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Modelling and Layout of Duplex House (G+2) by Using Revit

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Abstract - This project focuses on the planning, layout design and 3D modelling of a G+2 duplex residential building using Autodesk Revit software based on Building Information Modelling (BIM) technology. The main objective of the project is to develop an accurate architectural model that includes floor plans, elevations, sections, 3D views, and detailed building components in an integrated digital environment. Revit allows all building elements such as walls, doors, windows, floors, roofs, and staircases to be modelled parametrically, which helps in making quick modifications and maintaining coordination between drawings. The duplex house layout is designed to accommodate two residential units with proper space planning, ventilation, lighting, circulation, and functional room arrangements. The ground floor, first floor, and second floor layouts are prepared according to residential building planning standards. The model also includes structural components, levels, grids, and material applications to create a realistic building representation. Using Revit, the complete building model is developed in 3D along with rendering and walkthrough views for better visualization of the project. The project demonstrates how Building Information Modelling (BIM) tools like Revit can be effectively used for residential building design, modelling, and documentation. It improves design accuracy, reduces drafting errors, saves time in making revisions, and helps in better project visualization and presentation. The final outcome of the project includes detailed 2D drawings, a 3D building model, rendered views, and a complete duplex house layout prepared using Revit software.

Key Words: *Duplex Housing, G+2 Residential Building, Building Information Modelling (BIM), Revit Architecture, AutoCAD, 3D Modelling and Rendering, 2D Drafting.*

1. INTRODUCTION

Autodesk Revit is a software which helps to create the modelling and layout of three-dimensional Building Information Modelling (BIM) for architects, landscape architects, structural engineers, layout engineers, designers and contractors developed by Autodesk. It allows users to design a building and structure and shape of the 3D model by default furniture setup and its components in 3D, annotate the model with 2D drafting elements, and access building information from the building model's database. Revit is 4D BIM capable with tools to plan and track various stages in the building's lifecycle, from concept to construction and later maintenance and/or demolition.

Fig 1: Autodesk Revit BIM Software

Revit can be used as a very powerful collaboration tool between different disciplines in the building design sphere. The different disciplines that use Revit approach the program from unique perspectives. Each of these perspectives is focused on completing that

discipline's task. Companies that adopt the software first examine the existing workflow process to determine if such an elaborate collaboration tool is required.

In today's rapidly urbanizing world, the need for efficient and sustainable housing solutions has become more important than ever. As land availability decreases and population density rises, modern housing concepts such as duplex homes are gaining popularity due to their compact design, better space utilization, and affordability. A duplex house, typically consisting of two individual residential units within a single structure, provides a practical and versatile solution for families seeking independent yet connected living spaces. This concept not only meets the needs of nuclear and joint families but also offers an opportunity for rental income and long-term investment, making it a preferred choice in modern residential planning.

The motivation behind choosing this project lies in exploring and understanding how duplex housing can serve as a smart architectural solution for urban communities. With the growing focus on compact living and cost-effective construction, we aimed to develop a project that reflects both functional and aesthetic values. Additionally, with architecture and construction industries increasingly shifting toward digitization, mastering Building Information Modelling (BIM) tools such as Autodesk Revit Architecture has become essential. Revit offers a platform that allows the creation of intelligent 3D models, enabling designers to simulate, visualize, and coordinate all aspects of a building project from conceptualization to presentation.

The core objective of this project is to design a duplex residential building using Revit Architecture, integrating principles of space efficiency, functional zoning, and visual appeal. The process includes developing detailed floor plans, 3D modeling, realistic renderings, and walkthrough animations to effectively communicate the design intent. Through this, the project aims to strengthen our practical knowledge of residential planning and software-based design execution, while improving our technical skills and understanding of architectural workflows.

This major project holds significant academic and industry relevance. Academically, it allows students to apply classroom knowledge in a real-world context, bridging the gap between theory and practice. It enables us to understand design development from basic concepts to full-fledged documentation. From an industry perspective, the project reflects current professional standards where BIM tools like Revit are not just preferred but often required. Proficiency in such tools opens doors to job roles in design firms, construction companies, and real estate consultancies, making this project an important step toward career readiness.

The scope of the project includes conceptual planning, 2D drafting, 3D modelling, rendering, scheduling, and creation of working drawings for a duplex house. The project focuses mainly on the architectural aspects of the design. Structural detailing, MEP (Mechanical, Electrical, Plumbing) services, and site-specific environmental analysis are not deeply covered within this project. However, a basic understanding of area requirements, user needs, and modern living trends is considered throughout the design process.

Looking ahead, the future scope of this project is quite promising. The model can be further expanded by incorporating advanced sustainability features such as solar panels, green roofs, rainwater harvesting systems, and energy-efficient materials. Moreover, this model can be structurally analyzed using software like STAAD.Pro, and interior detailing can be enhanced through tools like 3ds Max. The project can also be developed into a full proposal for a real-time site with soil and environmental analysis, giving it practical execution value.

2. DETAILING ABOUT PROJECT

2.1 AutoCAD Plan

In the floor layouts, the building includes bedrooms, kitchens, living rooms, glass walls (Curtain Walls), windows, doors, ventilation openings, and common as well as attached washrooms. The building is also provided with ramp and staircase access for vertical circulation between floors.

