COMPHENSIVE DESIGN OF A GUEST HOUSE: AN INTEGRATED APPROACH USING BUILDING INFORMATION MODELING

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B.P. MANDAL COLLEGE OF ENGINEERING MADHEPURA - 852113

MAY - 2025

COMPHENSIVE DESIGN OF A GUEST HOUSE: AN INTEGRATED APPROACH USING BUILDING INFORMATION MODELING

A dissertation submitted in partial fulfilment of the requirements for the award of degree of

BACHELOR OF TECHNOLOGY

in

CIVIL ENGINEERING

Submitted by

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CERTIFICATE

This is to certify that the dissertation titled **"Comprehensive design of a guest house: An integrated approach using Building Information Modeling"** which is being submitted by Md Irshad (Registration No: 21101128043) , Mohit Chandra (Registration No: 21101128044), Akanksha kumari (Registration No: 21101128041), Prem Sagar (Registration No: 21101128001) and Kanhaiya Kumar Jha (Registration No: 21101128053) for the partial fulfillment of the requirements for the award of degree of Bachelor of Technology (B. Tech.) in Civil Engineering Department is a record of the student's own work carried out at Department of civil Engineering, B.P. Mandal College of Engineering Madhepura, Bihar, under my supervision and guidance. The matter embodied in this thesis has not been submitted elsewhere for the award of any other degree or diploma.

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DECLARATION

I certify that the work contained in this thesis is original and has been done by myself under the general supervision of my supervisors. The work has not been submitted to any other Institute for degree for diploma. I have followed the Institute norms and guidelines and abide by the regulation as given in the Ethical Code of Conduct of the Institute. Whenever I have used materials (data, theory and text) from other sources, I have given due credit to them by citing them in the text of the thesis and giving their details the reference section.

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ABSTRACT

This project presents a comprehensive approach to the planning, design, analysis, and visualization of a guest house building using the latest Building Information Modelling (BIM) tools. The aim was to create a fully functional and cost-effective building design that integrates architectural, structural, and aesthetic elements in a digital environment. The building was proposed on a plot measuring 92 ft × 76 ft, with a built-up area of 50 ft × 40 ft, designed to accommodate approximately 30 people.

The workflow began with 2D planning using AutoCAD, followed by 3D modelling in Revit, where architectural and structural elements were defined in detail. Structural analysis was performed using STAAD.Pro, which confirmed the safety of the building under various load combinations. Based on the analysis results, a detailed Bar Bending Schedule (BBS) was prepared for reinforcement detailing. For interior design and realistic visualization, SketchUp and Twinmotion were used, providing lifelike renderings and walkthroughs. A detailed cost estimation was carried out, with the total construction cost calculated at approximately ₹1.08 Crore. Additionally, Primavera was used to prepare a construction schedule with time-bound planning.

The integration of these tools demonstrated the efficiency and accuracy of BIM in handling complex design and construction processes. The project successfully achieved a structurally sound, visually appealing, and cost-effective guest house design, meeting both functional and aesthetic goals.

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CHAPTER – 1

Introduction

Structural planning and design require a blend of imagination, conceptual thinking, and a sound understanding of structural engineering principles, recent design codes, and construction standards. It also demands intuition, proper judgment, and a systematic approach to project execution. This study focuses on the comprehensive design and planning of a G+2 guest house, integrating multiple software tools to ensure accuracy, efficiency, and cost-effectiveness.

The development of any construction project begins with layout planning, followed by design, structural analysis, cost estimation, and project scheduling. The layout planning aspect is a crucial part of urban development, which includes the organization of residential and commercial spaces, essential infrastructure such as roads, water distribution systems, sewerage networks, stormwater drains, and other amenities like schools and healthcare centers.

This project involves the design, modeling, estimation, and scheduling of a G+2 guest house, utilizing advanced software tools to enhance precision and efficiency. The scope includes:

Architectural Planning using AutoCAD: AutoCAD is employed to create precise 2D floor plans and structural layouts, ensuring functional and space-efficient designs.

3D Modeling using Revit: Revit is used for building information modeling (BIM), providing realistic 3D visualizations and integrating structural and architectural elements seamlessly.

Interior Design using SketchUp: SketchUp is utilized to design and visualize interior spaces, focusing on aesthetics, furniture placement, and spatial harmony.

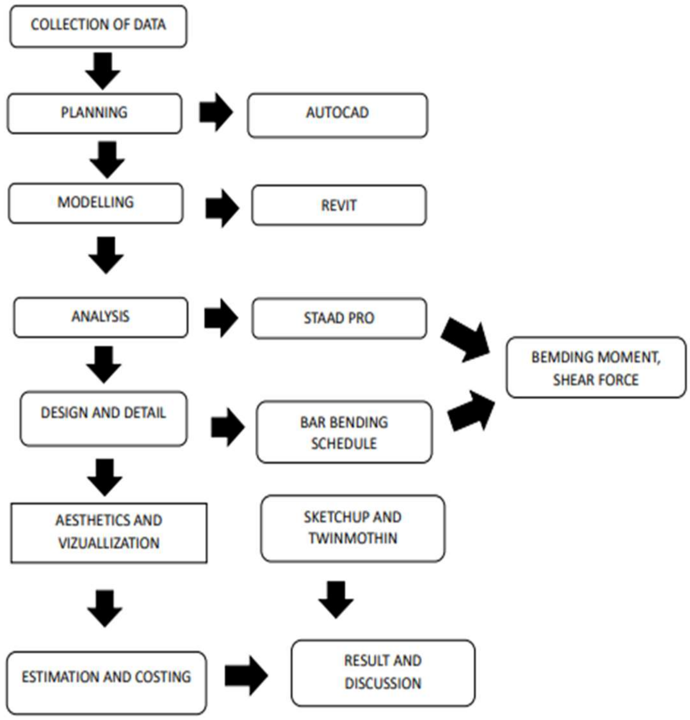
Project Scheduling and Cost Estimation using Primavera: Primavera helps in project management by scheduling tasks, tracking progress, allocating resources efficiently, and estimating the overall project cost.

The estimation phase includes calculating material quantities, labor requirements, and cost analysis to determine the total project budget before execution. The integrated approach of using multiple software tools ensures that every stage of the project, from design conceptualization to execution planning, is well-coordinated and optimized. This methodology enhances accuracy, reduces errors, and improves overall project efficiency.

Thus, this study aims to provide a comprehensive approach to guest house design .

1.1 Methodology Workflow

The methodology adopted for this project follows a systematic and software-integrated approach based on Building Information Modelling (BIM). The entire process was carried out in well-defined stages, with each step corresponding to a specific software tool for efficient planning, design, analysis, detailing, and visualization.



1.2 AutoCAD

Autodesk's AutoCAD, a leading CAD software since 1982, is pivotal for architectural, structural, and engineering planning. For this G+2 guest house project, AutoCAD facilitates precise 2D/3D architectural layouts, elevations, sections, and crucial structural detailing like beam, column, and foundation plans. Its dimensioning and annotation tools ensure clarity. Utilizing AutoCAD enhances precision, minimizes errors, and boosts efficiency in planning and execution. This digital approach improves decision-making and coordination, establishing a robust foundation for subsequent project stages like structural modeling and cost estimation, ensuring accurate design implementation by all stakeholders.

1.3 Revit

Autodesk Revit is a powerful BIM software used by architects, engineers, and construction professionals to design, model, and document buildings in 3D. Unlike traditional CAD tools, Revit uses intelligent parametric objects, allowing real-time updates across all views when changes are made. This enhances accuracy, coordination, and efficiency. It supports collaborative workflows through a central model, enabling multiple users from different disciplines to work together seamlessly. Revit combines tools for architecture, structure, and MEP (mechanical, electrical, plumbing) into a single application, fostering an integrated design.

1.4 STAADPro

STAADPro is a widely used structural analysis and design software developed by Bentley Systems. It allows civil and structural engineers to analyze and design structures such as buildings, bridges, towers, and dams. STAADPro supports a variety of materials including steel, concrete, timber, and aluminum, and complies with numerous international design codes. The software enables users to model complex structures in 3D, apply loads, perform structural analysis, and generate detailed design reports. With features like finite element analysis, dynamic analysis, and integration with BIM workflows, STAADPro enhances accuracy, reduces design time, and improves collaboration across engineering teams.

1.5 Microsoft Excel

Microsoft Excel is a powerful spreadsheet software developed by Microsoft, widely used for data organization, analysis, and visualization. It allows users to create and manage tables, perform complex calculations using built-in formulas and functions, and generate charts and graphs for data presentation. Excel is essential in fields like finance, engineering, education, and business for tasks such as budgeting, forecasting, data analysis, and reporting. Features like pivot tables, conditional formatting, and data filtering enhance productivity and decision-making. With support for automation through macros and integration with other Microsoft Office tools, Excel remains a versatile and indispensable tool for professionals and students alike.

1.6 SketchUP

SketchUp is a 3D modeling software widely used in architecture, interior design, engineering, construction, and game design. Known for its intuitive interface and ease of use, SketchUp allows users to create detailed 3D models quickly and efficiently. It supports a range of design processes, from conceptual sketches to detailed construction documentation. Users can also access an extensive library of pre-built models through the 3D Warehouse. With features like layout tools, real-time rendering extensions, and compatibility with other design software, SketchUp is ideal for visualizing ideas, presenting concepts, and collaborating on design projects in both professional and educational settings.

1.7 Twinmotion

Twinmotion is a real-time 3D visualization software developed by Epic Games, designed for architects, urban planners, and designers. It enables users to create high-quality images, panoramas, animations, and immersive VR experiences from 3D models with ease. Compatible with major design tools like Revit, SketchUp, and ArchiCAD, Twinmotion offers a user-friendly interface and drag-and-drop functionality. It features a vast library of materials, objects, and environmental settings to enhance realism. With real-time rendering, dynamic lighting, and weather effects, Twinmotion helps professionals bring their designs to life quickly, making it ideal for presentations, client reviews, and design iterations in architecture and construction projects.

1.7 Primavera

Primavera is a project management software developed by Oracle, widely used in construction, engineering, and large-scale project industries. It offers powerful tools for planning, scheduling, resource management, and risk analysis. Primavera enables project managers to break down complex projects into manageable tasks, assign resources, track progress, and control costs. Known for handling large, multi-project environments, it supports collaboration among teams and integrates with other enterprise systems. With features like critical path analysis, Gantt charts, and real-time reporting, Primavera enhances decision-making and helps ensure projects are delivered on time and within budget, making it essential for effective project lifecycle management.

CHAPTER – 2

Literature Review :

Building Information Modelling (BIM) has emerged as a revolutionary technology in the field of architecture, engineering, and construction (AEC). It enables the integration of multiple aspects of a building's lifecycle—from conceptual planning to structural analysis, cost estimation, scheduling, and visualization—into a single, coordinated digital model.

Several studies have highlighted the advantages of BIM over traditional 2D methods. According to Eastman et al. (2011), BIM enhances collaboration among stakeholders, improves accuracy in design, and reduces errors during construction. It allows real-time updates and change management, which are difficult to achieve in conventional CAD systems. In this project, AutoCAD was used to develop the initial 2D planning layout, while Revit provided a detailed 3D architectural and structural model. Literature by Azhar (2011) supports the use of Revit for improved design coordination, especially in multidisciplinary projects.

In terms of structural analysis, tools like STAAD.Pro are widely used in the industry for determining the safety and stability of structures. Researchers have validated its accuracy for analysing complex load combinations and generating structural outputs such as bending moments and shear forces. This aligns with the structural analysis carried out in this project.

For reinforcement detailing, the Bar Bending Schedule (BBS) plays a crucial role in providing cutting lengths, bar shapes, and steel quantities. Studies show that a properly prepared BBS reduces material waste and helps in accurate procurement and execution on site.

Visual representation is another important aspect of modern construction. The use of SketchUp and Twinmotion for interior modelling and visualization is supported by recent literature as an effective way to improve client understanding and decision-making. According to Jernigan (2007), real-time rendering tools significantly enhance project presentations and stakeholder communication.

Primavera, used for construction scheduling, is also well-documented in project management literature. It enables the creation of Work Breakdown Structures (WBS), resource allocation, and progress tracking, making it an essential tool for timely project delivery.

Cost estimation, being a vital part of project feasibility, is better handled when integrated with BIM. Various researchers have shown that BIM-based quantity take-off and cost estimation are more accurate and less time-consuming compared to manual methods.

In summary, the literature strongly supports the combined use of BIM tools like AutoCAD, Revit, STAAD.Pro, SketchUp, Twinmotion, and Primavera to achieve a holistic, efficient, and coordinated building design. This project adopts this multi-software approach and demonstrates the practical implementation of BIM in the comprehensive design of a guest house.

CHAPTER – 3

METHODOLOGY

3.1 PLANNING :

Plan refers to a 2D top-view drawing that represents the layout of a building or structure. It includes the arrangement of rooms, walls, doors, windows, staircases, and other architectural or structural elements.

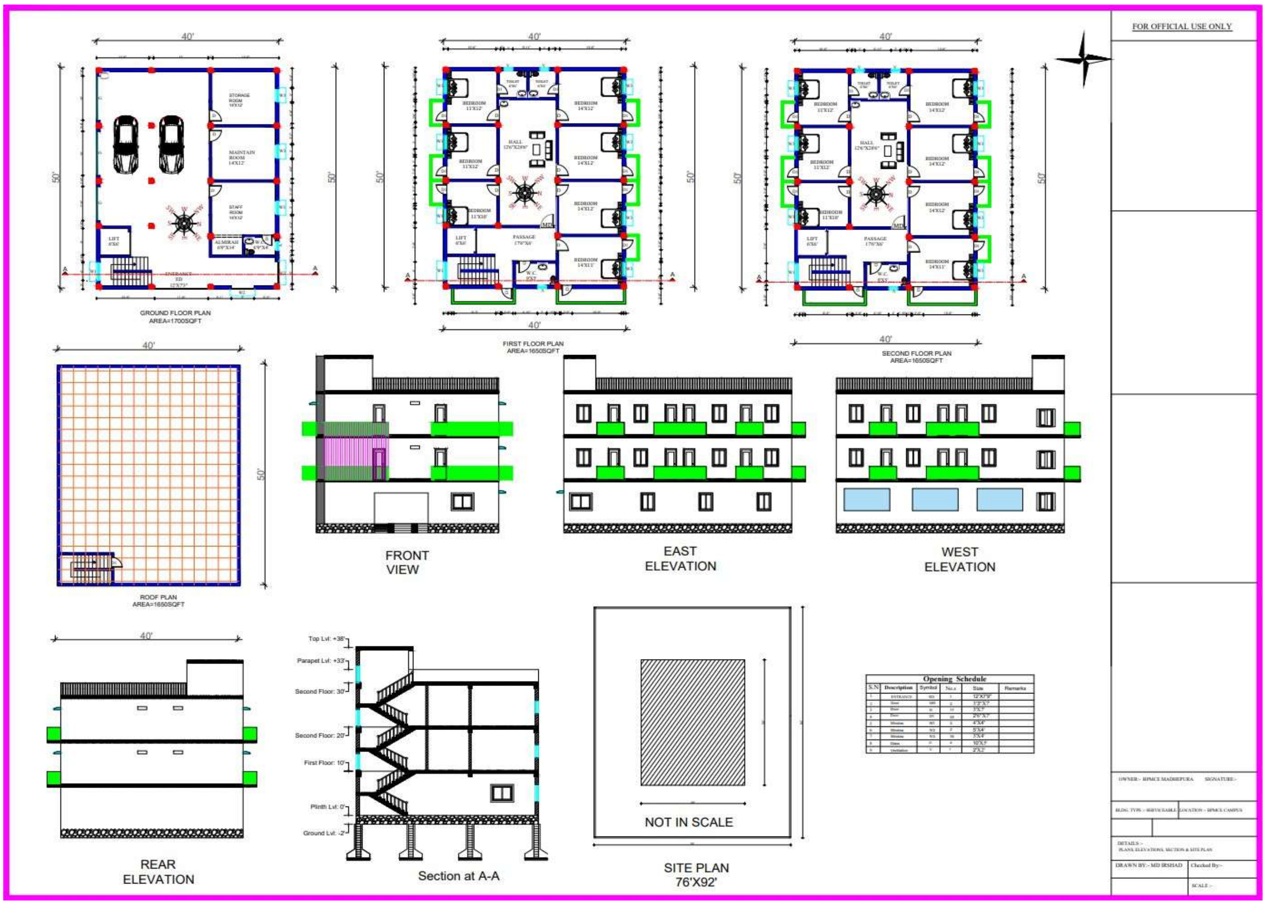


Fig.1(a)

