the rising cost of land, multi-storied buildings have become essential in metropolitan areas. They offer an efficient solution for accommodating both commercial and residential needs within limited land space. A multi-storied building increases usable floor area while minimizing the built-up footprint. Structural analysis plays a vital role in planning and designing such buildings to ensure safety, durability, and stability. Every project varies based of actors like load conditions, soil properties, and dynamic effects, which must be carefully considered during design.

This study focuses on the theoretical design of a G+4 mixed-use building constructed in accordance with IS 456:2000 using the limit state method. The structure sits on a 120' x 80' plot and includes:

- **Cellar Floor:** Dedicated for parking, serving both residents and commercial visitors.
- **Ground Floor:** Commercial space with 31 individual shops, suitable for retail, offices, or showrooms.
- **First to Third Floors:** Residential units, each floor consisting of six well-ventilated Two-BHK apartments.
- **Fourth Floor:** Amenity space including a conference room and a gym.

## Literature Review

Several studies have explored the integration of BIM and ETABS for effective structural design and analysis of multi-storey buildings. H. Mattern, M. Scheffer, and M. König focused on BIM-based Quantity Take-Off (QTO), emphasizing how BIM improves cost estimation by reducing errors and enabling automation when accurate modeling standards are met. Shivam Asawa studied the structural design of a G+5 residential building using ETABS and the Limit State Method, highlighting the identification and manual verification of critical structural elements like beams, columns, and slabs. Basavaraj R., Rajini Umaphathi, and Dr. P. Shiva Keshava analyzed and designed a G+4 commercial structure using ETABS, covering load calculations, 3D modeling, and RCC component detailing, and concluded the software is effective even for G+10 designs. Mohamed Shajahan and Kumaran examined multi-storey building behaviour under different load cases—gravity, lateral, serviceability, and ultimate—using ETABS, confirming the software's ability to ensure structural safety under all conditions. Lastly, Gayathri R., Harshitha, and Dr. T. S. Malleshiah studied a G+4 building in seismic Zone II with medium soil, using ETABS to model and size structural members, proving the software's efficiency over manual methods in delivering safe, serviceable, and economical designs. Together, these studies showcase how BIM and ETABS significantly improve the accuracy, reliability, and productivity of structural analysis and design in modern construction practices.



## Methodology

Fig:1-Methodology Flow Chart

### Geometrical Details:

Type of the project = Commercial Building - Apartment

Location = Kalburgi, Karnataka.

Type of Slab = One way slab and Two-way slab

Total Built-up Area = 9600 sq. ft (assumed 120' x 80')

Method of Analysis = Static Analysis (Linear)

The material is used for construction is reinforced concrete with M-25 grade of concrete and Fe-500 grades of steel.

### Material Properties of the structure:

Number of stories = G+4

Total Height of Building = 65'

Live Load = 2 KN/m and Floor load 1.5 KN/m

Dead Load = Self -weight of members and Wall load W1(9") = 13.11KN/m,

W2(6") = 8.55 KN/m and W3(4") = 5.70 KN/m

Table No: 1 Section Properties of structure

Sl. No	Members	Dimensions
1	Column	C1 (1' x 2') C2(9" x 1'3")
2	Beam	B1(9"x1'6") B2(9"x 2')
3	Slab	5"
4	Footing	F1(6'5"X8'2"X2'8") F2 (8'8"X9'8"X3'2") F3 (9'8"X11'4"X3'2")

Fig: 2- Typical Floor Plans

Autodesk Revit is a building information modelling software tool developed by Autodesk. for architects, landscape architects, structural engineers, mechanical, electrical, and plumbing (MEP) engineers, designers and contractors. The software allows users to design a building and structure and its components in 3D, annotate the model with 2D drafting elements, and access building information from the building model's database.