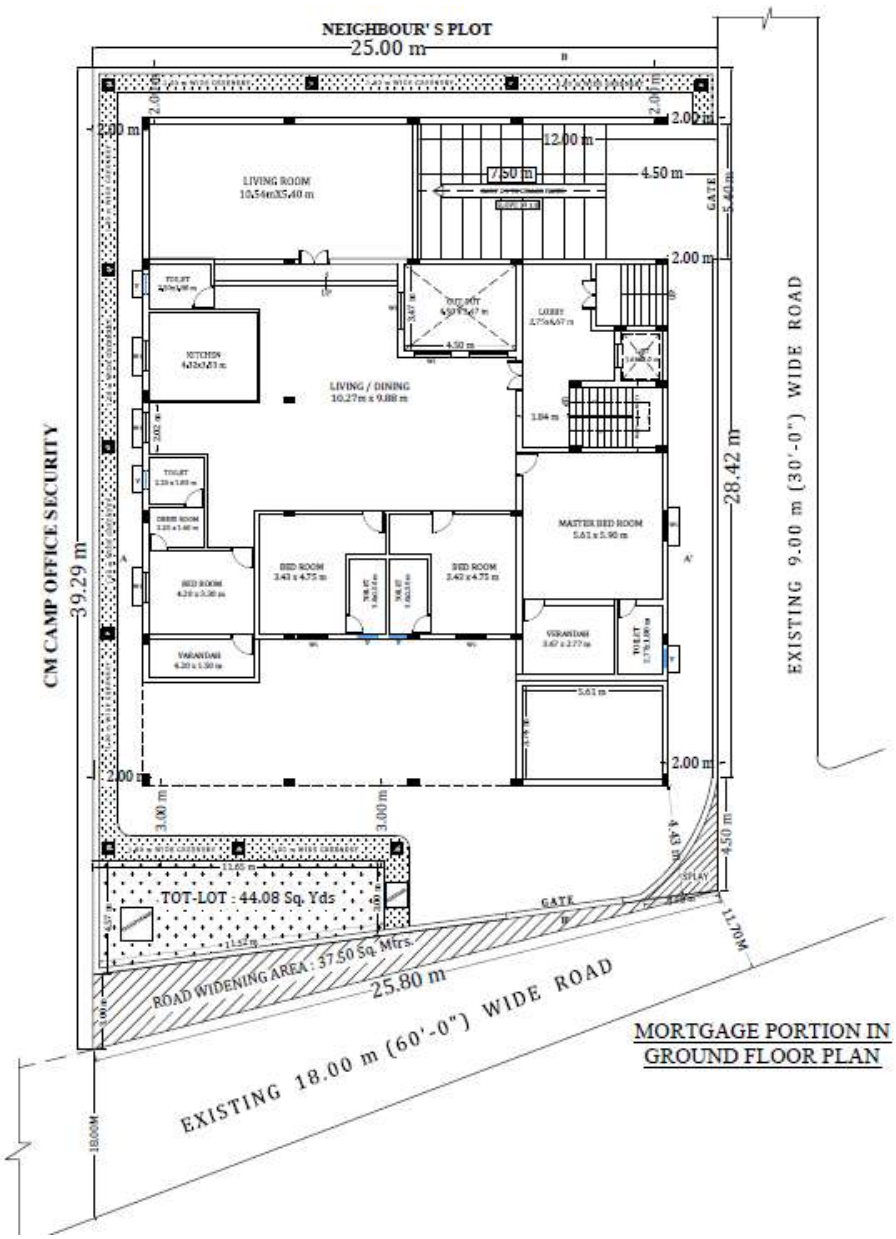

Fig 2: AutoCAD Ground Floor Plan

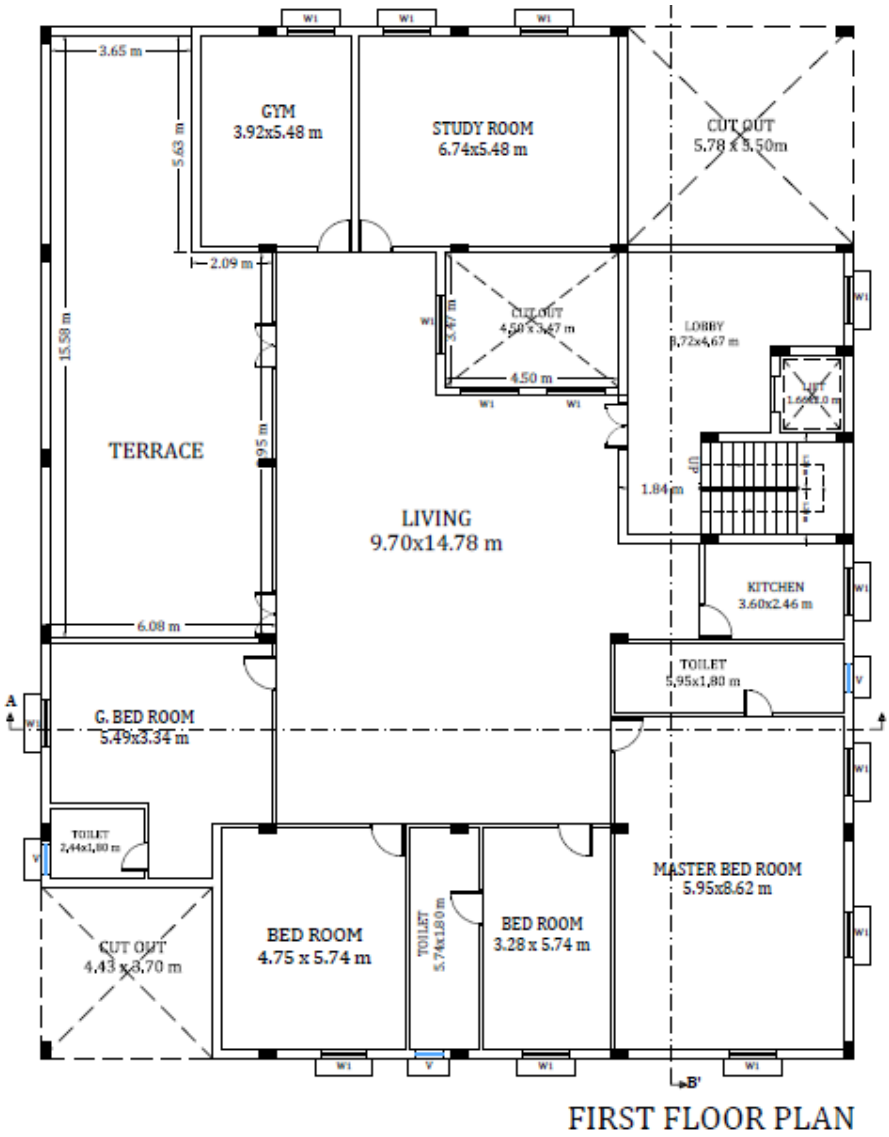

Fig 3: Ramp and Stairs Plan

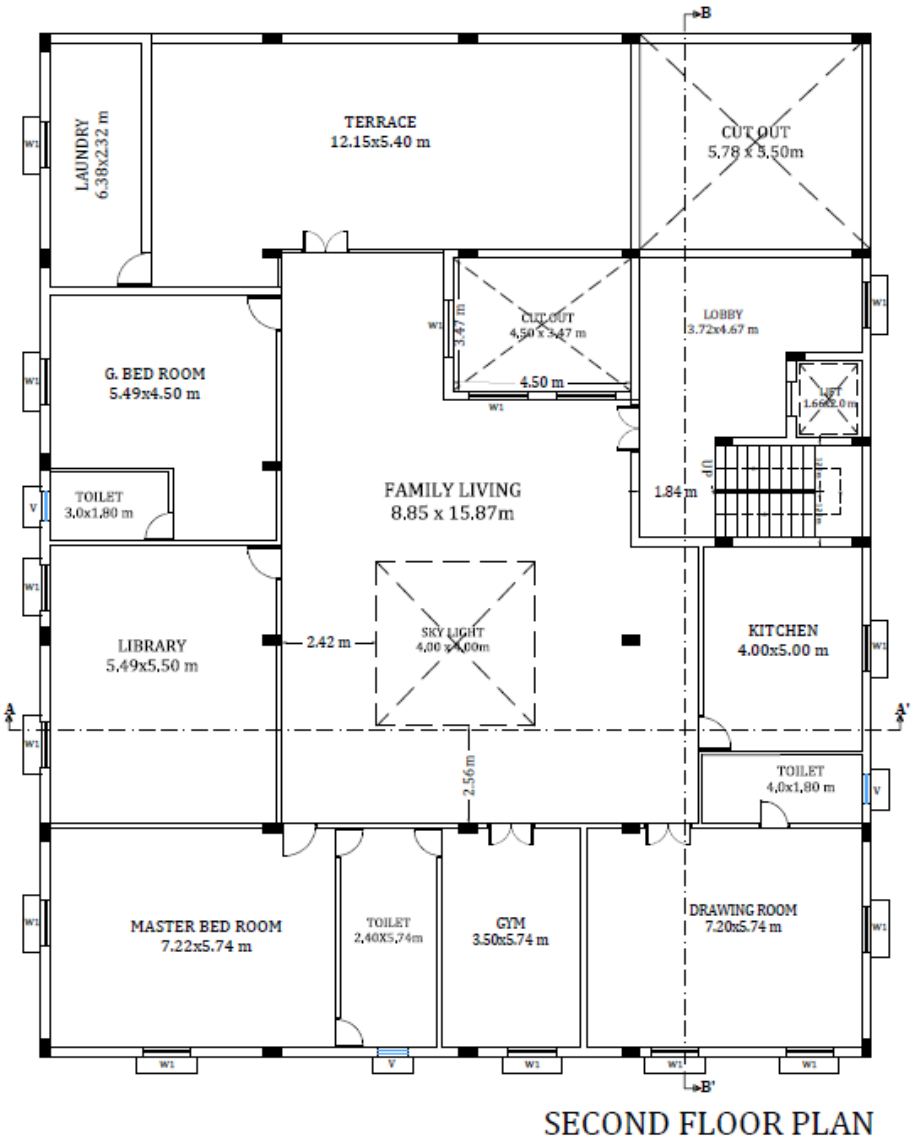

Fig 4: AutoCAD Detailed Plan

4.6 Creating Walls

To create the wall in Revit software, go to Revit and open the file menu. In the file menu, select project browser. In the Project Browser, under Floor Plans, double-click 00 Foundation to open that view in the drawing area. On the Design Bar, click Wall. In the Type Selector, select Basic Wall: Retaining - 12″ Concrete. On the Options Bar, click Draw. For Height, select 02 Entry Level. For Loc Line, verify that Wall Centreline is selected and verify that Chain is selected.