3.1.1 Ground floor plan

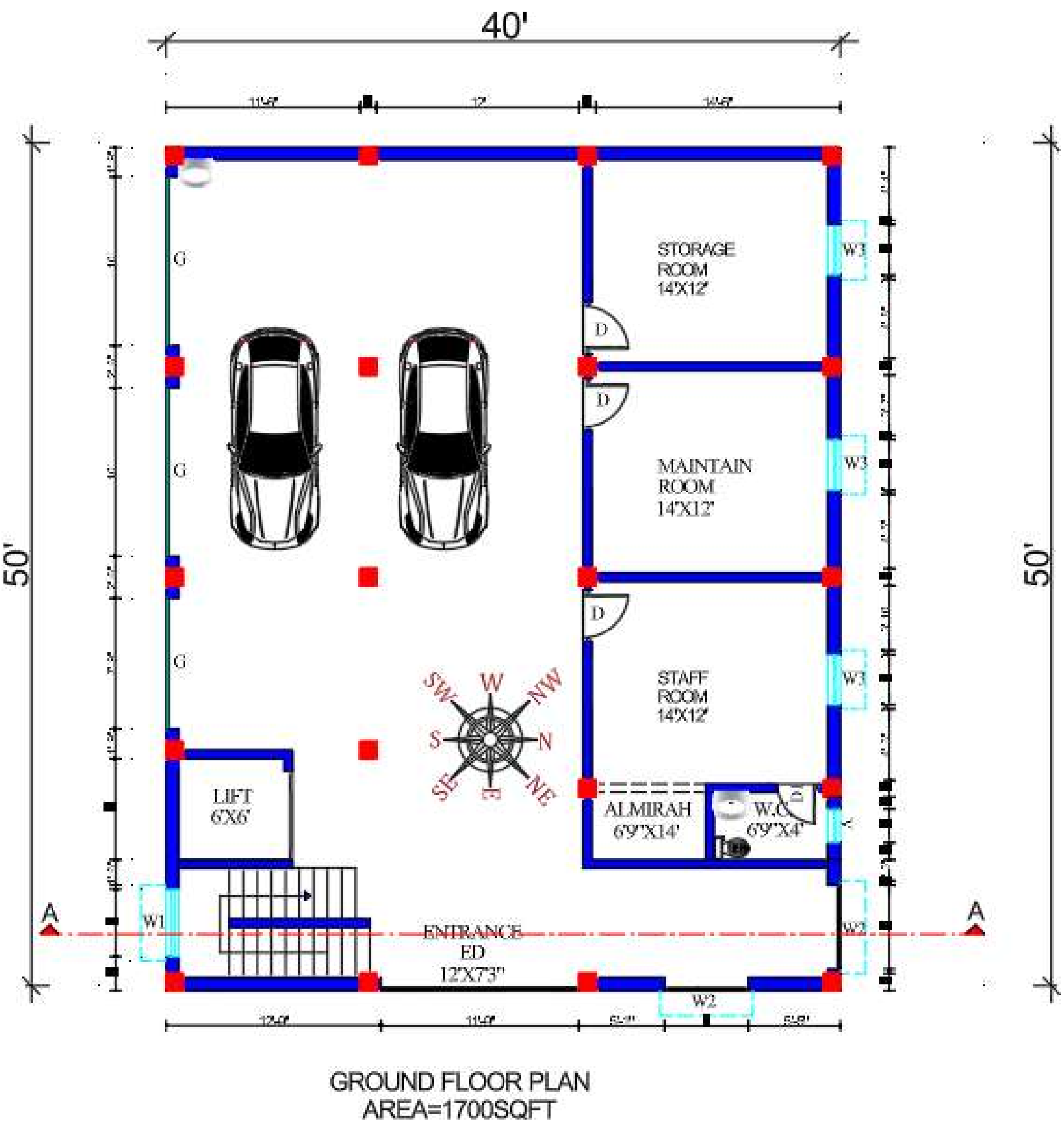


Fig.1(b)

Specification :

- Parking area
- Staff room
- Maintenance room
- Storage room

3.1.2 First floor plan

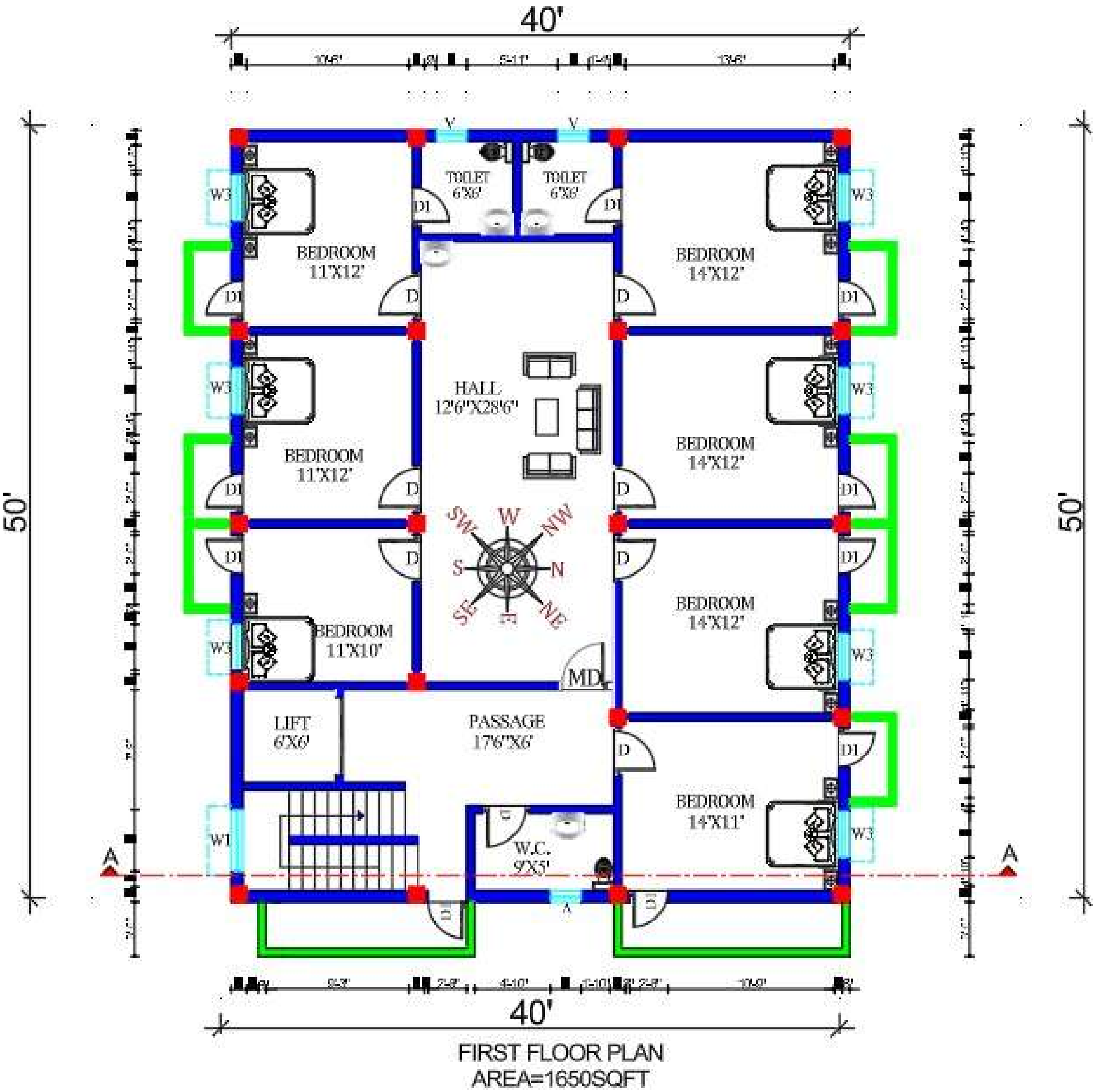


Fig.1(c)

Specification :

- 7 Bedroom
- A big size Hall

3.1.3 Second floor plan

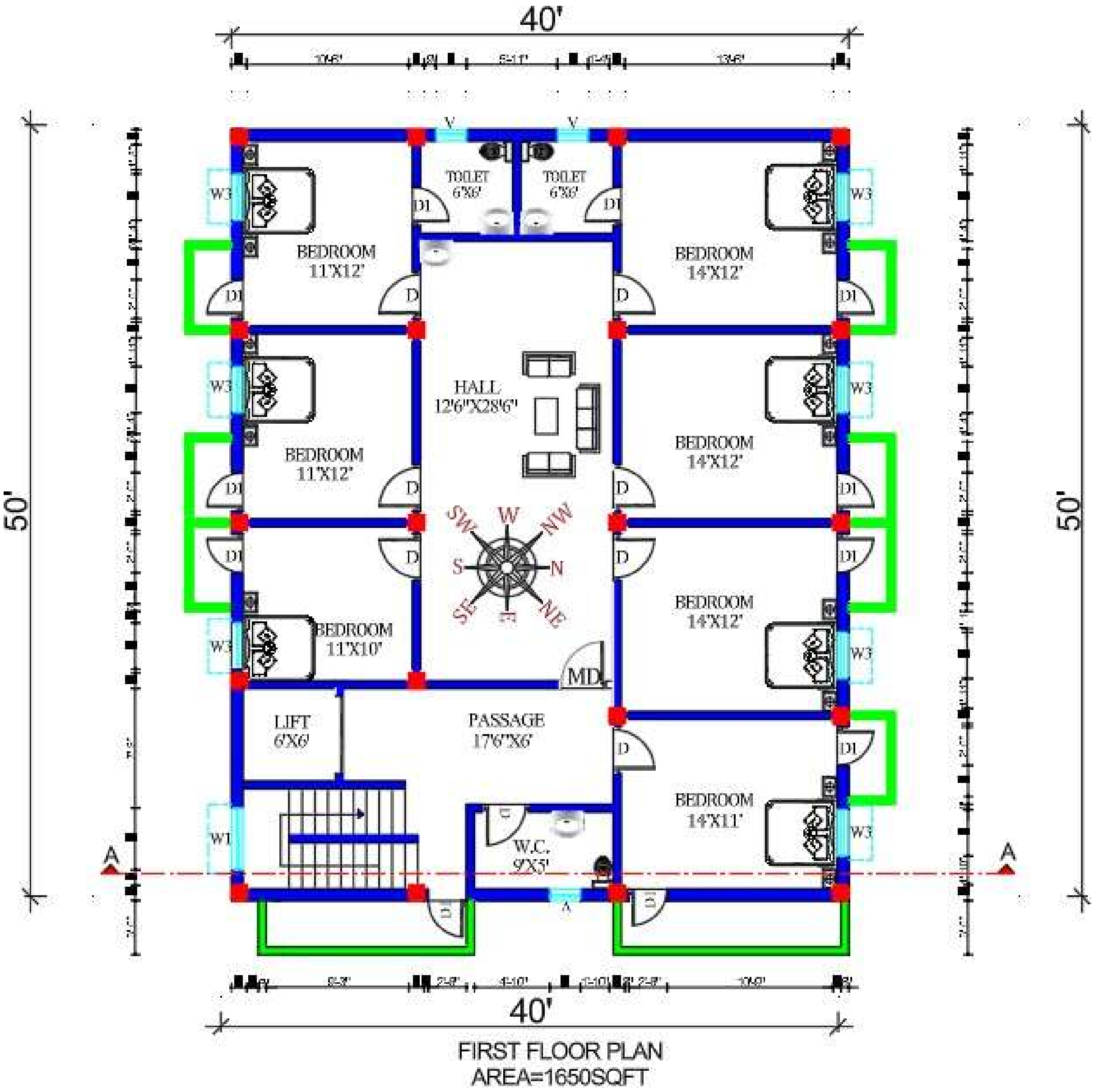


Fig.1(d)

Specification :

- 7 Bedroom
- A big size Hall
- Attached balcony

3.1.4 Elevation

3.1.4 (a) Front Elevation

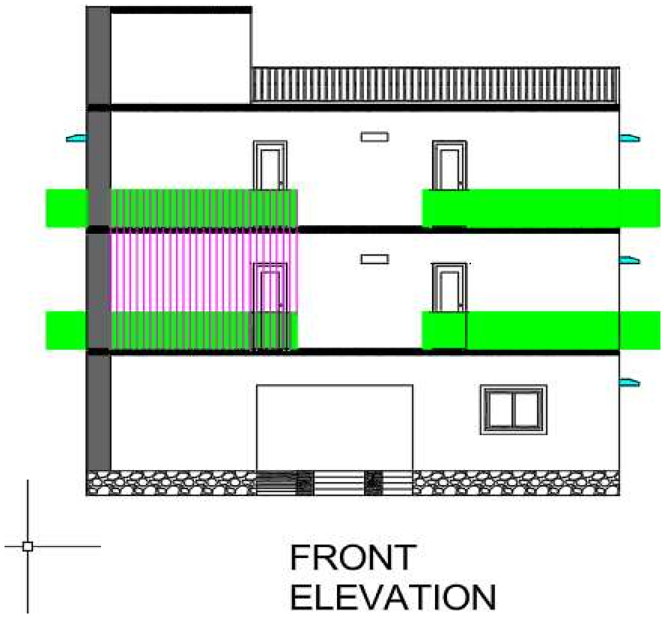


Fig.1(e)

3.1.4 (b) Rear Elevation

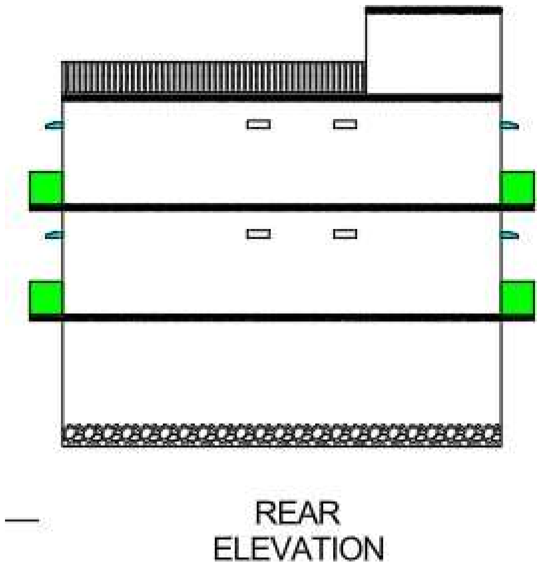


Fig.1(f)

3.1.4 (c) East Elevation

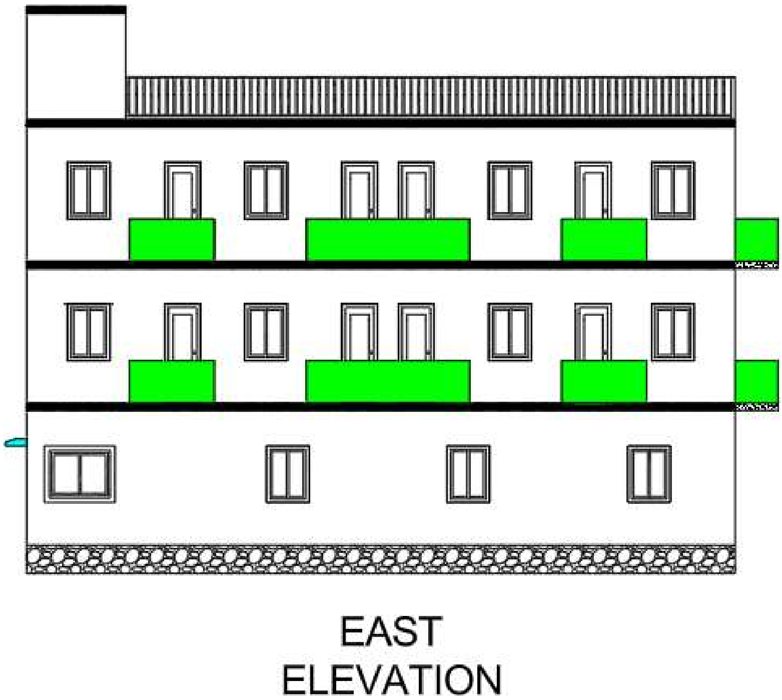


Fig.1(g)

3.1.4 (d) West Elevation

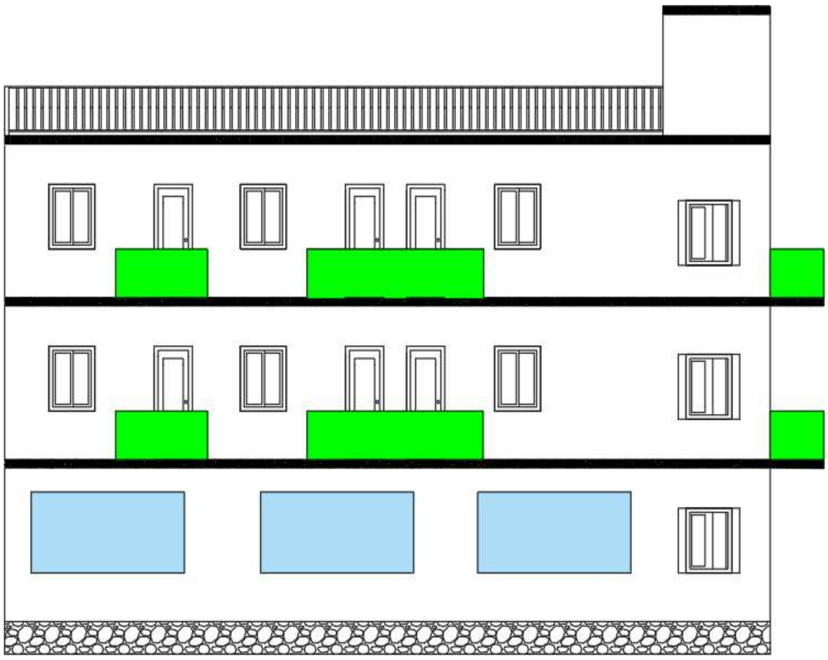


Fig.1(h)

3.1.5 Section at A-A

A Section Plan A-A in AutoCAD is a cut-through view of a building or structure along a specific vertical or horizontal plane, labeled as "A-A" for identification. It shows the internal components of the design, including walls, floors, ceilings, staircases, doors, and structural elements such as beams and columns.