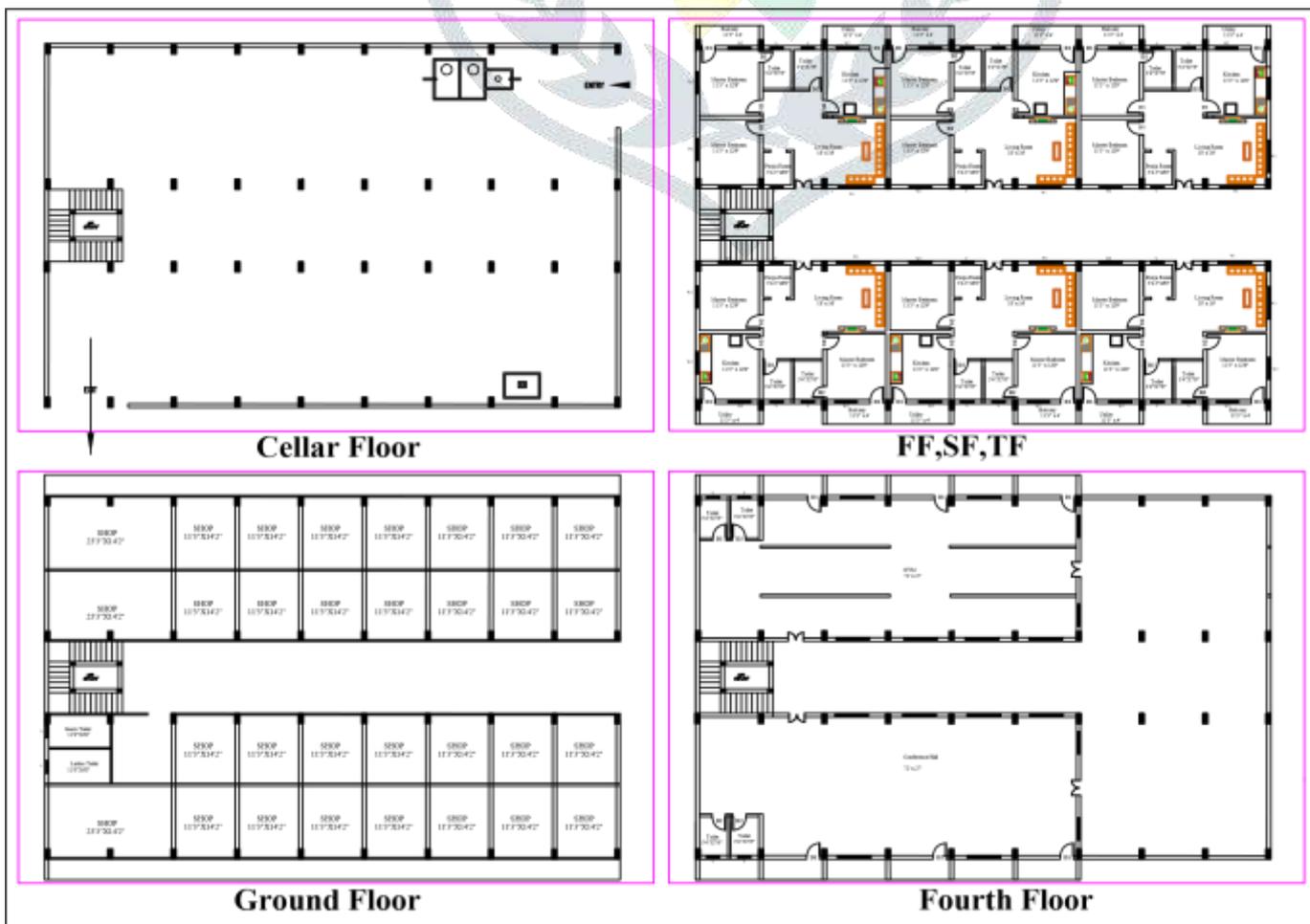




Fig: 3- Showing the Front Elevation, Section Elevation and 3D model in REVIT

### Results and Discussion using E-Tabs

Analysis and design of G+4 multi story building with a cellar floor is carried out in ETABS software which is located at Kalaburagi of plot size 120' x 80'. This building is subjected to DL, LL, WL, and FF. After analysis the following results were drawn.