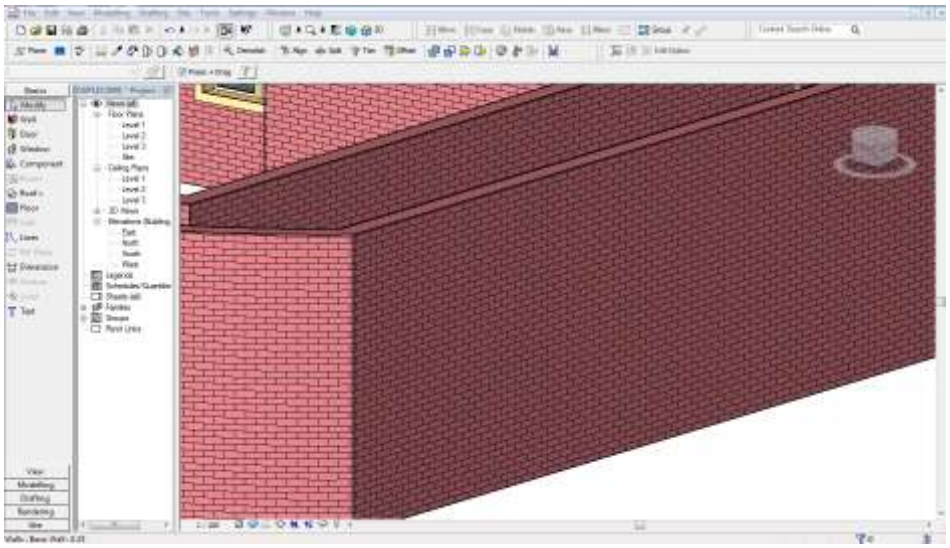

Fig 5: Wall Creation in Revit

4.7 Roof

The predominant roof type in the city is the pitched roof, and it should generally be used. Flat roofs may be considered in certain hillside locations, where this is a more common building form. Sloped roofs should incorporate a considerable amount of articulation in order to break up the mass of the building and make it visually more interesting. In duplexes or triplexes built on the hillside, the building should be terraced to reflect the sloping terrain.