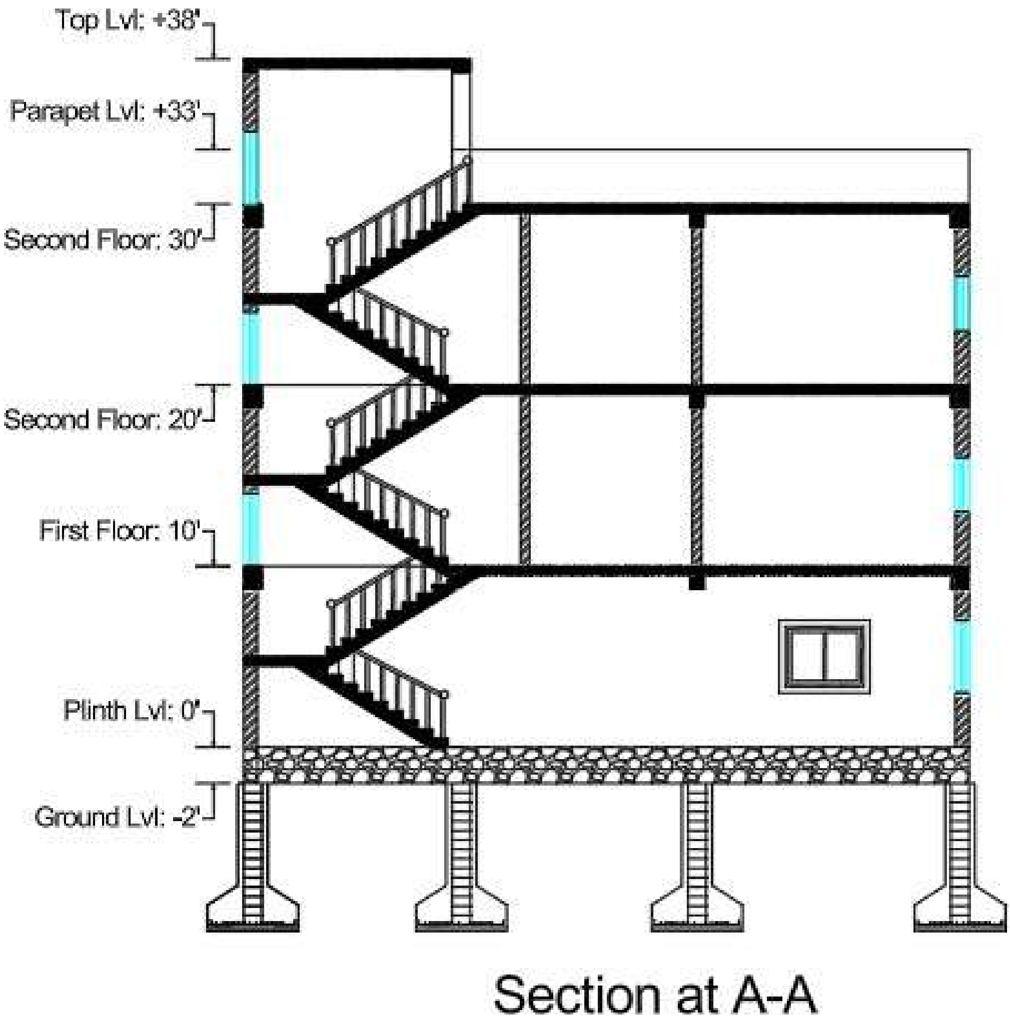


Fig.1(i)

3.1.6 Representation of structural members

3.1.6 (a) Column layout

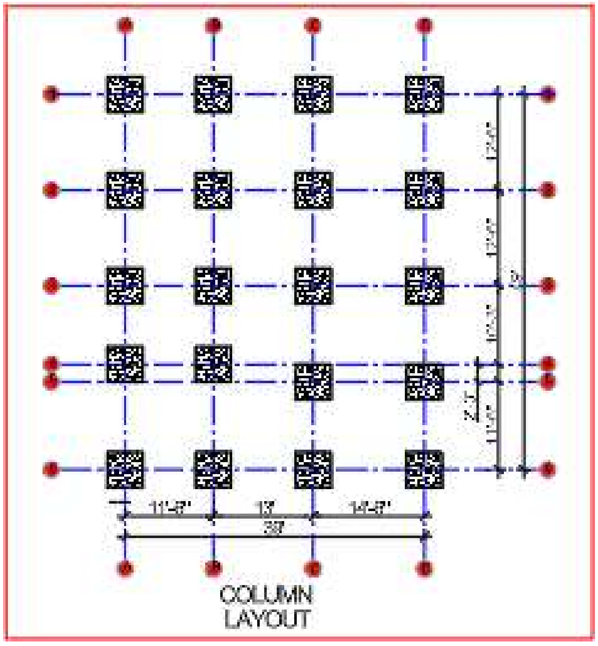
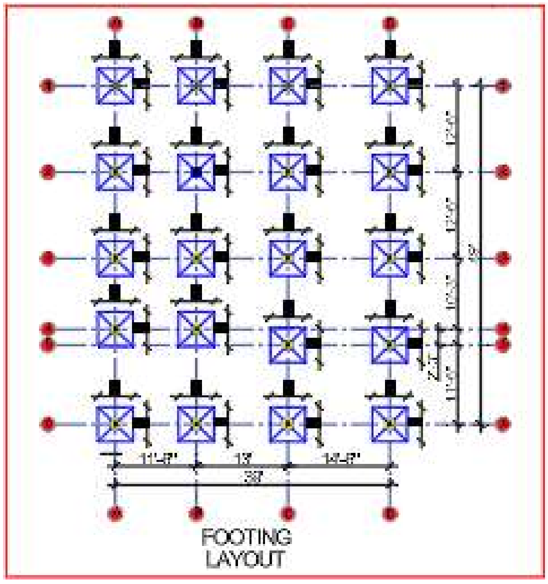


Fig.1(j)

3.1.6 (b) Footing layout

It consist of the placement of beam and distance of the one beam to another beam.

Fig.1(k)



3.1.7 Working plan

It consist of the placement of beam and distance of the one beam to another beam.

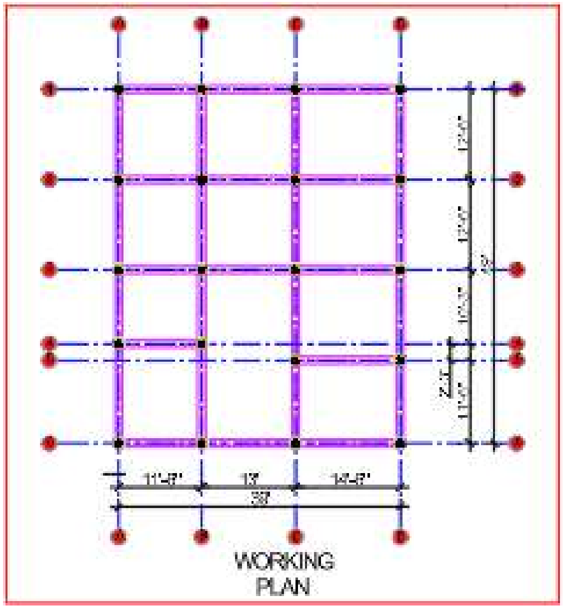
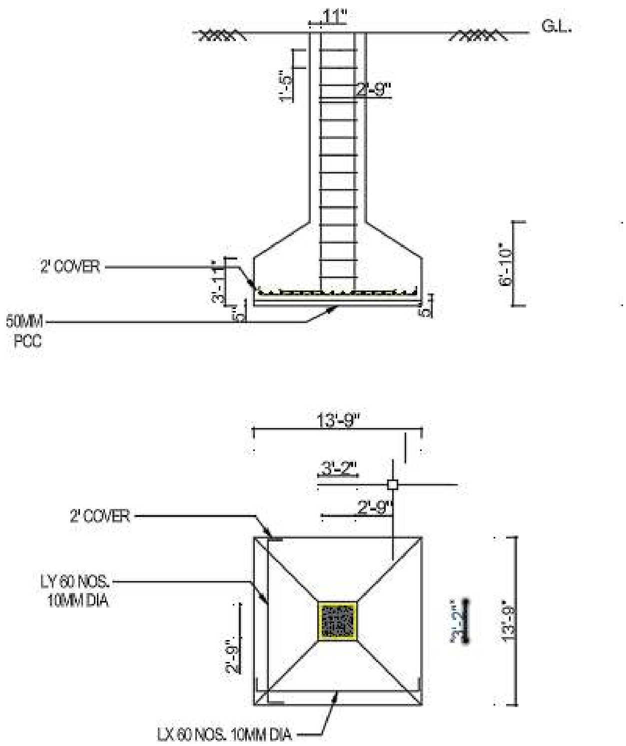


Fig.1(l)

3.1.8 Footing details

It consist the detail of the footing (cover, dia, Pcc).



3.2 3D MODELING USING REVIT :

3.2.1 Creating a 3D model in Revit involves a structured process, starting from setting up your project to refining the details. Here's a step-by-step breakdown:

Project Setup:

- Launch Revit: Open the Revit software.
- Create a New Project:
- Go to "Files" > "New" > "Project."
- Choose a project template. Templates provide predefined settings, views, and families (components).
- Select a template appropriate for your project (e.g., Architectural, Structural, Mechanical).
- Click "OK."

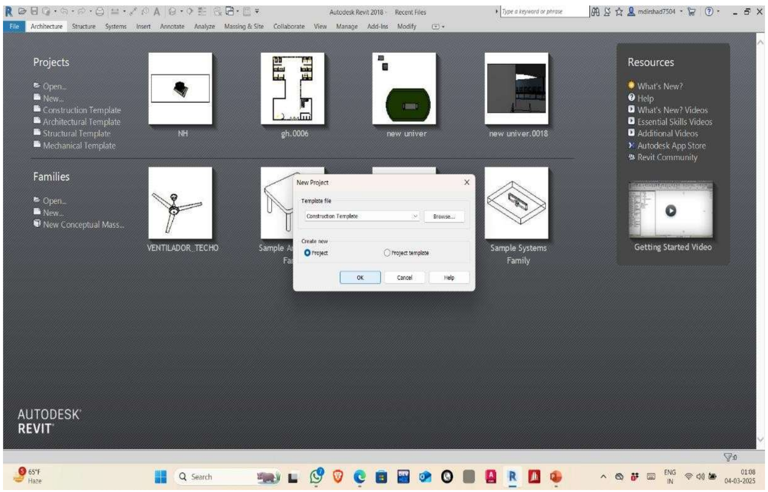


Fig. no. 2a

- Set Project Units:
- Go to "Manage" > "Project Units."
- Set the desired units for length, area, volume, etc. (e.g., meters, millimeters, feet inches).
- Click "OK."

Establish Levels and Grids:

- Levels: Levels represent vertical planes, typically floors or other significant heights.
- In an elevation view (e.g., East, North), use the "Level" tool (Architecture tab >
- Datum panel > Level).
- Create and adjust levels as needed.
- Grids: Grids define the structural or organizational layout of your building.
- In a plan view (e.g., Level 1), use the "Grid" tool (Architecture tab > Datum panel > Grid).
- Draw and label grid lines as required.

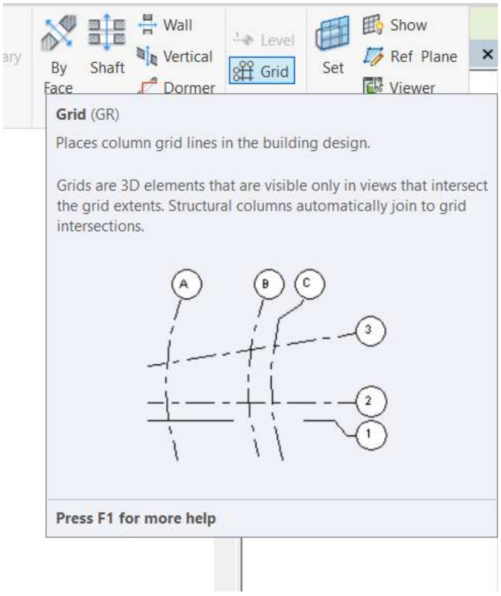


Fig. no. 2c

Modelling the Building Elements:

Walls:

- Go to "Architecture" > "Wall."
- Choose a wall type from the Properties palette (e.g., Generic, Exterior Brick).
- Adjust wall properties (height, location line, etc.).
- Draw walls by clicking points in the plan view.

Doors and Windows:

- Go to "Architecture" > "Door" or "Window."
- Select a door or window family from the Properties palette or load a new family.
- Place doors and windows into walls.

Floors:

- Go to "Architecture" > "Floor."
- Choose a floor type.
- Use drawing tools (lines, rectangles, etc.) to define the floor boundary.
- Click the green checkmark to finish.

Roofs:

- Go to "Architecture" > "Roof."
- Choose a roof type (e.g., Roof by Footprint, Roof by Extrusion).
- Draw the roof boundary or define the extrusion path.
- Adjust roof properties (slope, overhang, etc.).
- Click the green checkmark to finish.

Structural Elements (if applicable):

- Use the "Structure" tab for beams, columns, foundations, etc.
- Follow similar steps as for architectural elements.

Components:

- Go to "Architecture" > "Component" > "Place a Component".
- Load families for furniture, fixtures, and other building components.
- Place components in the model.

Modifying and Refining the Model:

Modify Tools:

- Use tools in the "Modify" tab (e.g., Move, Copy, Rotate, Align, Trim/Extend) to adjust elements.

Properties Palette:

- Adjust element properties (dimensions, materials, etc.) in the Properties palette.
  Visibility/Graphics:
- Control the visibility and appearance of elements using the Visibility/Graphics Overrides (VG).

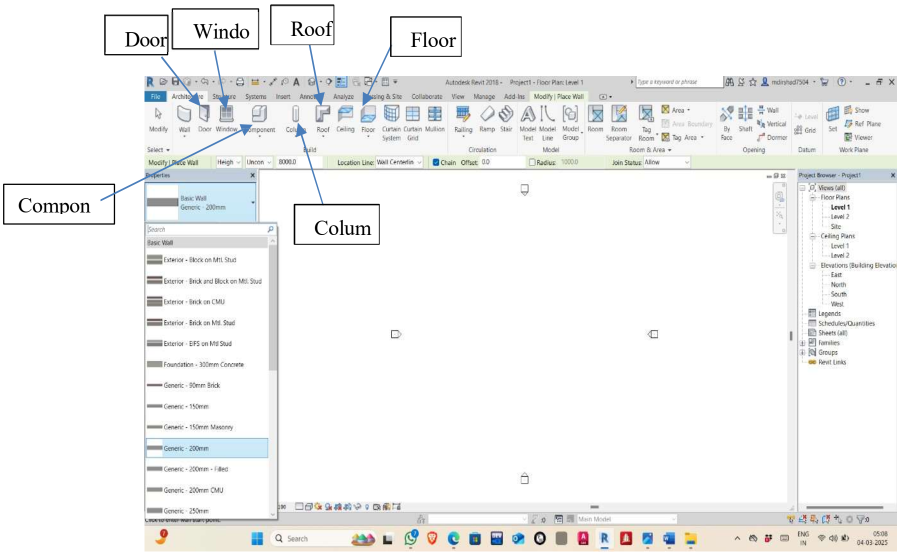
- Sections and Elevations:
- Create section and elevation views to see the model from different perspectives and refine details.

3D Views:

- Use the default 3d view, or create new 3d views.
- Use the view cube to rotate and manipulate the 3d view.
- Use the section box to cut away parts of the 3d model.
-

Materials:

- Apply materials to elements to give them realistic appearances.
- Manage materials through the material browser



Rendering and Presentation:

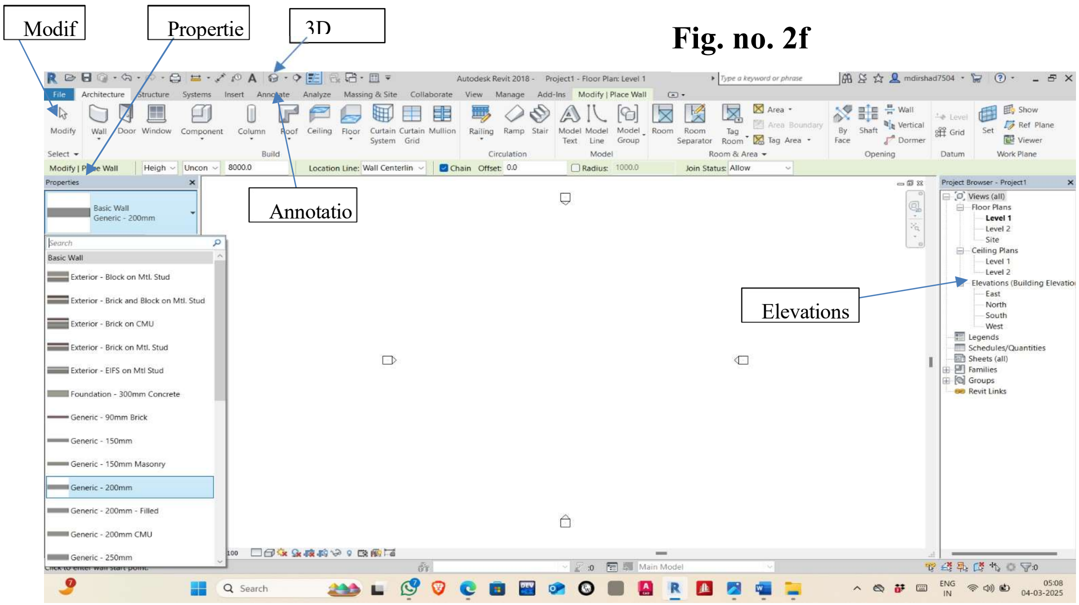


Fig. no. 2f

Rendering:

- Create realistic images of the model using the rendering tools.
- Adjust lighting, materials, and settings for optimal results.