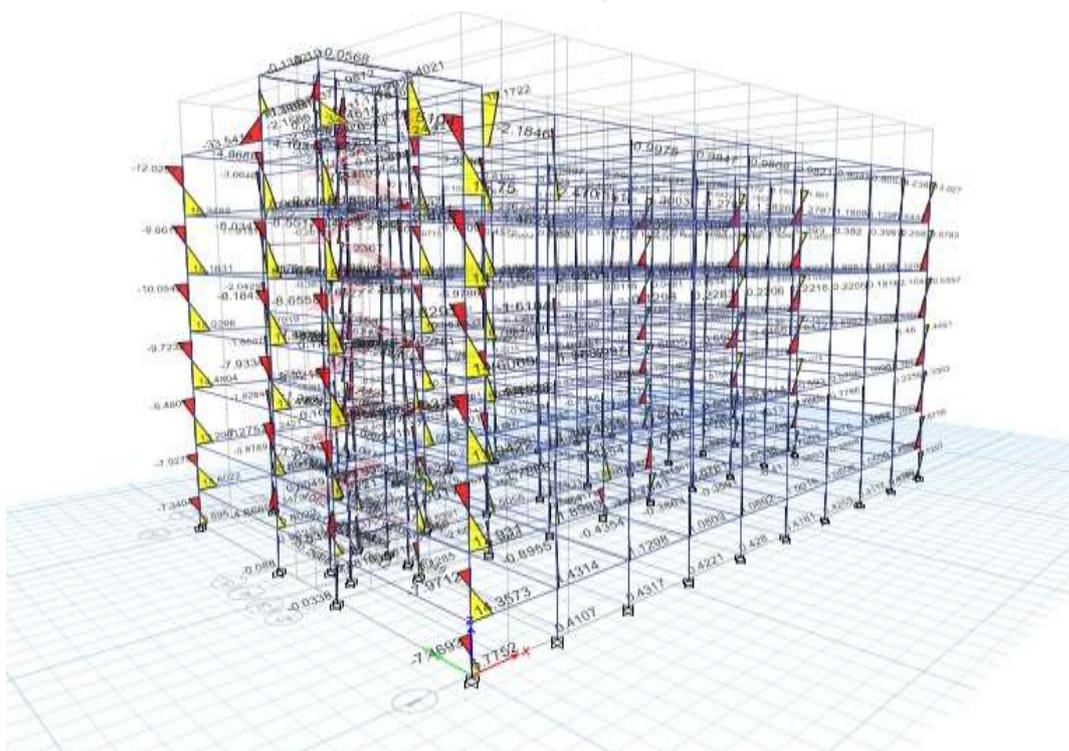


Fig: 4-Bending Moment Diagram after analysis in ETABS

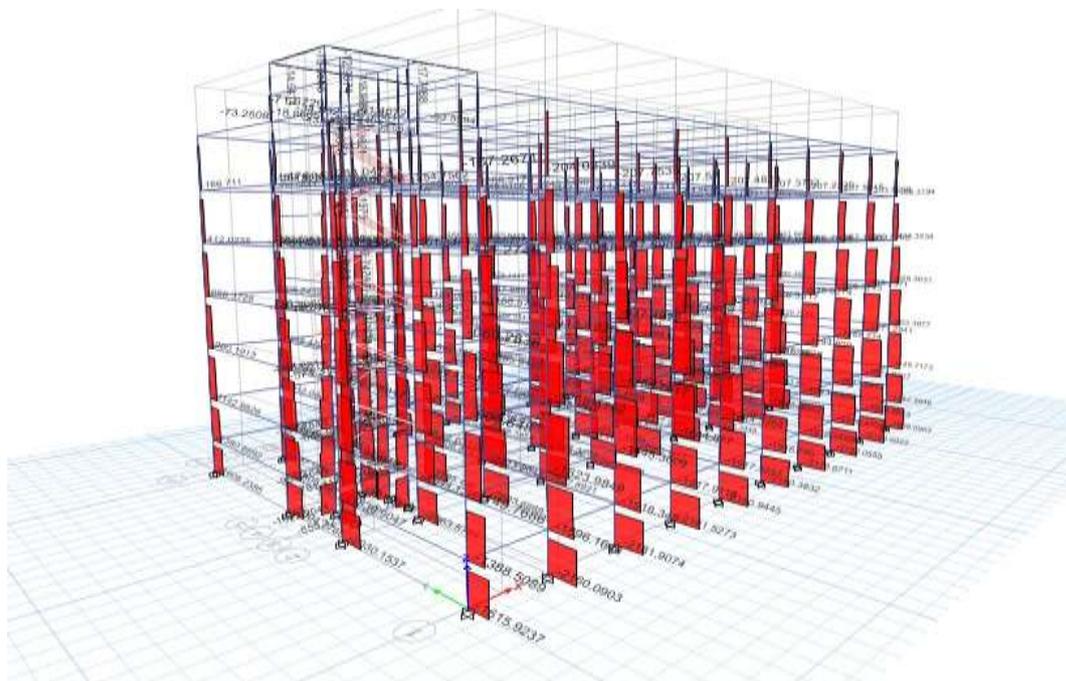


Fig: 5-Axial Force Diagram after analysis in ETABS

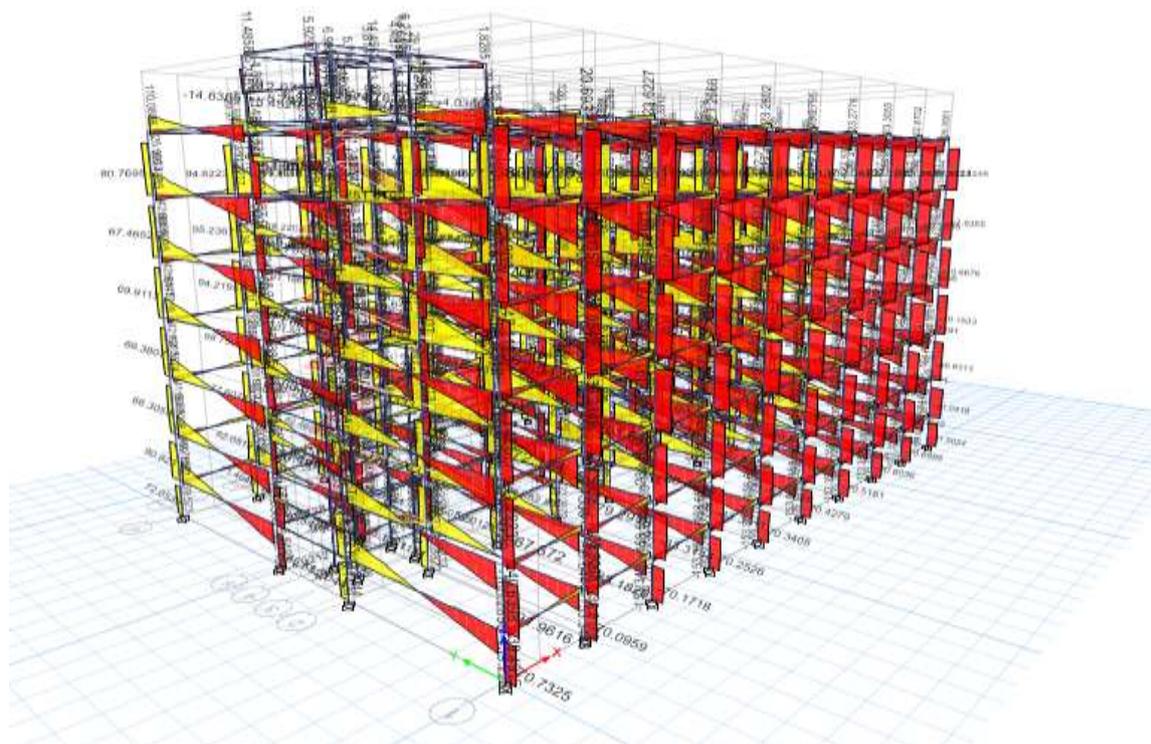


Fig: 6-Shear Force Diagram after analysis in ETABS

Table No: 2 Support reactions obtained from ETAB

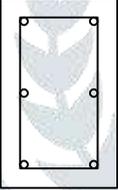
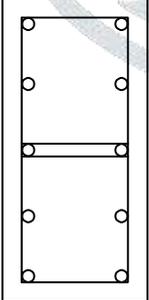
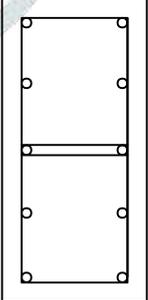
Reactions			
Group No.	FZ	MX	MY
	kN	kN-m	kN-m
1	1022.2041	-0.2695	2.9943
2	1935.3685	-46.3745	1.3596
3	2660.149	32.9641	-4.5999

## Reinforcement Detailing

Table No: 3 Footing Reinforcement Details

Footing Reinforcement Details		
Footing No.	Size Of Footing	Reinforcement Details
F1	6'5"X8'2"X2'8"	10mm # @ 150mmc/C In Both Direction
F2	8'8"X9'8"X3'2"	10mm # @ 150mmc/C In Both Direction
F3	9'8"X11'4"X3'2"	10mm # @ 150mmc/C In Both Direction

Table No: 4 Column Reinforcement Details

COLUMN REINFORCEMENT DETAILS			
COLUMN NO	SIZE OF COLUMN	REINFORCEMENT DETAILS UPTO FF	REINFORCEMENT DETAILS SF TO HR
C2	9"X14'7"	 <p>6NO'S OF 16MM DIA 2L</p>	 <p>6NO'S OF 12MM DIA 2L</p>
C1	12"X24"	 <p>12NO'S OF 25MM DIA 4L</p>	 <p>12NO'S OF 20MM DIA 4L</p>