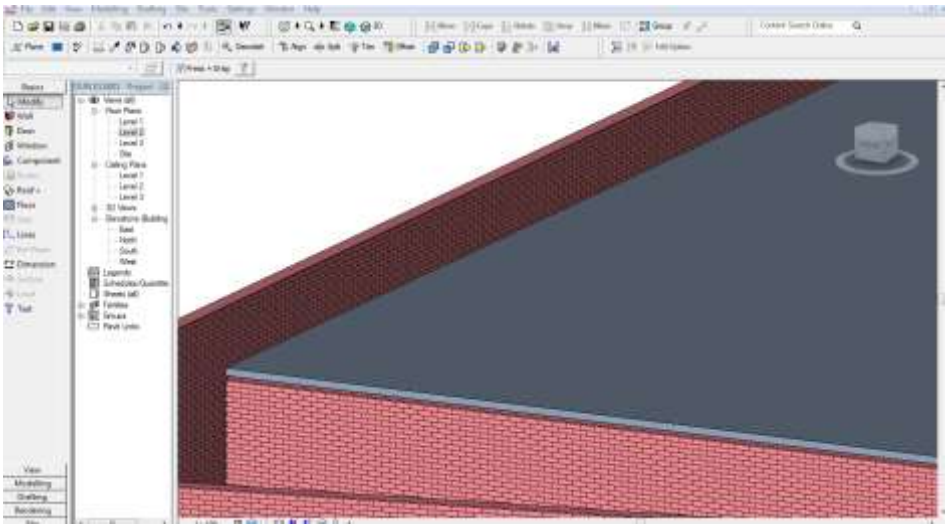

Fig 6: Roof Design

4.8 Adding Floors

To create floors in Revit Architecture, you must sketch them first in a sketch editor. Two different sketching options, Pick and Draw, are used to sketch the floors. Open the Lower-Level floor plan. On the Design Bar, click Floor, and then click Lines. On the Options Bar, click Pick Lines and verify that Offset is 0. Beginning with the north wall and moving counterclockwise, select the interior of the walls. If the floor lines do not create a closed sketch, the sketch is invalid and needs to be cleaned up. To be valid, the sketch must be a closed loop with no disconnected or crossing lines.

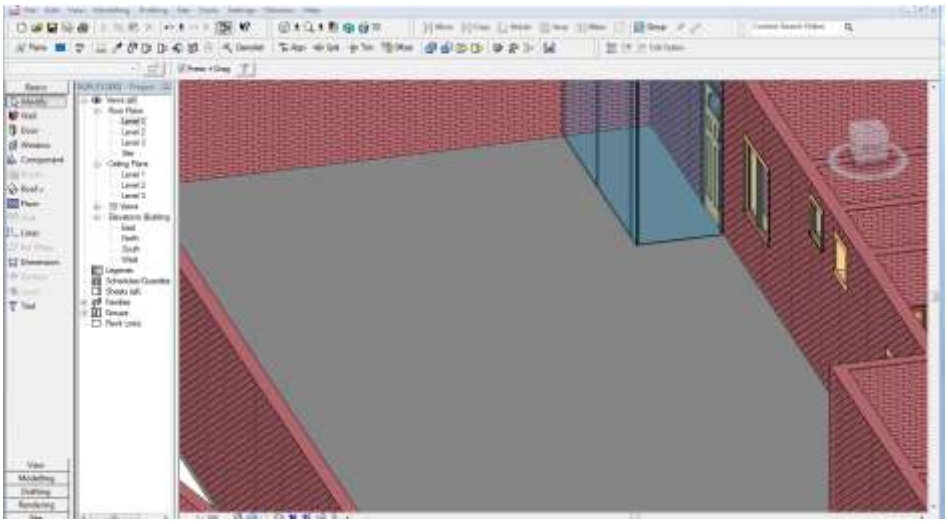

Fig 7: Flooring in Revit

4.9 Adding Interior Walls

Open the Lower-Level floor plan. On the Design Bar, click Wall. In the Type Selector, select Basic Wall: Generic - 6″. On the Options Bar, click Draw. For Height, select 02 Entry Level. For Loc Line, select Wall Centreline. Clear Chain. Two or three types of cladding materials should be used in order to avoid large expanses of uniform material for the exterior wall cladding. Consideration should be given to incorporating a secondary material into vertical design features to break up the mass of the building.

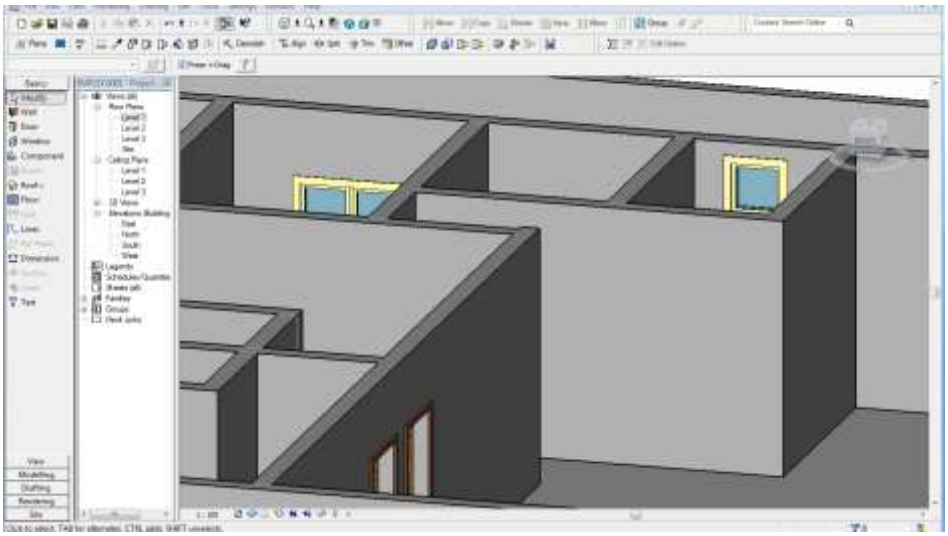

Fig 8: Adding Interior Walls

3. LITERATURE REVIEW

The concept of duplex residential buildings has gained significant importance in modern urban housing due to increasing population density, limited land availability, and the need for efficient space utilization. Duplex houses provide a practical solution for multi-family living, rental income opportunities, and better privacy compared to apartment-style housing. Proper spatial planning, circulation, ventilation, and functional zoning are essential aspects in duplex house design. Architectural planning principles and residential design standards play an important role in developing efficient and comfortable living spaces in multi-storey residential buildings such as G+2 duplex houses.