Sheets:

- Create sheets to organize views and schedules for printing or digital output.

Exporting:

- Export the model to other formats (e.g., DWG, IFC, FBX) for collaboration or use in other software

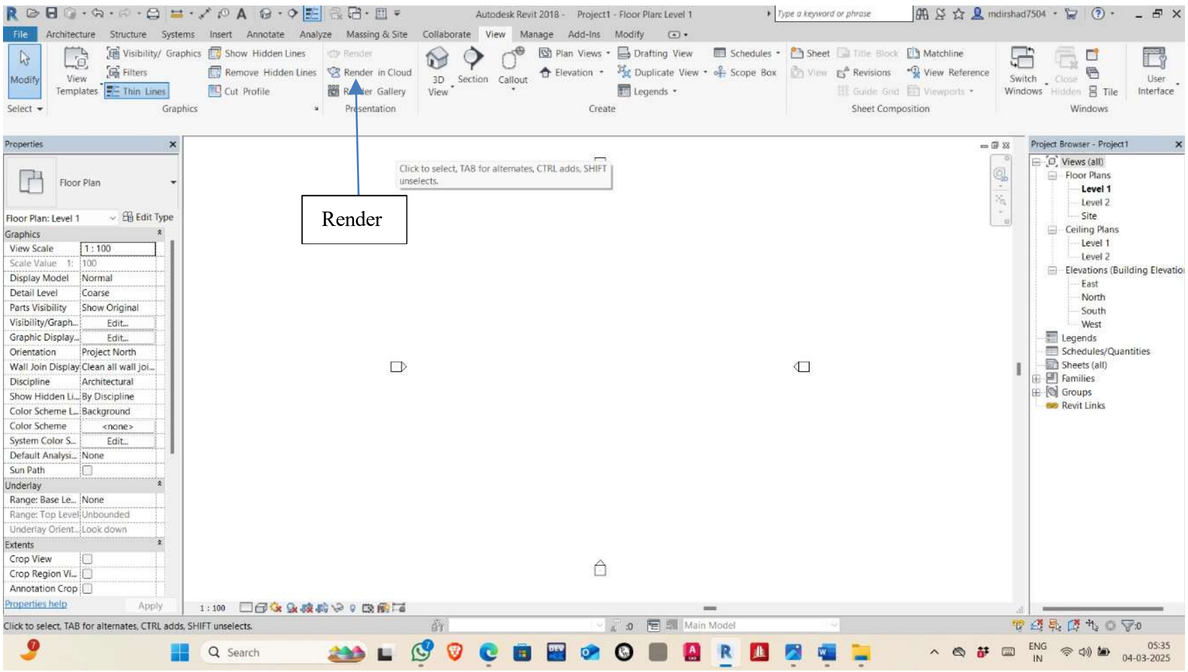


Fig. no. 2h
FRONT VIEW

Fig. no. 2i
BACK VIEW

Ceiling Plans :-

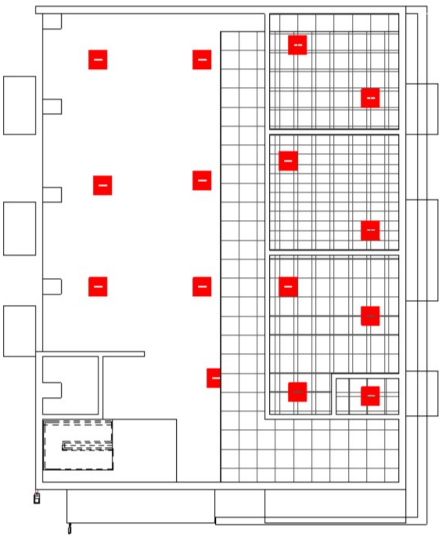


Fig. no. 2j
LEVEL 1

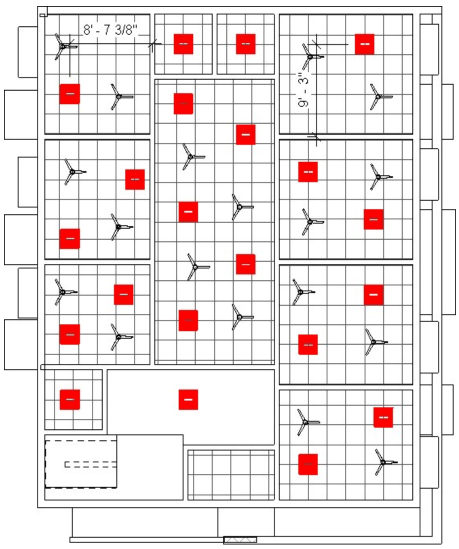


Fig. no. 2k
LEVEL 2

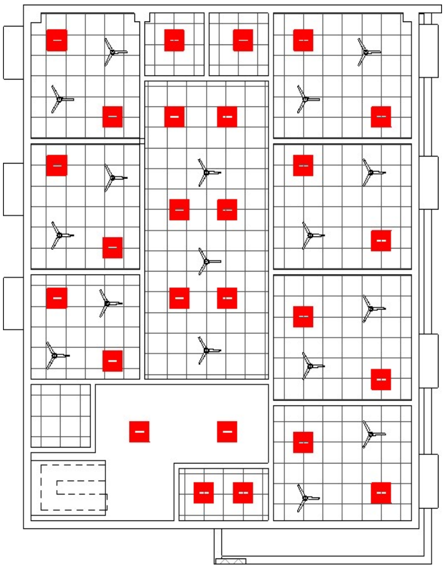


Fig. no. 2l
LEVEL 3

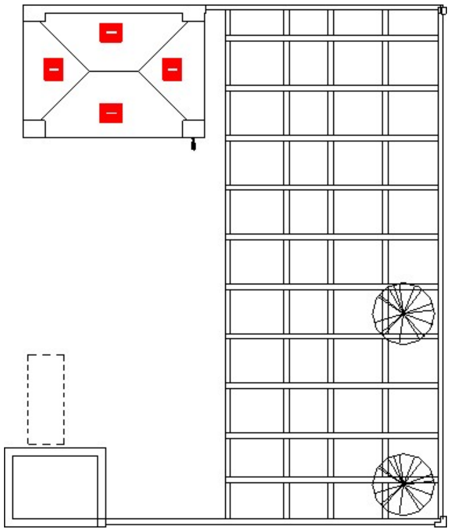
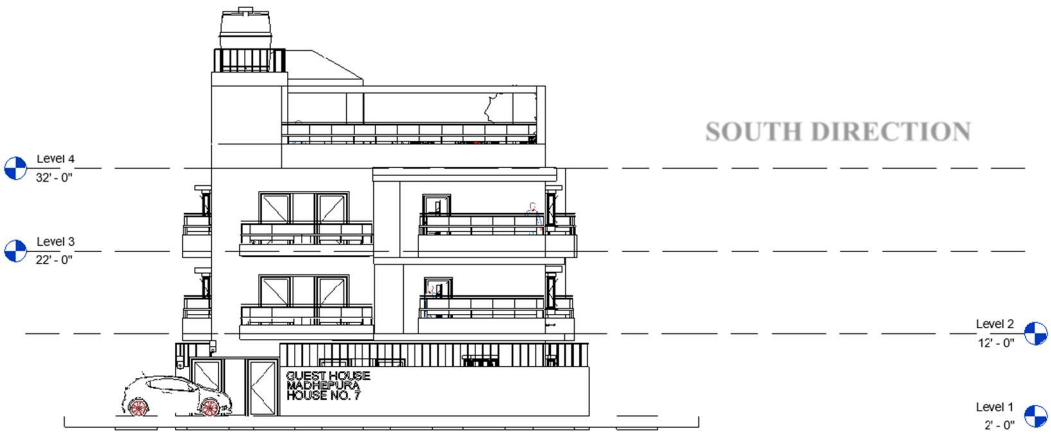
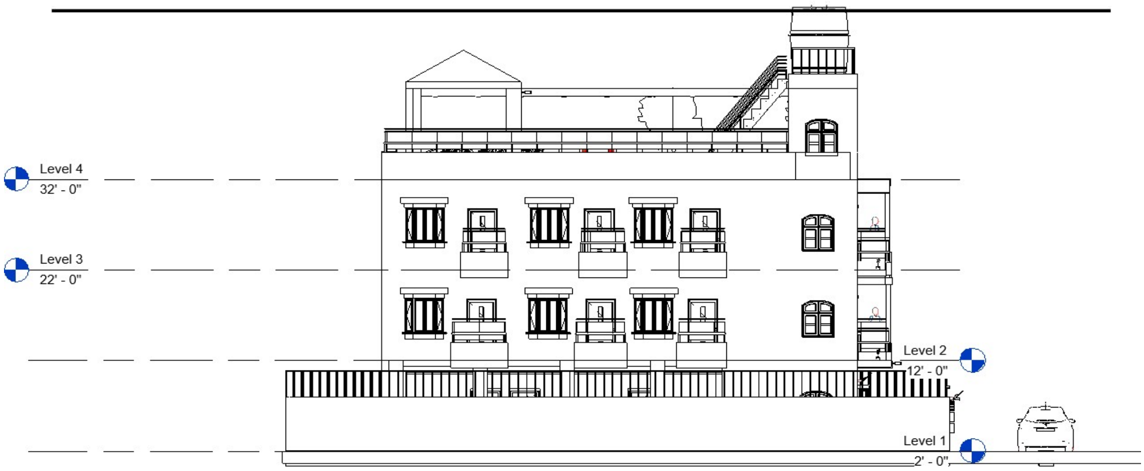


Fig. no. 2m
LEVEL 4

• ELEVATIONS :-


SOUTH DIRECTION
Level 4
32' - 0"
Level 3
22' - 0"
Level 2
12' - 0"
Level 1
2' - 0"
GUEST HOUSE
MADHEPURA
HOUSE NO. 7


Level 4
32' - 0"
Level 3
22' - 0"
Level 2
12' - 0"
Level 1
2' - 0"


Level 4
32' - 0"
Level 3
22' - 0"
Level 2
12' - 0"
Level 1
2' - 0"

RENDERING VIEW :-

Fig. no. 2q

3.3 STRUCTURAL ANALYSIS USING STAADPRO :

The structural design and analysis of the G+2 guest house using STAADPro was carried out through the following systematic steps:

1. Collection of Architectural Data

Floor plans, elevations, and sections were taken from AutoCAD and Revit models.

Column positions, beam spans, slab thicknesses, and structural dimensions were identified.

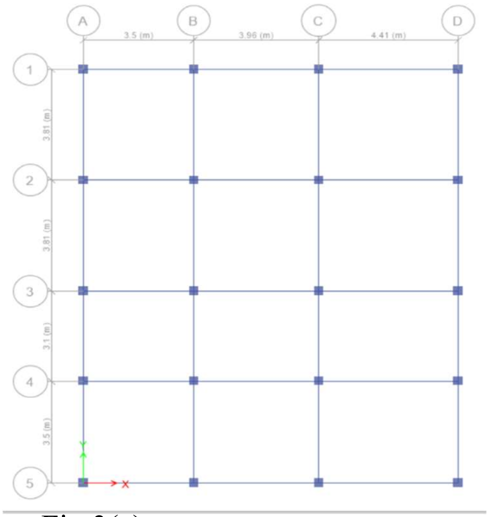


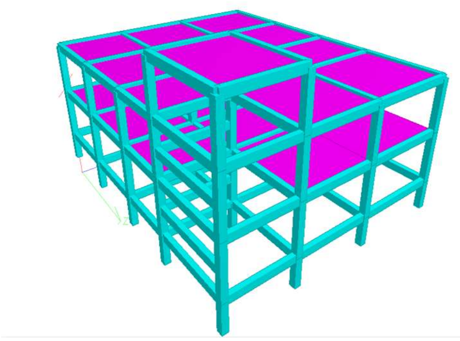
Fig.3(a)

3.3.1 Structural Modelling in STAADPro :

A 3D model of the building was developed using nodes (joints) and members (beams and columns).

Plate elements were used to represent slabs.

Building geometry was created floor-wise to ensure accuracy and uniformity.



3.3.2 Assumptions of Section Properties and materials :

Fig. 3(b)

Column

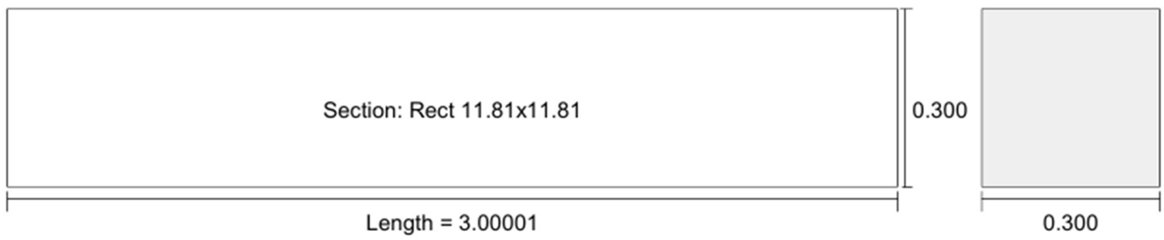


Fig.3(c)

Beam

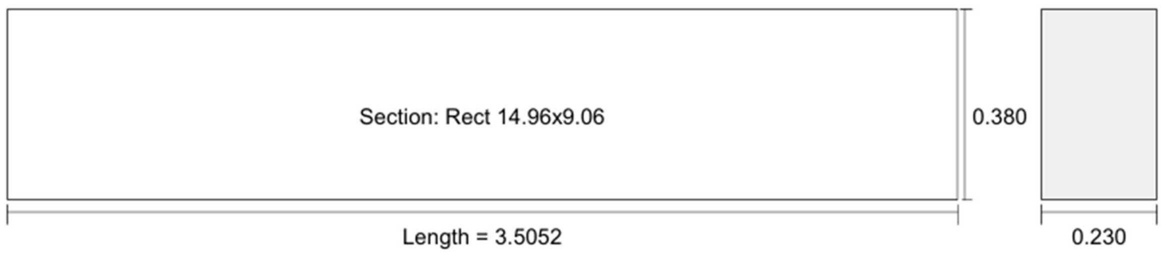


Fig 3(d)

3.3.3 Material properties and assumptions

Concrete grade – M20

Steel grade – Fe500

Slab thickness :150mm

Wall thickness :300mm

Floor finish :2kN/m^2

Live load :3.5kN/m^2

Brick loading- :20X * 0.25 * 3.5 = 17.5KN/m

Parapet loading - :20 * 0.25 * 1.2 = 6KN/m

Load combination

1.5 (DL+LL)

1.2 (DL+LL+EQx)

1.2 (DL+LL-EQx)

3.3.4 Application of load

Dead Load (DL): Self-weight was automatically considered by STAAD.Pro. Additional loads such as wall loads and floor finishes were added manually as per calculation or defined in the IS 875.

Live Load (LL): Applied as per IS 875 Part 2 for residential buildings.

Earthquake Load (EQ): Applied according to IS 1893 for Zone V, with defined parameters like zone factor, importance factor, and response reduction factor.