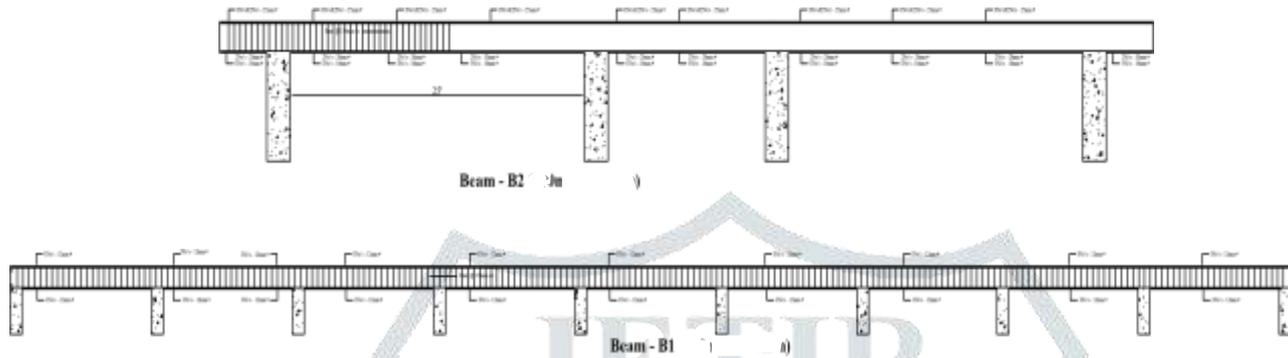
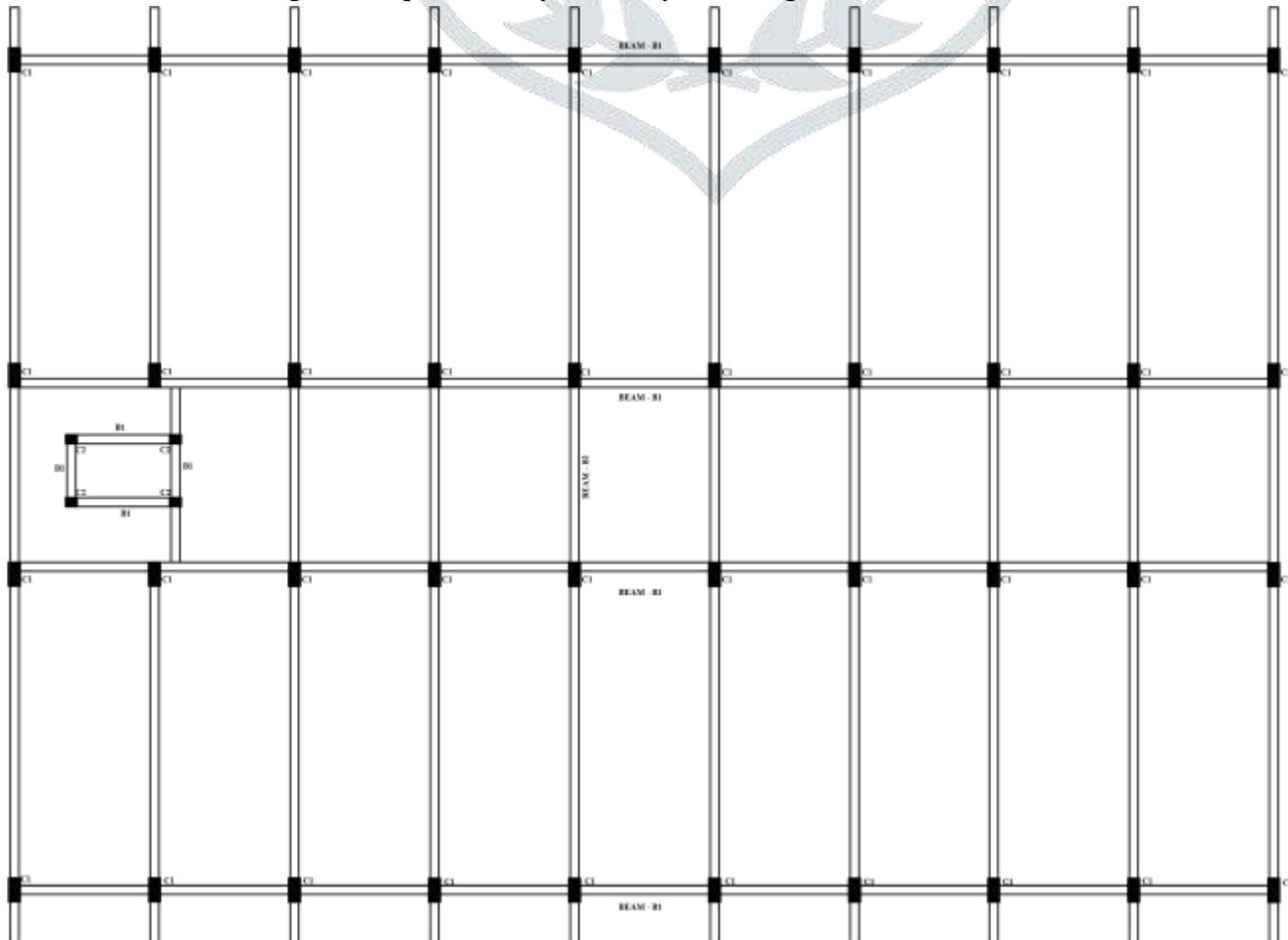


Fig.7- Typical Ground to Fourth Floor Beam Layout & Reinforcement Details

## Conclusion

This study comprehensively covers the structural and architectural planning of a G+4 mixed-use building by adopting a Building Information Modeling (BIM)-integrated workflow.

1. 2D Floor Plans, Elevations, and Sections were meticulously developed to represent spatial arrangements and ensure functional clarity for both residential and commercial components.
2. A detailed 3D model was created using BIM tools, providing enhanced visualization and facilitating better stakeholder communication, coordination.
3. Structural design was optimized by carefully selecting beam and column dimensions, reinforcement



ratios, and material specifications to ensure both economy and safety in accordance with IS 456:2000.

4. Reinforcement detailing for structural elements like beams, footing, and columns were drawn in AutoCAD

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