With the advancement of digital technology in the construction industry, Building Information Modelling (BIM) has become an essential tool for planning, designing, modelling, and documenting buildings. Software such as Autodesk Revit enables architects and engineers to create intelligent 3D models where plans, elevations, sections, schedules, and quantities are interconnected. BIM improves coordination between architectural and structural components, reduces design errors, saves time, and enhances visualization through rendering and walkthrough presentations. Many researchers and previous academic projects have demonstrated the effectiveness of Revit in residential building modelling and documentation.

Literature Sources:

1. Ching, F. D. K. (2007) – In the book Architecture: Form, Space, and Order, Ching emphasized the importance of spatial organization, circulation, and functional planning in residential buildings. The study explains how duplex housing provides privacy, efficient space utilization, and suitable planning for multi-family residential living within limited land areas.

2. Sharma et al. (2018), Journal of Housing Studies – This study highlighted duplex housing as an economical and efficient housing solution for urban middle-class families. The research emphasized the dual advantage of duplex houses, where one portion can be used for personal residence and the other for rental income, making it financially beneficial.

3. Eastman et al. (2011), BIM Handbook – The BIM Handbook defined Building Information Modelling (BIM) as a digital representation of the physical and functional characteristics of a building. The study explained that BIM improves collaboration among architects, engineers, and contractors and enhances visualization, coordination, and documentation in building design.

4. Malkawi & Nassar (2012) – The authors stated that BIM tools such as Autodesk Revit improve construction accuracy, assist in building performance analysis, and help reduce project time and cost overruns by minimizing design errors and improving coordination.

5. Autodesk Revit Documentation – According to Autodesk documentation, Revit Architecture supports parametric 3D modelling, 2D drafting, scheduling, quantity take-offs, rendering, and walkthrough presentations. The parametric modelling feature ensures that any changes made in one view are automatically updated in all views and drawings.

6. Patel & Shah (2019), Gujarat Technological University Project – This project involved modelling a residential building using Revit software. The study demonstrated that digital planning and BIM modelling improve visualization, drawing generation, and understanding of structural and architectural layouts.

7. S. Meena (2021), Final Year Project – This project focused on the design and analysis of a duplex house using Revit and STAAD.Pro. The integration of architectural modelling and structural analysis helped produce accurate building components and professional-level project documentation.

8. NBS National BIM Report (2020) – The report highlighted the increasing adoption of BIM worldwide and identified Revit as one of the most widely used BIM tools. The report also emphasized the importance of BIM education in universities to prepare students for modern construction industry practices.

9. IS 8888 & NBC 2016 Guidelines – These Indian standards serve as reference guidelines for residential building planning and design. They provide regulations related to minimum room dimensions, setbacks, lighting, ventilation, safety requirements, and planning standards for residential buildings including duplex houses.

10. University Projects & Research Papers (Various) – Many academic projects and research papers focus on modelling G+1 and G+2 duplex residential buildings for urban housing using BIM tools. These studies commonly include architectural planning, 3D modelling, rendering, and basic material estimation using Revit schedules.

4. METHODOLOGY

The methodology adopted for this project involves planning, architectural modelling, structural modelling, coordination, and documentation of a G+2 duplex residential building using Autodesk Revit. The project begins with requirement analysis and space planning based on residential building standards and duplex housing requirements. The building layout is planned considering functionality, circulation, lighting, ventilation, and municipal building regulations such as setbacks, height restrictions, and building coverage. Proper zoning of living spaces, bedrooms, kitchen, toilets, and terraces is done to ensure comfortable residential planning.

After planning, the architectural model of the building is developed in Autodesk Revit by creating levels, grids, walls, doors, windows, floors, roofs, staircases, and balconies. The model is developed floor by floor for Ground Floor, First Floor, and Second Floor. Revit families are used for placing building components, and room tags and dimensions are assigned to define the spaces properly. Once the architectural model is completed, structural elements such as columns, beams, slabs, and footings are modelled based on structural load paths and grid layout. This helps in integrating both architectural and structural components within a single BIM model.

Further, model coordination is carried out to ensure proper alignment between architectural and structural components. Sections, elevations, and 3D views are used to check the alignment and detect clashes between structural and architectural elements. Finally, schedules such as door schedules, window schedules, area statements, and basic quantity take-offs are generated automatically in Revit. All drawings including plans, elevations, sections, and schedules are placed on sheets and plotted for final documentation and presentation.

4.1 Requirement Analysis and Planning

- Site dimension assumed: 40 ft × 60 ft
- Functionality: Duplex layout with living spaces, bedrooms, kitchen, toilets, balconies, and terraces
- Planning includes proper ventilation, lighting, circulation, and space utilization
- Design complies with local municipal regulations including setbacks, building height limits, and building coverage
- Consideration given to duplex arrangements such as front/back duplex or top/bottom duplex depending on site conditions

4.2 Architectural Modelling

- Levels created for Ground Floor, First Floor, and Second Floor in Revit
- Grids created to place columns and walls accurately
- Walls, doors, and windows modelled using Revit families
- Floors, roofs, balconies, and parapet walls created
- Room tags and dimensions assigned to define room areas and space usage
- Staircase designed for vertical circulation between floors
- Balconies and terraces designed for elevation aesthetics and functional use
- 3D model developed for visualization and rendering

4.3 Structural Design

- RCC columns placed based on grid layout and load transfer path
- Beams provided connecting columns to support slabs
- Slabs defined using structural floor components
- Footings modelled and placed under column locations
- Structural components coordinated with architectural model

• Basic structural layout prepared within Revit environment

4.4 Model Coordination

• Architectural and structural models coordinated in 3D view
• Sections and elevations used to check vertical and horizontal alignment
• Clash detection performed manually by checking intersections between beams, columns, walls, and slabs
• Adjustments made to ensure proper alignment of structural and architectural elements
• Final coordinated model prepared for documentation

4.5 Schedule and Sheet Creation

• Auto-generated door schedules and window schedules created
• Room area schedules and area analysis prepared
• Basic BOQ (Bill of Quantities) generated from Revit schedules
• Final drawings including plans, sections, elevations, and schedules placed on drawing sheets
• Sheets plotted with proper scale, title block, and annotations for final project submission

4.10 Door

In this exercise, doors are loaded from the Training Files folder into the project and then interior and exterior doors are added to the model. On the Basics tab of the Design Bar, click Door. Additional door types can be loaded from the Training Files folder. Load doors including Bifold-4 Panel, Double-Glass 2, and Single-Glass 2. Add exterior doors by opening the 01 Lower-Level floor plan. In the Type Selector, select Double-Glass 2: 72″ x 84″, and place the door in the appropriate wall locations.