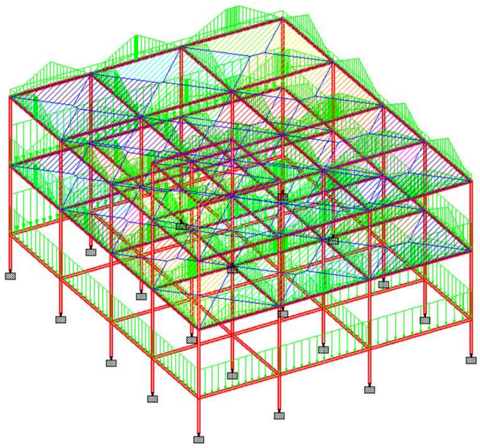


Fig.3(e)

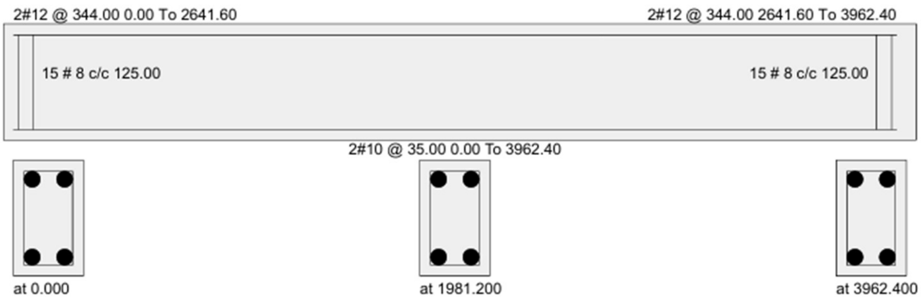
Different loan on the members and floors

3.3.5 Design and parameter

For Beam

Beam no. 124

Design Code: IS-456



Design Load

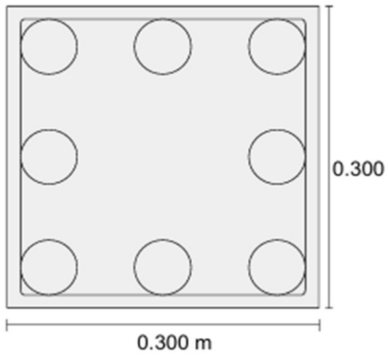
Mz(Kn Met)	Dist.et	Load
14.830000	2.000000	9
-25.639999	0.000000	9
-29.280001	4.000000	9

Design Parameter

Fy(Mpa)	500.000000
Fc(Mpa)	20.000000
Depth(m)	0.379999
Width(m)	0.230000
Length(m)	3.962400

Beam no. 68

Design Code: IS-456



Design Load

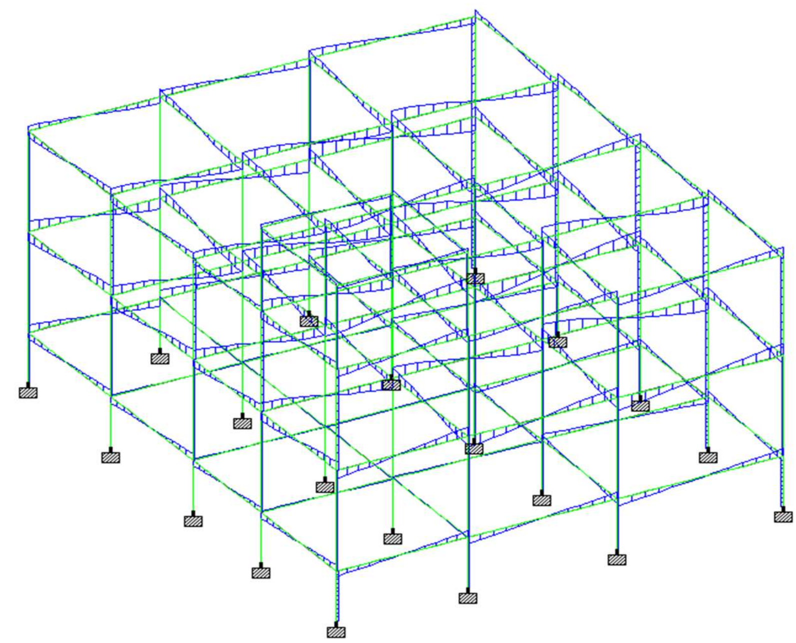
Load	3
Location	End 1
Pu(Kns)	-41.380001
Mz(Kns-Mt)	0.730000
My(Kns-Mt)	33.799999

Design Results

Fy(Mpa)	500
Fc(Mpa)	20
As Reqd(mm²)	864.000000
As (%)	1.005000
Bar Size	12
Bar No	8

3.3.6 Result and discussion

Shear force diagram



- Bending moment diagram

Fig 3(G)

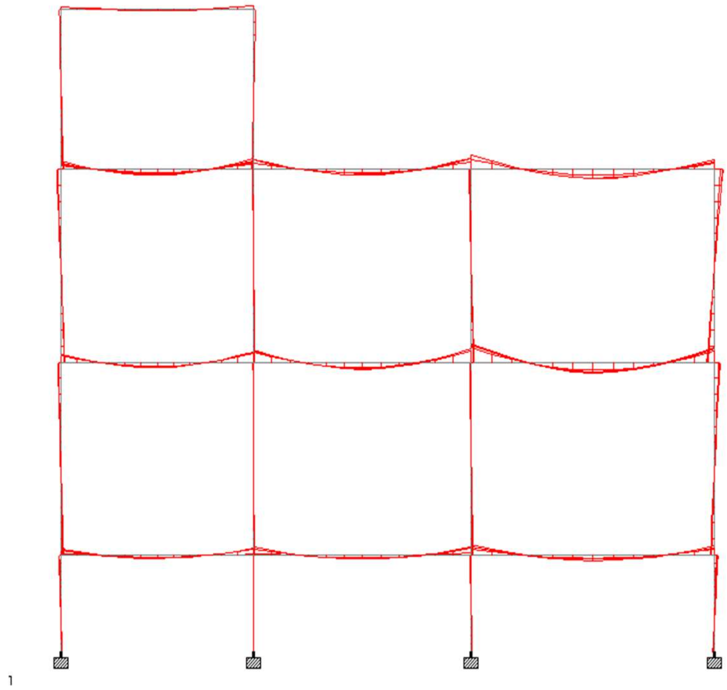


Fig 3(f)

Fig 3(h)

Deflection diagram

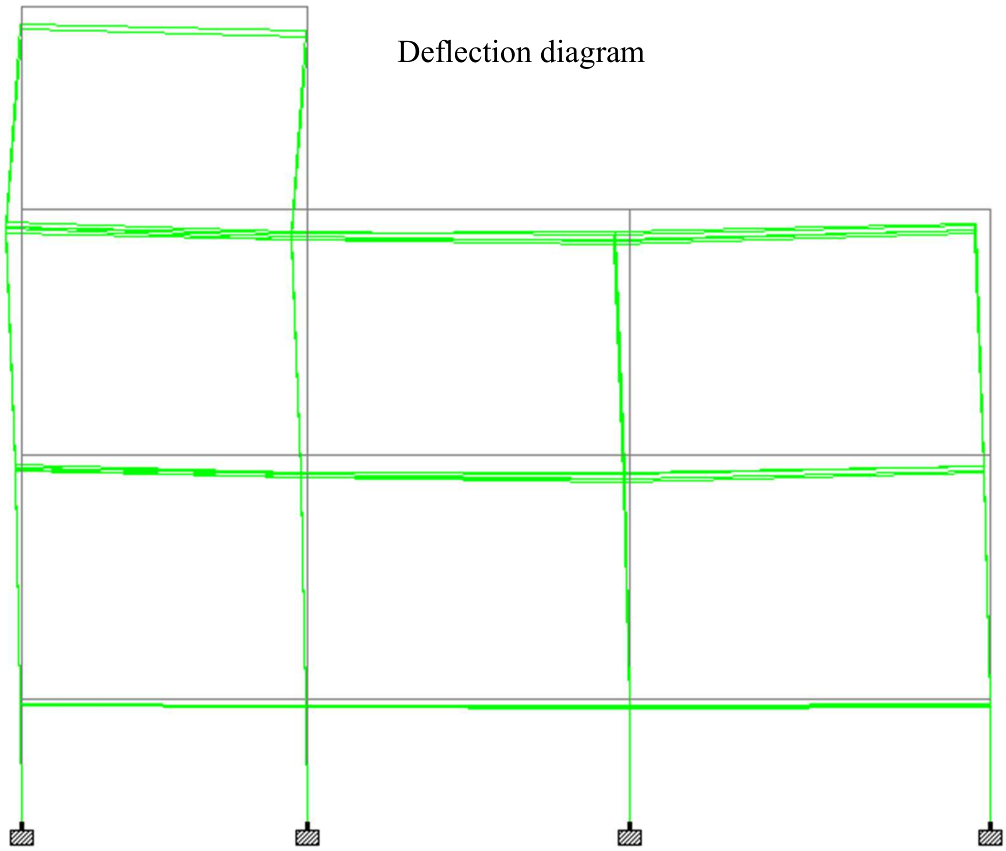


Fig 3(j)

```
                    SUMMARY OF PROVIDED REINF. AREA
----------------------------------------------------------------------------
SECTION      0.0 mm      876.3 mm     1752.6 mm     2628.9 mm     3505.2 mm
----------------------------------------------------------------------------
 TOP       2-10d         2-10d         2-10d         2-10d         2-10d
REINF.   1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)

BOTTOM     2-10d         2-10d         2-10d         2-10d         2-10d
REINF.   1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)    1 layer(s)

SHEAR   2 legged  8d  2 legged  8d  2 legged  8d  2 legged  8d  2 legged  8d
REINF.  @ 125 mm c/c  @ 125 mm c/c  @ 125 mm c/c  @ 125 mm c/c  @ 125 mm c/c
----------------------------------------------------------------------------


SHEAR DESIGN RESULTS AT DISTANCE d (EFFECTIVE DEPTH) FROM FACE OF THE SUPPORT
-----------------------------------------------------------------------------

SHEAR DESIGN RESULTS AT   495.0 mm AWAY FROM START SUPPORT
  VY =      8.12 MX =     -0.01 LD=     9
  Provide 2 Legged  8d  @ 125 mm c/c

SHEAR DESIGN RESULTS AT   495.0 mm AWAY FROM END SUPPORT
  VY =     -9.37 MX =     -0.01 LD=     9
  Provide 2 Legged  8d  @ 125 mm c/c

============================================================================


********************END OF BEAM DESIGN RESULTS********************
```

```
============================================================================
             IS-456    L I M I T    S T A T E    D E S I G N
         C O L U M N   N O.    157  D E S I G N    R E S U L T S


      M20                   Fe500 (Main)               Fe500 (Sec.)

LENGTH:  2500.0 mm   CROSS SECTION:  300.0 mm X  300.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    1 END JOINT:    78  TENSION COLUMN


REQD. STEEL AREA   :      720.00 Sq.mm.
REQD. CONCRETE AREA:    89280.00 Sq.mm.
MAIN REINFORCEMENT : Provide   4 - 16 dia. (0.89%,    804.25 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 255 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :   1073.52   Muz1 :     34.52   Muy1 :     34.52

INTERACTION RATIO: 0.03 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:     9
END JOINT:     78 Puz :   1104.35    Muz :     41.63    Muy :     41.63    IR: 0.37
   STAAD SPACE                                          -- PAGE NO.   297

============================================================================


********************END OF COLUMN DESIGN RESULTS********************
```

```
173. CONCRETE TAKE
174. END CONCRETE DESIGN
   STAAD SPACE                                              -- PAGE NO.  298

      **************  CONCRETE  TAKE OFF  **************
           (FOR BEAMS, COLUMNS AND PLATES DESIGNED ABOVE)
  NOTE: CONCRETE QUANTITY REPRESENTS VOLUME OF CONCRETE IN BEAMS, COLUMNS, AND PLATES DESIGNED ABOVE.
        REINFORCING STEEL QUANTITY REPRESENTS REINFORCING STEEL IN BEAMS AND COLUMNS DESIGNED ABOVE.
        REINFORCING STEEL IN PLATES IS NOT INCLUDED IN THE REPORTED QUANTITY.

      TOTAL VOLUME OF CONCRETE =        46.1 CU.METER

                     BAR DIA        WEIGHT
                     (in mm)       (in New)
                    --------       --------
                         8          13207
                        10           6164
                        12           6480
                        16           6620
                        20           3483
                                ------------
                      *** TOTAL=      35954

175. FINISH
```

Volume Of Material

3.4 BAR BENDING SCHEDULE :

A Bar bending Schedule (BBS) is Comprehensive list of reinforcement bars used in reinforced concrete work. It specifies the type, size, length, shape, quantity, and location of each rebar needed for construction. It is an essential document in civil engineering and construction that helps in cost estimation, cutting and bending of bars, and minimizing wastage.

3.4.1 Footing

Dimension of Footing = 5 feet * 5feet

Depth of Footing = 300 mm

Length of Footing (mm) = 1524 mm

Diameter of Main Bar = 16 mm

Diameter of Distribution Bar = 12 mm

7.1.1 Calculation For 16 mm diameter Main Bar

No. of bars = (length of Footing – 2* Clear Cover)/spacing + 1

= (1524-100)/150 + 1

No of Bars = 11 Bar

Length of T1 = length of Footing – 2*clear Cover + 2*Bend Length – 2* Bend Deduction

Length of T1 Bar = 1524-(2*50) + 2(12*16)-2(2*16)

Length of T1 Bar = 1524 – 100 + 384 – 64

= 1744 mm

= 1.744 m

3.4.2 Calculation For 12mm diameter Distribution Bar

No. of bars = (width of Footing – 2* Clear Cover)/spacing + 1

No of Bars = 11

Length = 1524-(2*500) + 2*(12*12)-2(2*12)

= 1524 – 100 + 288 – 48

= 1644 mm

= 1.644 m

Sl No.	Shape of Bar	Bar Description	Bar Dia. (mm)	Spacing (mm)	No. of bar	Cutting Length(mm)	Cutting length(m)	Total length of Bar (m)	Weight of Bar (kg/m)	Total Weight (kg)
1		Main Bar	16	150	11	1744	1.744	19.184	1.58	30.311
2		Distibution Bar	12	150	11	1664	1.664	18.304	0.88	16.108
										Total Weight=46.419

3.4.3 Column

Cross-section = 1 feet * 1 feet (300 mm * 300 mm)

Footing Depth = 300 mm

Column Cover = 40 mm

Beam Length = 381 mm

Underground Column Depth = 1.224 m

Floor to Floor Height = 2667 mm

Parapet Wall = 914.4 mm

Top level = 5’ = 1524 mm

Dia. Of Main Bar = 16 (provided at the corners),12 (Provided in center of each phase)

Diameter of lateral Ties Bar = 12 mm

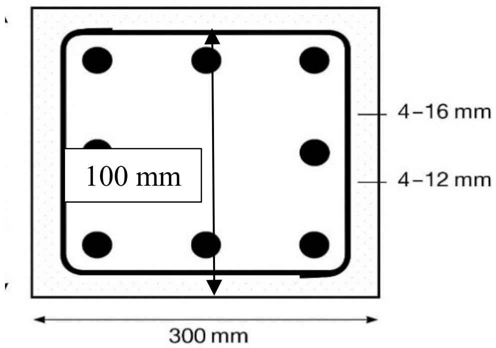


Fig 3.4-b Cross section of Column with reinforcement

3.4.4 Calculation for Main Bar

For 16 mm Dia. Bar

Cutting Length = (Footing Depth – cover – Main Bar – Distribution Bar) + L length + underground Column + No. Of Beams + No. of Floor + Parapet + Top Level + lapping

Length – bend + Develop Length

CL = (300-50-16-12)+300+1224+(4*381)+3*2667+914.4+1524+50-(2*2*16)+777

CL = 14471.4 MM

CL = 14.5 m

For 12 mm dia. Steel

CL = 14294 mm

CL = 14.3 m

Lateral Ties 12 mm Dia.

Length of Lateral Ties = 2(a'+b') +Book length +4*90-degree bend

= 2(a'+b') + 4(6*dia)+2(10.785*dia.)

= 2(204 + 204) + 4(6*12)+2(10.785*12)

= 1362.84 mm

= 1.4 m

Developer Length Formula = (Dia. * Stress in Steel)/(4*Design Bond Stress)

Stress in Steel = 0.87*fy

Design Bond Stress = 1.4 N/mm2

for Deformed bar increased by 60%

Development Length = (16*435)/(4*2.24) = 777 mm

Sl. No.	Shape Of Bar	Bar Discription	Bar Dia.	No. of bar	Length of Bar (mm)	Length of Bar (m)	Total length of Bar (m)	Wt. of bar (kg/m)	Total Wt. of Bar (kg)
1		Longitudinal Bar	16	4	14471	14.5	58	1.58	91.64
			12	4	14294	14.3	57.2	0.88	50.336
2		Lateral Ties	12	78	1362	1.4	109.2	0.4	43.68
									Total Weight=185.656 Kg

Fig 7.2.1 bar Bending Schedule for Column

No. Column = 20

Total weight of steel Used = 3711.2 kg

3.4.5 Beam

Cross Section of Beam = width*depth = (0.2286*0.381) m2

Main Bar of 16 mm Dia.

Anchor Bar of 16 mm Dia.

Bentup Bar of 16 mm Dia.

Vertical Stirrups = 12 mm dia. 150 c/c

Cover = 30 mm

3.4.6 Calculation of Main Bars

Provided at bottom of Beam in tension Zone

For Effective Length of Beam = 3500 mm

Clear Span of Beam = Leff – 0.304801 = 3.195 m

Length = clear Span + 2*Ld = 3195+ 2* 778 = 4751 mm = 4.75 m

3.4.7 Calculation of Anchor Bar

They are Provided at Top of the Beam For Negative Moment at Supports

Length = 3195 + 2*778 = 4751 mm = 4.75 m

3.4.8 Calculation of Cranked Bar

They are used to resist share near Supports and are Placed with bends at ¼ Span from each end.

Horizontal Leg = 3500 / 4 = 875 mm

Vertical Rise = Effective Depth = 381 – 2*30 = 321 mm

Crank Length = ((875)^2+321^2)^1/2 = 932 mm

2 Cranks are Provided = 2*932 = 1864 mm

Middle Strength Length = 3500-2*875 = 1750 mm

Bend Allowance (for 45-degree bend) = 2*7 = 40 mm

Total Length of Cranked Bar

1864 + 1750 +2*778 +14 = 5183 mm = 5.18 m

3.4.9 Stirrups

Provide in Closed Loops with Hooks

Internal Width = 228.6 – 2(30+6) = 157 mm

Internal Height = 321 -30 -6 = 285 mm

Perimeter of Stirrups including 2 Hooks of 10*2 mm = 2(157+285)+120 = 880 mm

= 0.88 m

The Same Process is Done for Different Span of Beams .

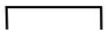
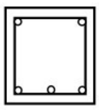
Sl No.	Shape of Bar	Bar Discription	Bar Dia. (mm)	No. of Bar	Beam Length(m)	Length of Bar(mm)	Length of Bar(m)	Total length of Bar	Wt. of Bar	Total wt. of bar
1		Main bar	16	3	3.2	4751	4.75	14.25	1.58	22.55
					3.66	5214	5.21	15.63		24.69
					4.1	5654	5.65	16.95		26.78
					3.505	5059	5.06	15.18		23.98
					2.7952	4349	4.35	13.05		20.62
2		Anchor bar	16	2	3.2	4750	4.75	9.5	1.58	15
					3.66	5214	5.21	10.42		16.5
					4.1	5654	5.65	11.3		17.9
					3.505	5059	5.06	10.12		15.99
					2.7952	4349	4.35	8.7		13.8
3		Bentup Bar	16	1	3.2	5180	5.18	5.18	1.58	8.2
					3.66	5340	5.34	5.34		8.44
					4.1	5766	5.77	5.77		9.12
					3.505	5184	5.18	5.18		8.18
					2.7952	4526	4.53	4.53		7.16
4		Vertical Stirrups	12	23	3.2	1212	1.21	27.83	0.88	24.5
				25	3.66	1196	1.19	29.27		25.7
				28	4.1	1196	1.19	33.32		29.33
				25	3.505	1212	1.21	30.25		26.7
				20	2.7952	1212	1.21	24.2		21.3

Fig 7.3: Bar Bending Schedule of Beam

Total Steel Required for Beam = 9099.48 kg

3.4.10 Slab

Slab Thickness = 150 mm
Concrete cover = 25 mm
Dia. Of bar = 16 mm
Slab Dimensions = 39 feet * 49 feet = 11.89 m * 14.94 m
Effective length = 11.89 – 2*0.025 = 11.84 m
Effective Width = 14.94 – 2*0.025 = 14.89 m

Calculation for Main Bar in Longer Span

No. of Bars = Effective Span / Spacing + 1 = 11.84 /0.15 + 1 = 80 Bars

Length Of Bar = 14.94 – 0.025 * 2 = 14.89 m

Calculation For Main Bars In Shorter Span

No. Bars = 14.89 /0.15+1 = 100 Bars

Length of Bar = 11.89 – 0.05 = 11.84

Top Extra Bar in Longer Span

Length of Extra Bar = ¼ * Ly = 3.735 m

Provided In Middle 50% Width 0.5 * 11.89 = 5.945 m

Spacing = 150 mm

No. of Bars = 5.945 / 0.15 + 1 = 40 mm

Top Extra Bar in Shortest Span

Length of Extra Bar = ¼ *Lx = 11.89 / 4 = 2.9725 m

Provided at 50 % width in middle = 0.5*14.94 = 7.47 m

No. Of Bars = 7.47/0.15 = 50 Bars

Fig 7.4 Bar Bending Schedule of Slab

Sl No.	Bar Shape	Bar Description	Bar Dia (mm)	No. of Bars	Length per Bar (m)	Total Length (m)	Unit Weight (kg/m)	Total Weight (kg)
1		Main Bar – Longer Span	16	80	14.89	1191.2	1.58	1880.1
2		Main Bar – Shorter Span	16	100	11.84	1184	1.58	1871.7
3		Top Extra Bar – Longer Span	16	40	3.735	149.4	1.58	235.1
4		Top Extra Bar – Shorter Span	16	50	2.9725	148.625	1.58	234.8
								Total Weight=4221.7 kg

3.5 SCHEDULING USING PRIMAVERA :

Work Breakdown Structure (WBS) :

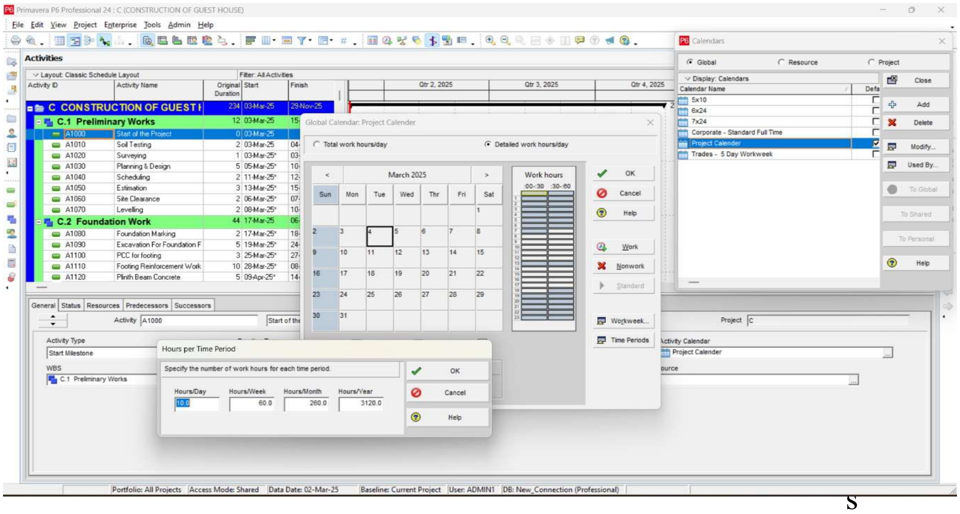
The Work Breakdown Structure (WBS) is a hierarchical method used to break down a project into smaller, manageable components. In the context of constructing a G+2 guest house, the WBS organizes the project into phases such as site preparation, foundation, superstructure, roofing, finishing, and inspection. Each phase is further divided into detailed tasks or work packages. This structure helps project managers to allocate resources, estimate costs, track progress, and ensure that all activities are completed on time. The WBS ensures clarity in task execution and enables effective monitoring throughout the project construction.

WBS Code	WBS Name
Const	Guest House
Const.1.1	Site Investigation
Const.1.1.1	Soil Testing
Const.1.1.2	Surveying
Const.1.2	Planning and Design
Const.1.2.1	Selection Of Planning
Const.1.2.2	Selection Of design
Const.1.2.3	Scheduling Of plan
Const.1.2.4	Project Sanctioning
Const.1.2.5	estimation
Const.1.3	Preliminary works
Const.1.3.1	Site Clearance
Const.1.3.2	Approval
Const.1.3.3	Site Levelling
Const.1.4	Foundation

Const.1.3.1	Site Clearance
Const.1.3.2	Approval
Const.1.3.3	Site Levelling
Const.1.4	Foundation
Const.1.4.1	Excavation
Const.1.4.2	Sand filling And compaction
Const.1.4.3	PCC
Const.1.4.4	Steel binding
Const.1.4.5	Formwork for foundation
Const.1.4.6	Concreting
Const.1.5	steel erection
Const.1.5.1	column
Const.1.5.2	beam
Const.1.5.3	concreting
Const.1.6	Floor slab
Const.1.6.1	sub base and building
Const.1.6.2	formwork and concrete
Const.1.7	masonary work
Const.1.7.1	Laying of bricks
Const.1.7.2	installing roof drains
Const.1.7.3	roofing
Const.1.8	installation of accesssories
Const.1.8.1	door windows and ventilators
Const.1.8.2	floor and ceiling work
Const.1.8.3	elevators or lifts
Const.1.9	electrical installation
Const.1.10	plumbing
Const.1.11	exterior work and finishing
Const.1.11.1	painting

3.5.1 Gantt Chart :

A Gantt Chart is a project management tool that visually displays a project's tasks along a timeline. Each task is represented by a horizontal bar, with the length indicating its duration. The chart shows the start and end dates of tasks, along with their dependencies. It helps project managers track progress, allocate resources, and identify overlapping tasks or potential delays. By using Gantt Charts, project managers can easily visualize the entire project's schedule, ensuring that tasks are completed on time and in the correct sequence. This tool is essential for keeping projects organized and maintaining efficient workflow.



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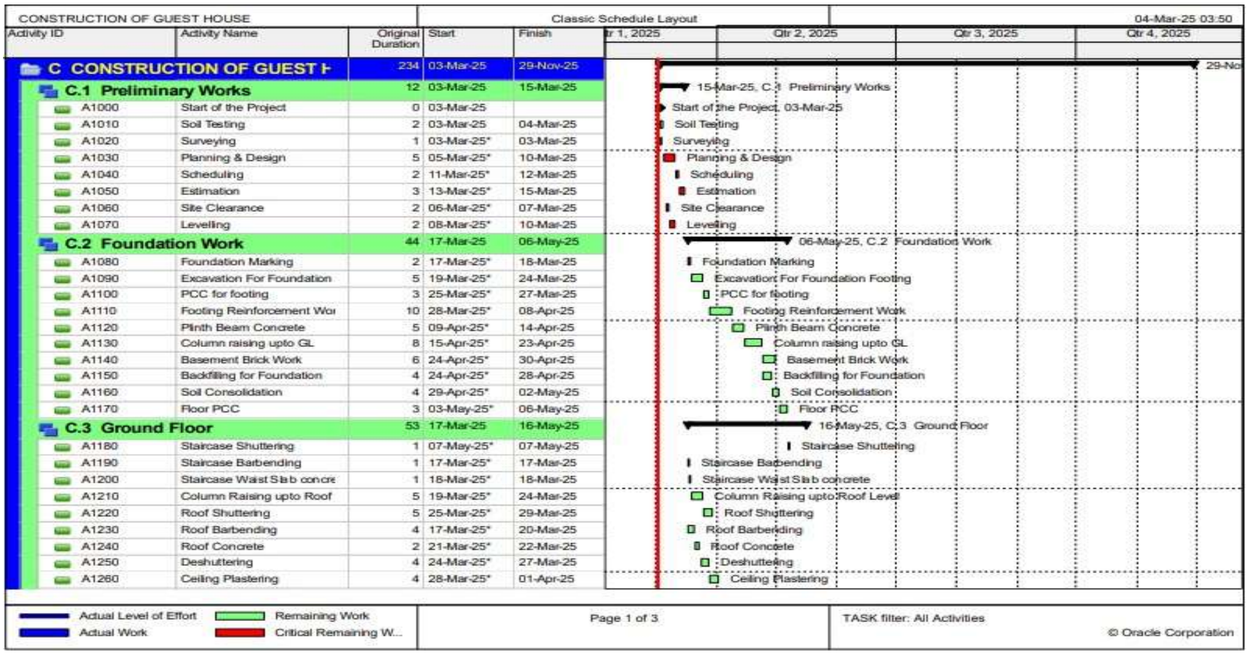


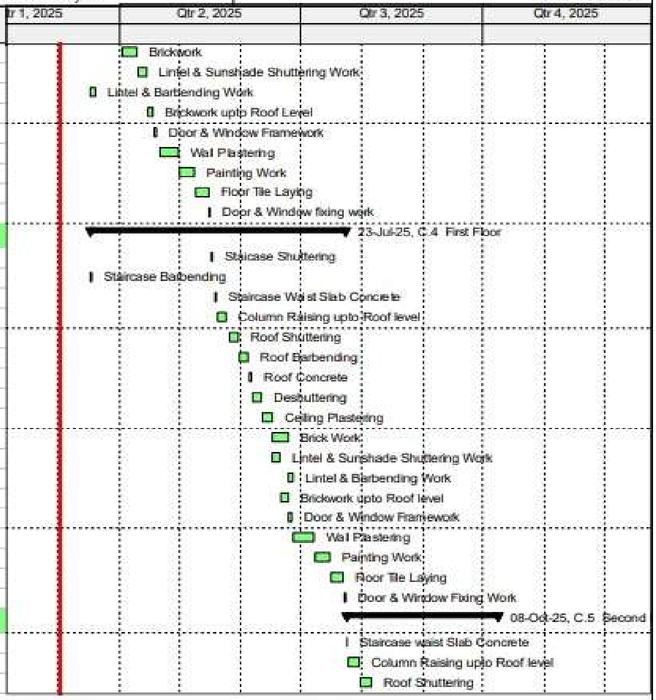
CONSTRUCTION OF GUEST HOUSE — Classic Schedule Layout — 04-Mar-25 03:50

Activity ID	Activity Name	Original Duration	Start	Finish
C CONSTRUCTION OF GUEST H		234	03-Mar-25	29-Nov-25
C.1 Preliminary Works		12	03-Mar-25	15-Mar-25
A1000	Start of the Project	0	03-Mar-25	
A1010	Soil Testing	2	03-Mar-25	04-Mar-25
A1020	Surveying	1	03-Mar-25*	03-Mar-25
A1030	Planning & Design	5	05-Mar-25*	10-Mar-25
A1040	Scheduling	2	11-Mar-25*	12-Mar-25
A1050	Estimation	3	13-Mar-25*	15-Mar-25
A1060	Site Clearance	2	06-Mar-25*	07-Mar-25
A1070	Leveling	2	08-Mar-25*	10-Mar-25
C.2 Foundation Work		44	17-Mar-25	06-May-25
A1080	Foundation Marking	2	17-Mar-25*	18-Mar-25
A1090	Excavation For Foundation	5	19-Mar-25*	24-Mar-25
A1100	PCC for footing	3	25-Mar-25*	27-Mar-25
A1110	Footing Reinforcement Wor	10	28-Mar-25*	08-Apr-25
A1120	Plinth Beam Concrete	5	09-Apr-25*	14-Apr-25
A1130	Column raising upto GL	8	15-Apr-25*	23-Apr-25
A1140	Basement Brick Work	6	24-Apr-25*	30-Apr-25
A1150	Backfilling for Foundation	4	24-Apr-25*	28-Apr-25
A1160	Soil Consolidation	4	29-Apr-25*	02-May-25
A1170	Floor PCC	3	03-May-25*	06-May-25
C.3 Ground Floor		53	17-Mar-25	16-May-25
A1180	Staircase Shuttering	1	07-May-25*	07-May-25
A1190	Staircase Barbending	1	17-Mar-25*	17-Mar-25
A1200	Staircase Waist Slab concre	1	18-Mar-25*	18-Mar-25
A1210	Column Raising upto Roof	5	19-Mar-25*	24-Mar-25
A1220	Roof Shuttering	5	25-Mar-25*	29-Mar-25
A1230	Roof Barbending	4	17-Mar-25*	20-Mar-25
A1240	Roof Concrete	2	21-Mar-25*	22-Mar-25
A1250	Deshuttering	4	24-Mar-25*	27-Mar-25
A1260	Ceiling Plastering	4	28-Mar-25*	01-Apr-25

Actual Level of Effort — Remaining Work — Actual Work — Critical Remaining W...

Page 1 of 3 — TASK filter: All Activities — © Oracle Corporation

CONSTRUCTION OF GUEST HOUSE		Classic Schedule Layout			04-Mar-25 03:50
Activity ID	Activity Name	Original Duration	Start	Finish	
A1270	Brickwork	7	02-Apr-25*	09-Apr-25	
A1280	Lintel & Sunshade Shutterir	4	10-Apr-25*	14-Apr-25	
A1290	Lintel & Barbending Work	3	17-Mar-25*	19-Mar-25	
A1300	Brickwork upto Roof Level	3	15-Apr-25*	17-Apr-25	
A1310	Door & Window Framework	2	18-Apr-25*	19-Apr-25	
A1320	Wall Plastering	9	21-Apr-25*	30-Apr-25	
A1330	Painting Work	7	01-May-25*	08-May-25	
A1340	Floor Tile Laying	6	09-May-25*	15-May-25	
A1350	Door & Window fixing work	1	16-May-25*	16-May-25	
C.4 First Floor		111	17-Mar-25	23-Jul-25	
A1360	Staicase Shuttering	1	17-May-25*	17-May-25	
A1370	Staircase Barbending	1	17-Mar-25*	17-Mar-25	
A1380	Staircase Waist Slab Conci	1	19-May-25*	19-May-25	
A1390	Column Raising upto Roof	5	20-May-25*	24-May-25	
A1400	Roof Shuttering	5	26-May-25*	30-May-25	
A1410	Roof Barbending	4	31-May-25*	04-Jun-25	
A1420	Roof Concrete	2	05-Jun-25*	06-Jun-25	
A1430	Deshuttering	4	07-Jun-25*	11-Jun-25	
A1440	Ceiling Plastering	4	12-Jun-25*	16-Jun-25	
A1450	Brick Work	7	17-Jun-25*	24-Jun-25	
A1460	Lintel & Sunshade Shutterir	4	17-Jun-25*	20-Jun-25	
A1470	Lintel & Barbending Work	3	25-Jun-25*	27-Jun-25	
A1480	Brickwork upto Roof level	3	21-Jun-25*	24-Jun-25	
A1490	Door & Window Framework	2	25-Jun-25*	26-Jun-25	
A1500	Wall Plastering	9	27-Jun-25*	07-Jul-25	
A1510	Painting Work	7	08-Jul-25*	15-Jul-25	
A1520	Floor Tile Laying	6	16-Jul-25*	22-Jul-25	
A1530	Door & Window Fixing Worl	1	23-Jul-25*	23-Jul-25	
C.5 Second Floor		66	24-Jul-25	08-Oct-25	
A1540	Staircase waist Slab Concre	1	24-Jul-25*	24-Jul-25	
A1550	Column Raising upto Roof	5	25-Jul-25*	30-Jul-25	
A1560	Roof Shuttering	5	31-Jul-25*	05-Aug-25	

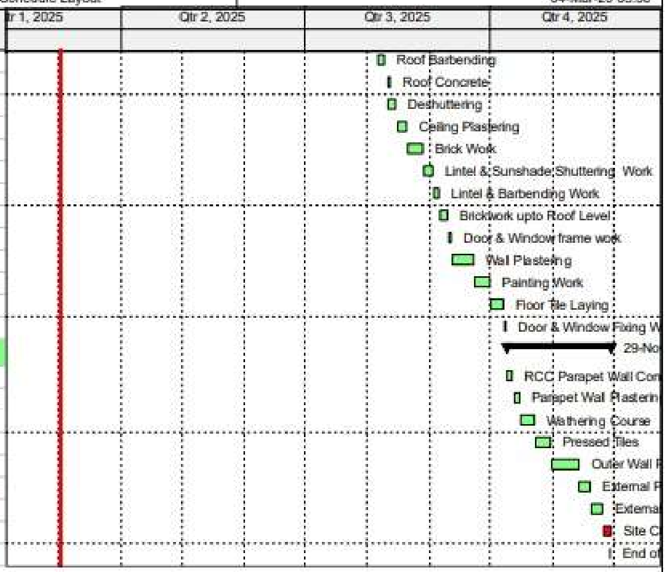


Actual Level of Effort | Remaining Work | Actual Work | Critical Remaining W...