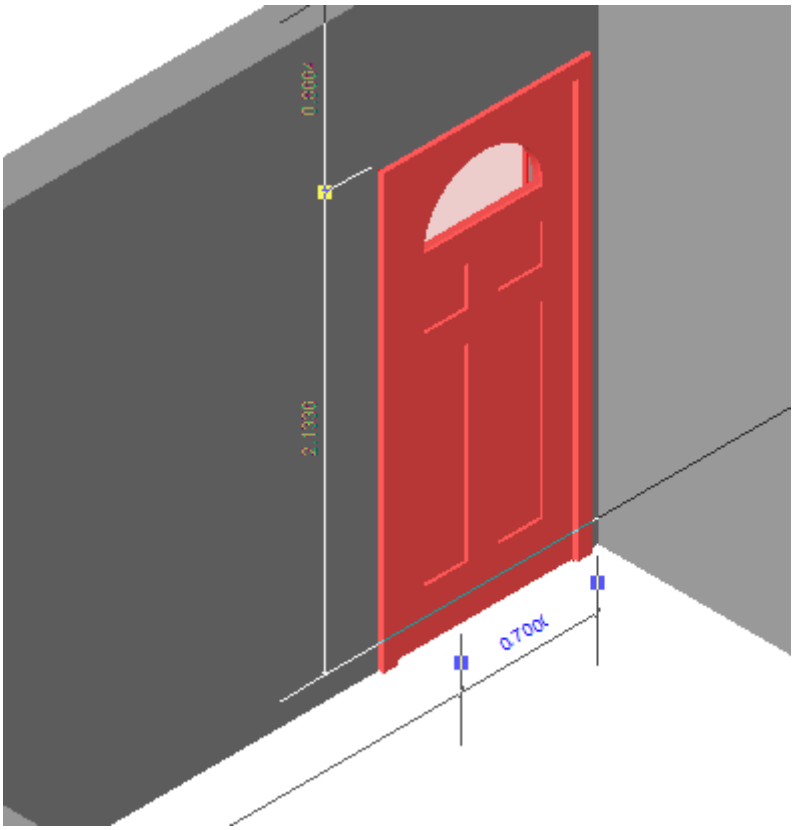

Fig 9: Door Placement in Revit

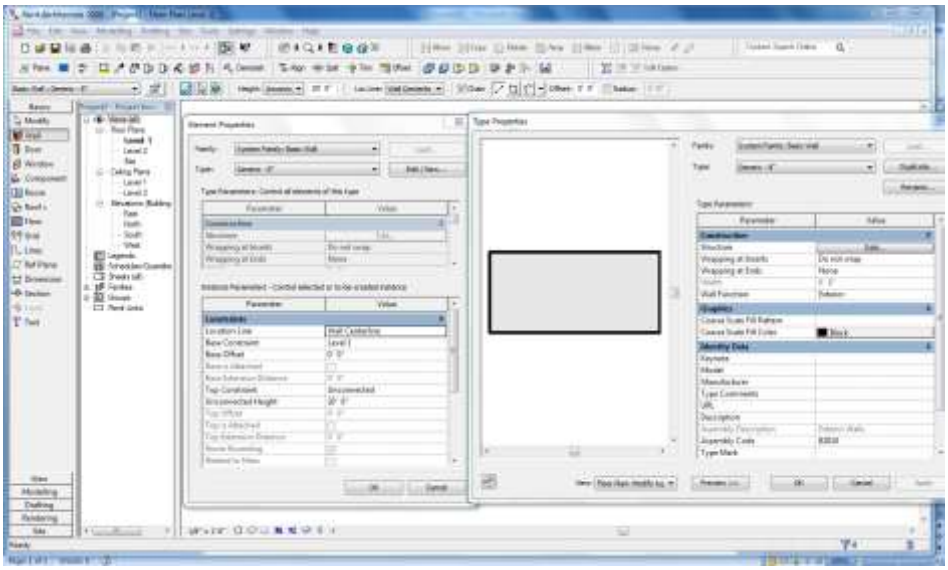

Fig 10: Door Types and Placement

4.11 Adding Windows

In this exercise, work is done in elevation and plan views to add windows to the model. Alignment and dimension tools are used to more precisely position the windows. Open the South elevation view and zoom in to the building. On the Design Bar, click Window and clear Tag on Placement. Load Casement 3x3 with Trim from the Training Files folder. Add windows and position them with alignment to the top of the retaining wall.