Page 2 of 3

TASK filter: All Activities

CONSTRUCTION OF GUEST HOUSE		Classic Schedule Layout			04-Mar-25 03:50
Activity ID	Activity Name	Original Duration	Start	Finish	
A1570	Roof Barbending	4	06-Aug-25*	09-Aug-25	
A1580	Roof Concrete	2	11-Aug-25*	12-Aug-25	
A1590	Deshuttering	4	11-Aug-25*	14-Aug-25	
A1600	Ceiling Plastering	4	16-Aug-25*	20-Aug-25	
A1610	Brick Work	7	21-Aug-25*	28-Aug-25	
A1620	Lintel & Sunshade Shutterir	4	29-Aug-25*	02-Sep-25	
A1630	Lintel & Barbending Work	3	03-Sep-25*	05-Sep-25	
A1640	Brickwork upto Roof Level	3	06-Sep-25*	09-Sep-25	
A1650	Door & Window frame work	2	10-Sep-25*	11-Sep-25	
A1660	Wall Plastering	9	12-Sep-25*	22-Sep-25	
A1670	Painting Work	7	23-Sep-25*	30-Sep-25	
A1680	Floor Tile Laying	6	01-Oct-25*	07-Oct-25	
A1690	Door & Window Fixing Worl	1	08-Oct-25*	08-Oct-25	
C.6 External Finishes		45	09-Oct-25	29-Nov-25	
A1700	RCC Parapet Wall Concret	3	09-Oct-25*	11-Oct-25	
A1710	Parapet Wall Plastering	3	13-Oct-25*	15-Oct-25	
A1720	Wathering Course	6	16-Oct-25*	22-Oct-25	
A1730	Pressed Tiles	7	23-Oct-25*	30-Oct-25	
A1740	Outer Wall Plastering	12	31-Oct-25*	13-Nov-25	
A1750	External Plumbing & Sanita	5	14-Nov-25*	19-Nov-25	
A1760	External Painting	5	20-Nov-25*	25-Nov-25	
A1770	Site Clearing & Handing Ov	4	26-Nov-25*	29-Nov-25	
A1780	End of Project	0	29-Nov-25*	29-Nov-25	



Actual Level of Effort | Remaining Work | Actual Work | Critical Remaining W...

Page 3 of 3

TASK filter: All Activities

3.5 INTERIOR DESIGN USING SKETCHUP :

Top view

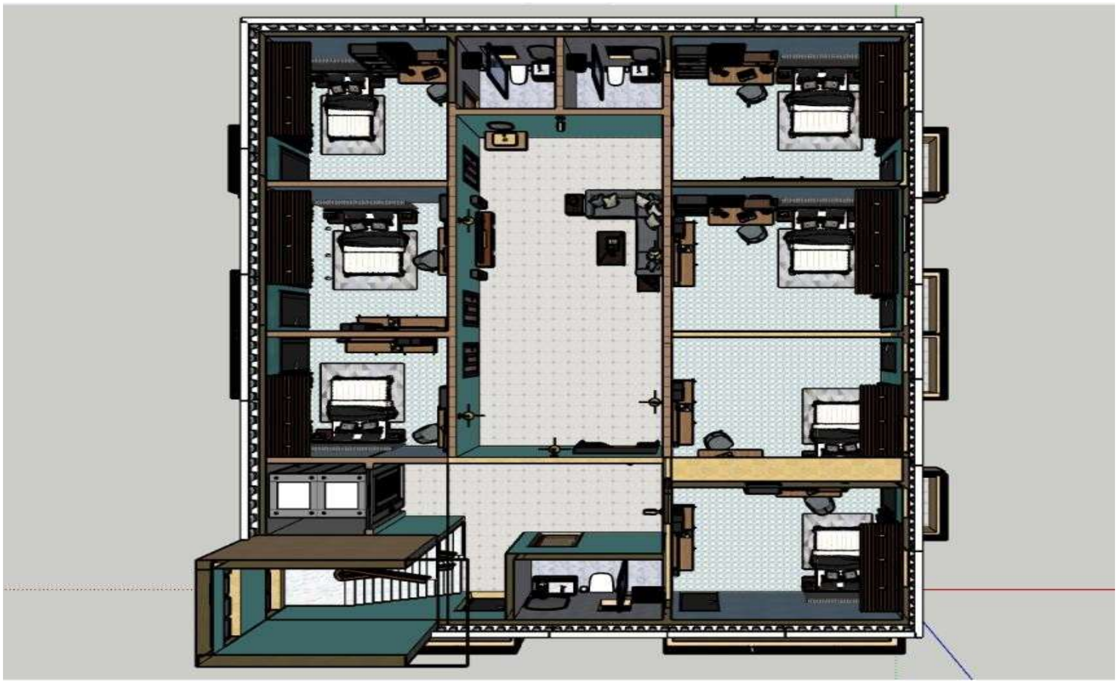
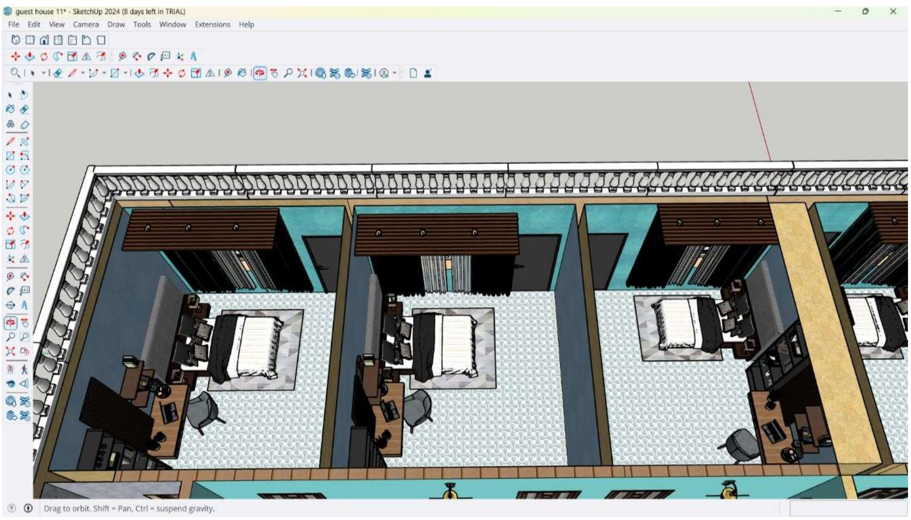


Fig:4(a)

Rooms :

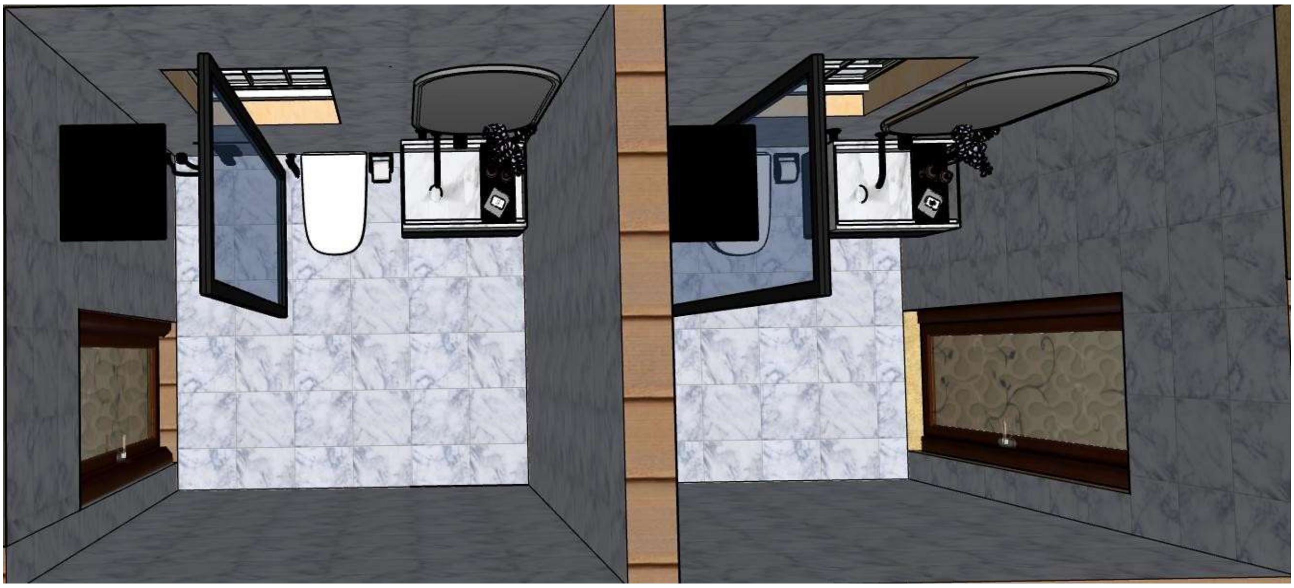
Fig:-4(b)



Hall :

Fig no:-4(c)

Bathroom :



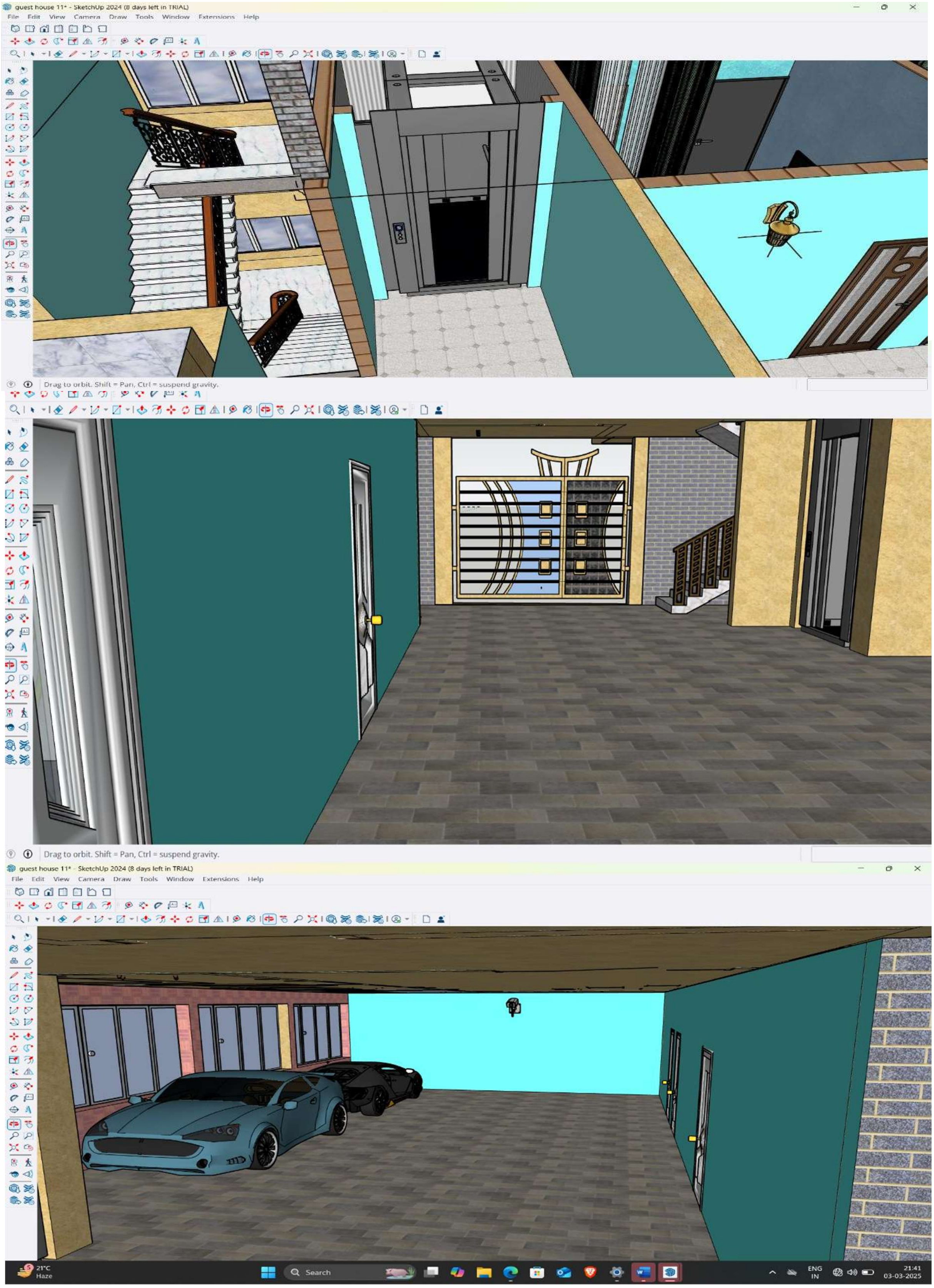


Fig:-4.(e), 3.(f) Stair, Lift, and Parking

3.6 REAL TIME 3D VISUALISATION USING TWINMOTION :

Here are the steps to create 3D visualization in Twinmotion using Revit:

1. Prepare the Revit Model

- Open your model in Autodesk Revit.
- Clean the model by hiding unnecessary elements or linking models as needed.
- Ensure all geometry and materials are properly assigned for better visualization.

2. Install and Use the Twinmotion Revit Plugin (Datasmith Exporter)

- Download and install the Twinmotion Datasmith Exporter plugin for Revit from the Epic Games or Autodesk App Store.
- After installation, a Twinmotion (Datasmith) tab will appear in Revit.

3. Export the Revit Model

- In Revit, go to the Twinmotion tab.
- Click "Export to Datasmith" and choose a location to save the .udatasmith file.
- This file is used to transfer the model into Twinmotion.

4. Open Twinmotion

- Launch Twinmotion.
- Click "Import", then select the exported .udatasmith file.
- Twinmotion will import the model with geometry and materials.

5. Enhance the Model in Twinmotion

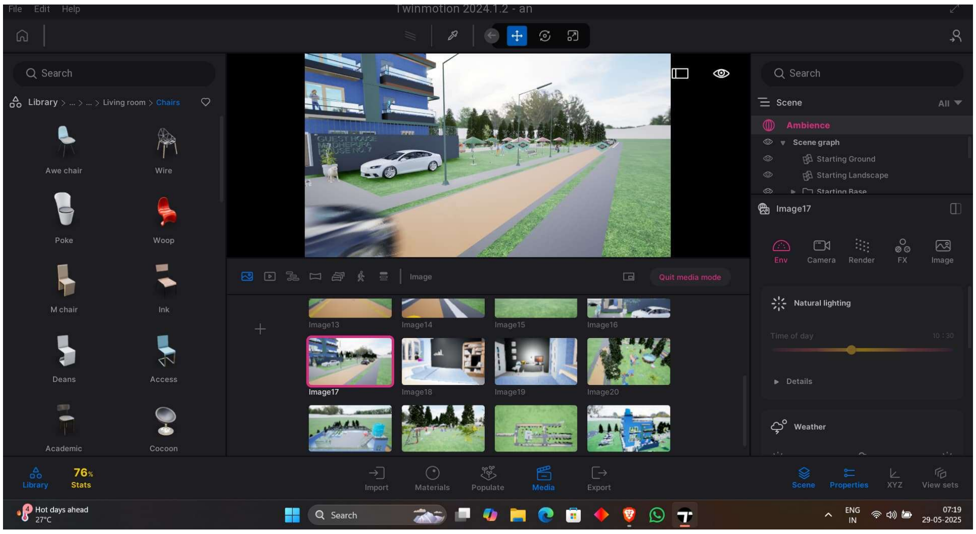
- Add materials: Replace or adjust imported materials using Twinmotion's vast material library.
- Place assets: Add furniture, vegetation, vehicles, and characters.
- Set environment: Adjust lighting, weather, and geographic location to match real-world conditions.
- Animate elements: Add animation for people, doors, vehicles, or day-night cy cles if needed.

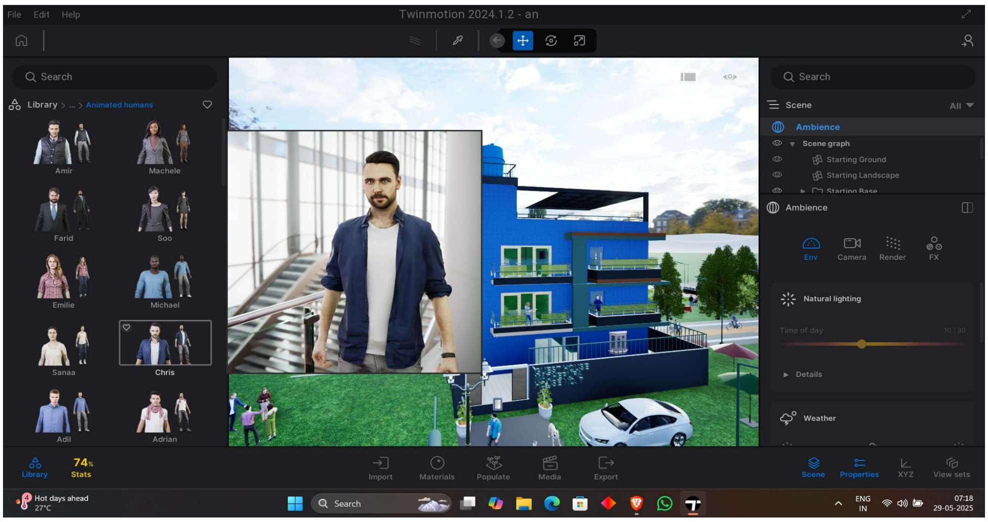
6. Create and Export Visuals

- Use camera tools to set up still images, animations, or panoramic views.
- Create presentations or videos for clients.
- Export your visuals in desired formats (image, video, panorama, or Twinmotion Presenter).