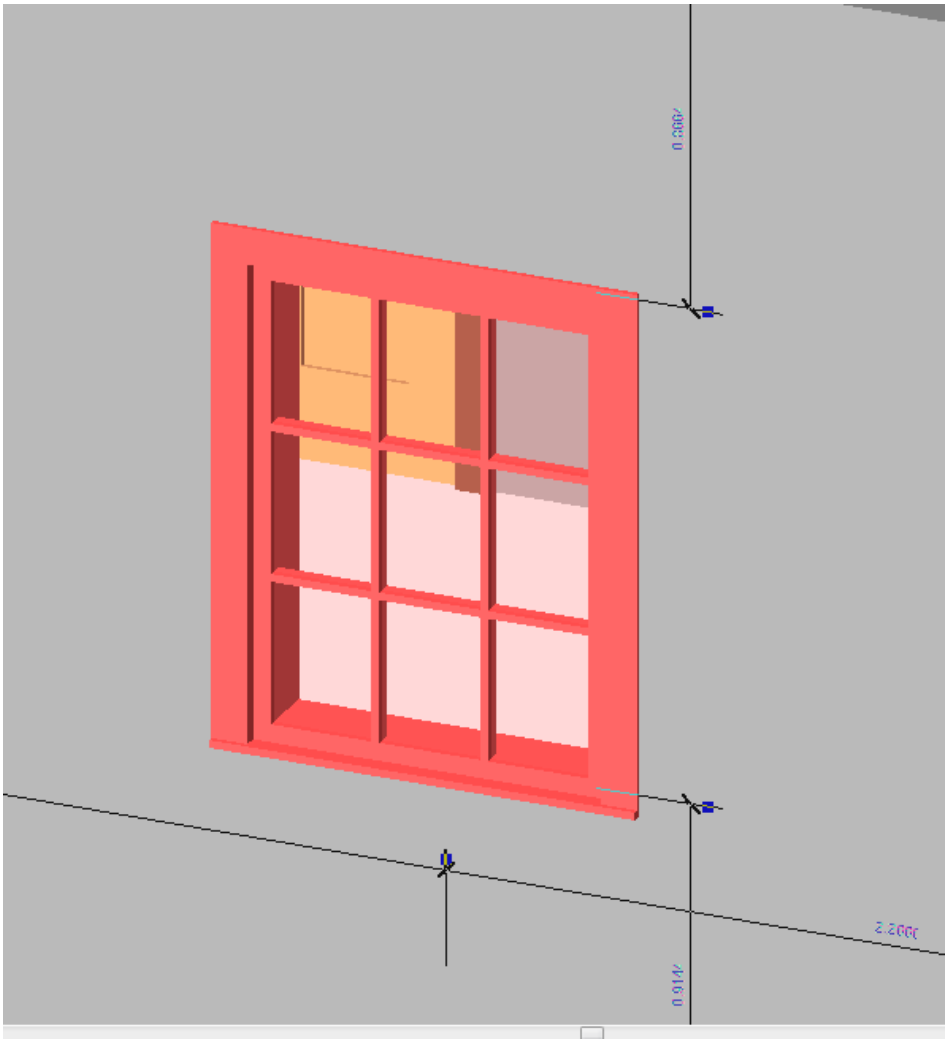

Fig 11: Window Placement (Elevation View)

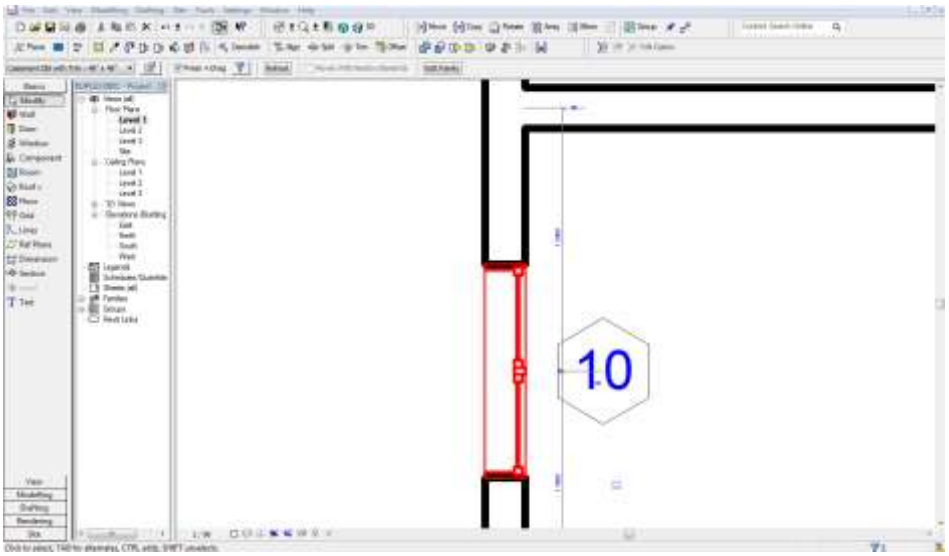

Fig 12: Windows in 2D Plan View

4.12 Adding a Curtain Wall

In this exercise, existing exterior walls are changed to curtain walls. A curtain wall type is then created that can be applied to other walls using the Match Type tool. Open the Lower-Level floor plan. Create a curtain wall at the northeast corner of the building. Zoom to the east wall, use the Split tool, and split the east wall just above the door. Select the upper portion of the east wall and the adjacent portion of the north wall. In the Type Selector, select Curtain Wall: Storefront.