7. Update Workflow (Optional)

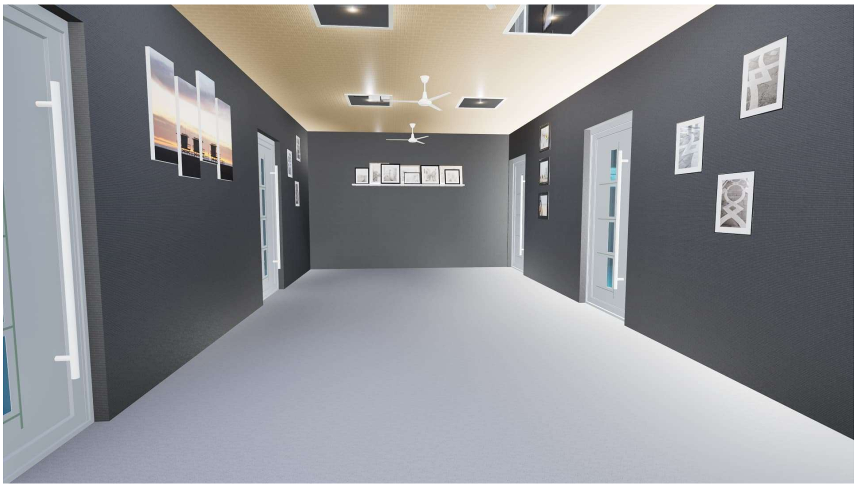
- If you revise the Revit model, you can re-export and update the existing project in Twinmotion using the “Synchronize” feature (if using Direct Link in newer versions).






GUEST HOUSE


GUEST HOUSE



3.8 ESTIMATION AND COSTING :

The detailed and abstract estimate of the G+2 Residential building is estimated by using the plans which are drawn in the AutoCAD software. The quantities are calculated by using the dimensions and cost is estimated by knowing the quantities and applying Standard schedule of rates to it.

S .NO	ITEM DESCRIPTION	NO	LENGTH(FT)	WIDTH(FT)	HEIGHT(FT)	QUANTITY	UNIT
1	SITE CLEANING	1	95	80		7600	SQ.FT
2	EXCAVATION FOR FOUNDATION	16	5	5	5.785	2314	CU.FT
3	PCC at Foundation Thickness=3"10.25A	16	5	5	0.25	100	CU.FT
4	footing Rectangulas Pratum (0.75) Thickness=fff)	16	4	4	0.75	192	CU.FT
5	Column Concreteup to Plinth Column (12"x12")	16	1	1	37.875	606	CU.FT
6	Earth Filling in Plinth Maintaince Room Storage Room + STAFF ROOM	3	14	12	3	1512	CU.FT
	PARKING	1	34.25	24	3	2466	CU.FT
	LIFT	1	6	6	3	108	CU.FT
	STAIR	1	12.5	6	3	229.5	CU.FT
	PASSAGE	1	24.5	33.75	3	248.625	CU.FT
	ALMIRAH + WC	2	6.75	4	3	162	CU.FT
					PLUS	4726.125	CU.FT
7	BRICK WORK IN SUPER STRUCTURE (GROUND FLOOR)						
	LONG WALL (9") =0.75FEET	2	50	0.75	10	750	CU.FT
	SHORT WALL(9")	2	40	0.75	10	600	CU.FT
	SHORT WALL(9") (STORAGE ROOM + MAINTAIN ROOM + STAFF ROOM , VERTICAL)	3	14	0.75	10	315	CU.FT
	HORIZONTAL (STORAGE ROOM + MAINTAIN ROOM + STAFF ROOM)	3	12	0.75	10	270	CU.FT
	ALMIRAH + WC (HORIZONTAL)	2	6.075	0.75	10	91.125	CU.FT
	SHORT WALL (WC) (HORIZONTAL)	1	4	0.75	10	30	CU.FT
	SHORT WALL STAIR (HORIZONTAIL)	1	12.5	0.75	10	93.75	CU.FT
	LIFT (HORIZONTAIL)	1	6	0.75	10	45	CU.FT
8	1st FLOOR						
	LONG WALL (9") =0.75FEET	2	50	0.75	10	750	CU.FT
	SHORT WALL (9")	2	40	0.75	10	600	CU.FT
	SHORT WALL (BEDROOM) (VERTICAL)	4	14	0.75	10	420	CU.FT
	SHORT WALL (BEDROOM) (VERTICAL)	3	11	0.75	10	247.5	CU.FT
	SHORT WALL (BEDROOM) (HORIZONTAL)	3	12	0.75	10	270	CU.FT
	SHORT WALL (BEDROOM) (HORIZONTAL)	1	11	0.75	10	82.5	CU.FT
	SHORT WALL (BEDROOM) (HORIZONTAL)	2	12	0.75	10	180	CU.FT
	SHORT WALL (BEDROOM) (HORIZONTAL)	1	10	0.75	10	75	CU.FT
	W.C (HORIZONTAL)	1	9	0.75	10	67.5	CU.FT
	SHORT WALL (STAIR) (HORIZONTAL	1	12.5	0.75	10	93.75	CU.FT
	TOILET(HORIZONTAL)	2	6	0.75	10	90	CU.FT
	PASSAGE(HORIZONTAL)	1	12.5	0.75	10	93.75	CU.FT
9	2ND FLOOR						
	LONG WALL (9") =0.75FEET	2	50	0.75	10	750	CU.FT
	SHORT WALL (9")	2	40	0.75	10	600	CU.FT
	SHORT WALL (BEDROOM) (VERTICAL)	4	14	0.75	10	420	CU.FT
	SHORT WALL (BEDROOM) (VERTICAL)	3	11	0.75	10	247.5	CU.FT
	SHORT WALL (BEDROOM) (HORIZONTAL)	3	12	0.75	10	270	CU.FT
	SHORT WALL (BEDROOM) (HORIZONTAL)	1	11	0.75	10	82.5	CU.FT
	SHORT WALL (BEDROOM) (HORIZONTAL)	2	12	0.75	10	180	CU.FT
	SHORT WALL (BEDROOM) (HORIZONTAL)	1	10	0.75	10	75	CU.FT
	W.C (HORIZONTAL)	1	9	0.75	10	67.5	CU.FT
	SHORT WALL (STAIR) (HORIZONTAL)	1	12.5	0.75	10	93.75	CU.FT
	TOILET(HORIZONTAL)	2	6	0.75	10	90	CU.FT
	PASSAGE(HORIZONTAL)	1	12.5	0.75	10	93.75	CU.FT
	BALCONY (1ST) (3') (HORIZONTAL)	28	3	0.75	3	189	CU.FT
	BALCONY (1ST) (6')	14	6	0.75	3	189	CU.FT
	BALCONY (2ND) (15') (HORIZONTAL)	2	15	0.75	3	67.5	CU.FT
	BALCONY (2ND (3') (VERTICAL)	2	3	0.75	3	13.5	CU.FT
	BALCONY (3RD (14') (HORIZONTAL)	2	14	0.75	3	63	CU.FT
	BALCONY (3RD) (3') (VERTICAL)	2	3	0.75	3	13.5	CU.FT
					TOTAL =	8670.375	CU.FT
10	FLOOR TILES						
	PARKING	1	34.25	24		822	SQ.FT
	ROOM (STROAGE + MAINTANCE + STAFF)	3	14	12		504	SQ.FT
	PASSAGE	1	24.5	33.75		826.875	SQ.FT

	ALMIRAH + W.C	2	6.75	4		54	SQ.FT
11	1ST FLOOR						
	(A) BEDROOM	2	11	12		264	SQ.FT
	(B) BEDROOM	1	11	10		110	SQ.FT
	(C) BEDROOM	3	14	12		504	SQ.FT
	(D) BEDROOM	1	14	11		154	SQ.FT
	TOIILET	2	6	6		72	SQ.FT
	W.C	1	9	5		45	SQ.FT
	HALL	1	12.5	28.6		357.5	SQ.FT
	PASSAGE	1	17.5	6		105	SQ.FT
12	2ND FLOOR						
	(A) BEDROOM	2	11	12		264	SQ.FT
	(B) BEDROOM	1	11	10		110	SQ.FT
	(C) BEDROOM	3	14	12		504	SQ.FT
	(D) BEDROOM	1	14	11		154	SQ.FT
	TOIILET	2	6	6		72	SQ.FT
	W.C	1	9	5		45	SQ.FT
	HALL	1	12.5	28.6		357.5	SQ.FT
	PASSAGE	1	17.5	6		105	SQ.FT
					TOTAL =	5429.875	SQ.FT
13	DEDUCTION						
	VENTILATION	7	2	0.75	2	21	CU.FT
	ENTRANCE	1	12	0.75	7.75	69.75	CU.FT
	DOOR (MD)	2	3.25	0.75	7	34.125	CU.FT
	DOOR (D)	17	3	0.75	7	267.75	CU.FT
	DOOR (D1)	22	2.5	0.75	7	288.75	CU.FT
	WINDOW (W1)	3	4	0.75	4	36	CU.FT
	WINDOW (W2)	2	5	0.75	4	30	CU.FT
	WINDOW (W3)	16	3	0.75	4	144	CU.FT
	GLASS (G)	4	10	0.75	5	150	CU.FT
					TOTAL =	1041.375	CU.FT
14	DEDUCTION						
	ACTUAL BRICK WORK	1	8670.375	MINUS	1041.375	7629	CU.FT
	13.5 BRICK IN 1(CUFT)	1	7629	@	13.5	102991.5	NOS
15	SLAB CONCRETE	2	50	40	0.5	2000	CU.FT
	STEEL IN SLAB @ 2.90KG/CUFT	2	2000	@	2.9	11600	KG
	CEMENT (0.22 BAG/CU.FT)	2	2000	@	0.22	880	BAG
	SAND (0.414 CUFT/1 CUFT)	2	2000	@	0.414	828	CU.FT
	AGGREGATE (0.82 CUFT / 1CUFT)	2	2000	@	0.829	3316	CU.FT

CONSTRUCTION MATERIAL IN STRUCTURE				
S.N	ITEM DESCRIPTION	QUANTITIY	RATE	COST
1	NORMAL CEMENT	1920 BAG	375-400 PER BAG	768000
2	WATERPROOF CEMENT	183 BAG	420-440 PRE BAG	80520
3	PCC CEMENT	1674 BAG	350-380 PER BAG	636120
4	RIVER SAND	18171 CFT	44 CFT	799524
5	AGGREGATE	6687 CFT	40 CFT	267480
6	BRICK (1ST)	148735 NOS	9 PER PIEC	1338615
7	STEEL	47600 KG	80-85 KG	3808000
			TOTAL COST	7698259

CONSTRUCTION MATERIAL IN FINISHING				
S.N	ITEM DESCRIPTION	QUANTITY	RATE	COST
1	1'X1' (1 BOX=9 PIC)	261NOS	25-30 SQFT	7308
2	2'X2'(1 BOX=4)	700NOS	30-35SQFT	24500
3	CEMENT BLOCK	5763NOS	9-13 PER PCS	74919
4	GRANITE	935 SQ FT	60-70 SQ FT	60775
5	PVC DOOR (TOILET BATH)	7 NOS	2000-2500	17500
6	WOODEN DOOR (INTERNAL)	33 NOS	2500-3000	92400
7	INTERANCE DOOR (MAIN GATE)	2 NOS	20000-30000	60000
8	IRON DOOR FRAME	33 NOS	1600-2000 NOS	59400
9	WINDOW	2080 SQ FT	550-800SQFT	196000
10	WALL PUTTY	226 BAG	850-900 BEG	192100
11	PAINT	735 LTR	250 LITER	183750
12	GLASS	200SQ FT	300-500 SQFT	60000

13	WATER TANK	200SQ FT	4-7 LTR	60000
			TOTAL COST	1088652

CONSTRUCTION LABOUR COST				
1.	ITEM DESCRIPTION	QUANTITY	RATE	COST
2	EXCAVATION	2674 CFT	10-12 CFT	26740
3	SOIL / MURRUM FILLING	4668.125 CFT	4-5 CFT	2390
4	PCC WORK	100 CFT	35-40 CFT	4000
5	FLORING PCC WORK	2000 CFT	15-20 SQ FT	40000
6	FOOTING FOUNDATION WORK	192 CFT	40-45 CFT	7680
7	COLUMN CONCRETE WORK	480 CFT	55-60 CFT	28800
8	PLINTH BEAM WORK		55-60 CFT	
9	RCC SLAB CONCRETING WORK	400 CFT	45-50 SQ FT	200000
10	CONTILEVER & ELEVATION SLAB CONCRETING WORK		60-65 CFT	106000
11	SHUTTRING WORK	4000 SQ FT	40-45 SQ FT	19200
12	SHUTTRING BORD MAKING WORK	480 SQ FT	40-45 SQ FT	19200
13	STEEL REINFORCEMENT AND BENGING WORK	47600 KG	7-8 KG	238000

13	STEEL REINFORCEMENT AND BENGING WORK	47600 KG	7-8 KG	238000

14	BRICK WORK & BLOCK WORK	X	X	X
15	9’’	13485SQ FT	30-35 SQ FT	404550
16	PLASTRING WORK			
17	12MM	26970 SQ FT	15-18 SQFT	404550
18	6MM	4000 SQ FT	18-20 SQFT	108000
19	PUTTY/PRIMER/PAINT WORK	32970 SQ FT	12-15 SQ FT	428610
20	TILE LAYING &FLOORING WORK	2757 SQ FT	15-20 SQ FT	50346
21	SKIRTING	539 FT	20 FT	10780
22	TILE SPAKER WORK	2757 SQ FT	2 SQ FT	5594
23	MARBALE AND GRANITE FINISHING WORK	935 SQ FT	35-40 SQ FT	37400
24	DOOR & WINDOW FABRICATION WORK	3047 SQ FT	25-30 SQ FT	91425
25	TOILET BATHROOM WATERPROOFING	262 SQ FT	20-25 SQ FT	5220
25	REPAIR & MAINTANANCE WORK	6000 SQ FT	3-5 SQ FT	30000
			TOTAL COST	2249285

TABLE – 7.3

OVERALL COST OF CONSTRUCTION				
S.N	DESCRIPTION	QUANTITY	RATE	AMOUNT

1	CEMENT IN BAG	3777 BAG	394	1484640
2	STEEL IN KG	47600 KG	80	3808000
3	SAND IN CFT	18171 CFT	44	799524
4	AGGREGATEIN CFT	6737 CFT	40	267480
5	BRICK IN NOS	148735 NOS	9	1338615
6	GRANITE SQFT	935 SQFT	65	60775
7	TILE SQFT	3060 SQFT	10.5	32130
8	PUTTY IN BAG	226 BAG	850	192100
9	PAINT	735 LTR	250	183750
10	FINISHING COST			190620
11	LABOUR COST			2249285
12	ENGINEER/ARCHITED			150000
			TOTAL COST	10756919
TOTAL COST OF CONSTRUCTION			APPROX	1 CR 8LAC

TABLE- 7.4

4. Result and Discussion :

The integrated use of these software tools provides a comprehensive and efficient approach to building design and construction. The combination of AutoCAD, Revit, SketchUp, and Primavera enhances the accuracy, visualization, and management of the project.
AutoCAD ensures precise planning and layout optimization.
Revit improves 3D visualization and design coordination.
SketchUp enhances the interior aesthetics and spatial arrangements.
Primavera enables effective scheduling and cost estimation, reducing project risks.
The integration of these software tools resulted in an accurate and efficient building design.
The structural safety, interior aesthetics, and functional space utilization were well-balanced.
Primavera's scheduling and cost estimation ensured the timely and cost-effective execution of the project.
The collaborative workflow between AutoCAD, Revit, STAAD.Pro, SketchUp, and Primavera streamlined the entire design and construction process.

5. Conclusion :

The project titled "Comprehensive Design of a Building Using BIM" successfully demonstrated the effective integration of modern software tools in the planning, analysis, design, visualization, scheduling, and estimation of a guest house building. By following a structured methodology an d using industry-standard applications like AutoCAD, Revit, STAAD.Pro, SketchUp, Twinmotio n, and Primavera, a complete building design was developed that is functionally efficient, structura lly sound, visually appealing, and economically viable. Through this project, the advantages of Building Information Modelling (BIM) were clearly realized. The BIM workflow ensured better accuracy, early error detection, improved coordination, and smoother communication among all components of the project. The structural design was verified using STAAD.Pro and was found to be safe against dead loads, live loads, and seismic forces as per IS codes. A detailed bar bending schedule and cost estimate were also generated, which make the project practical and executable. The total cost of construction was estimated to be approximately ₹1.08 Crore, and the project schedule Was developed using Primavera to ensure timely execution. The final 3D visualization through Twinmotion enhanced the understanding of space usage and interior design.

In conclusion, this project not only fulfilled its objective of designing a guest house but also strengthened the practical understanding of BIM tools and their real-world application in modern construction projects. It reflects the future of the construction industry and sets a bench mark for efficient, coordinated, and sustainable building design practices.

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