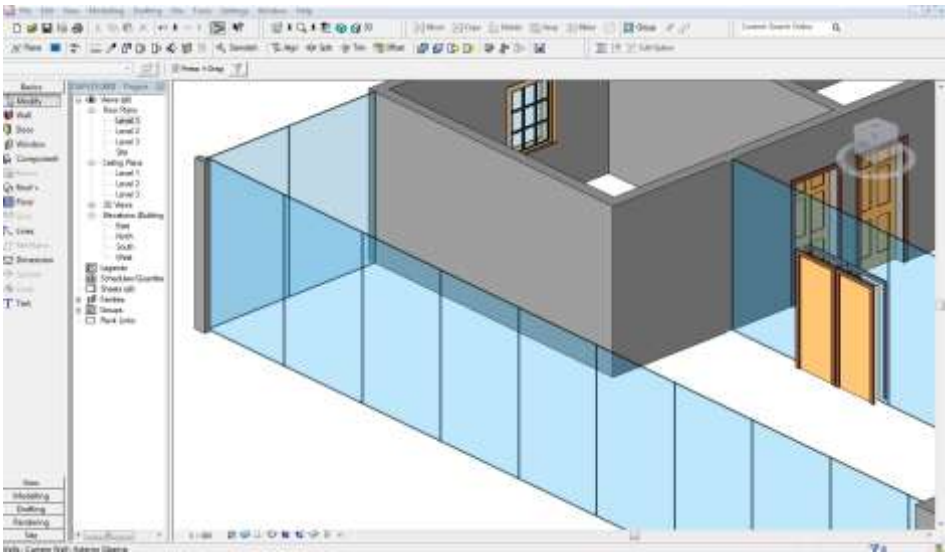

Fig 13: Curtain Wall in 3D View

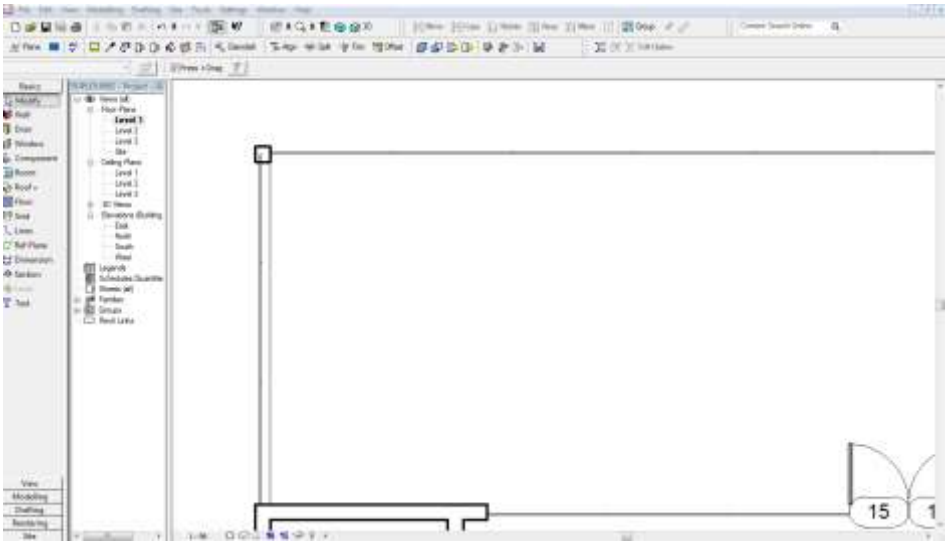

Fig 14: Curtain Wall in 2D Plan

4.13 Create a Curtain Wall Type

Select the north curtain wall at an end so the whole curtain wall is selected and click Properties. In the Element Properties dialog, click Edit/New. In the Type Properties dialog, click Duplicate. For Name, enter House 4'x4', and click OK. Under Vertical Grid Pattern, for Spacing, enter 4'. Under Horizontal Grid Pattern, for Spacing, enter 4'. Match the type of the north curtain wall to the east curtain wall using the Match Type tool on the Tools toolbar.

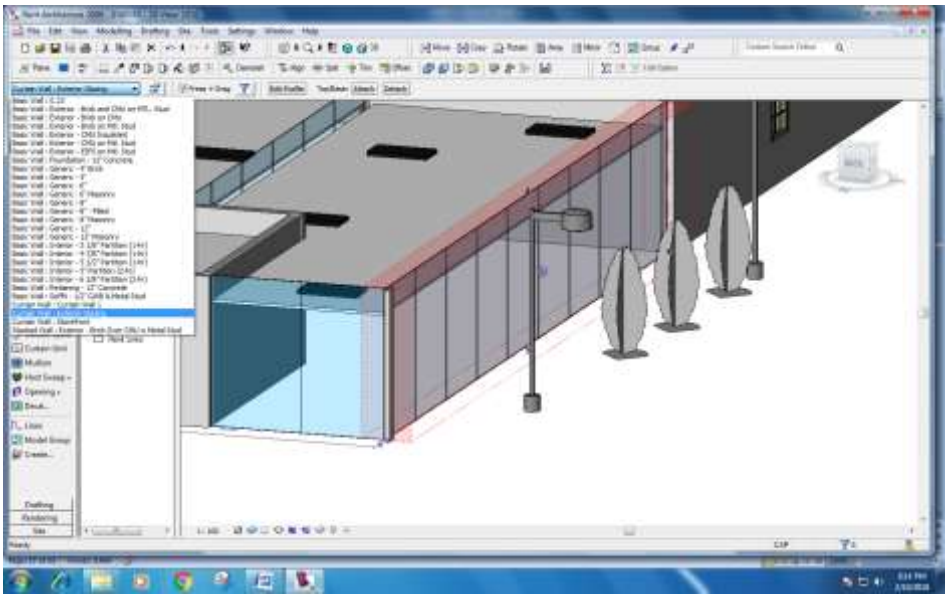

Fig 15: Outer Curtain Wall

4.14 Attaching Walls to the Roof

Open the 03 Roof floor plan. While pressing CTRL, select all the interior walls and exterior walls, except the curtain walls. On the Options Bar, click Attach. For Attach Wall, verify Top is selected. In the drawing area, select the roof. Attach the curtain walls and open the North elevation view. Move the cursor over the curtain wall, and press TAB until the status bar indicates that the curtain wall is selected, select the outside edge of the curtain wall, and then click Attach.

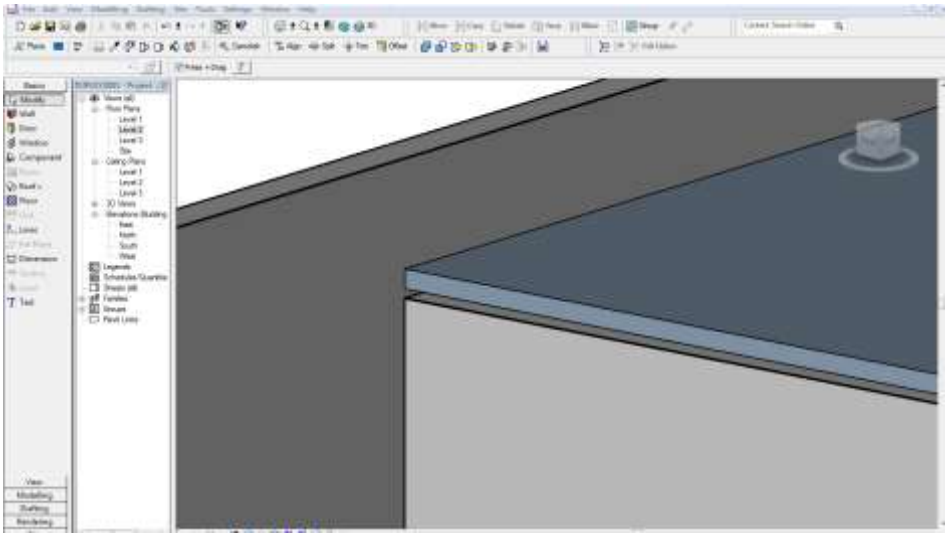

Fig 16: Attaching Walls to the Roof

4.15 Adding Stairs and Railings

In this exercise, the interior of the model is completed by adding a staircase on the lower level and then adding and modifying railings on the lower level and the entry level. Open the 01 Lower-Level floor plan. Zoom in to the east side of the model. Click the Modelling tab of the Design Bar and click Stairs. Click near the double doors to start the stair run. Move the cursor to the left until the tooltip indicates that no risers remain and click to specify the stair endpoint. On the Design Bar, click Finish Sketch.

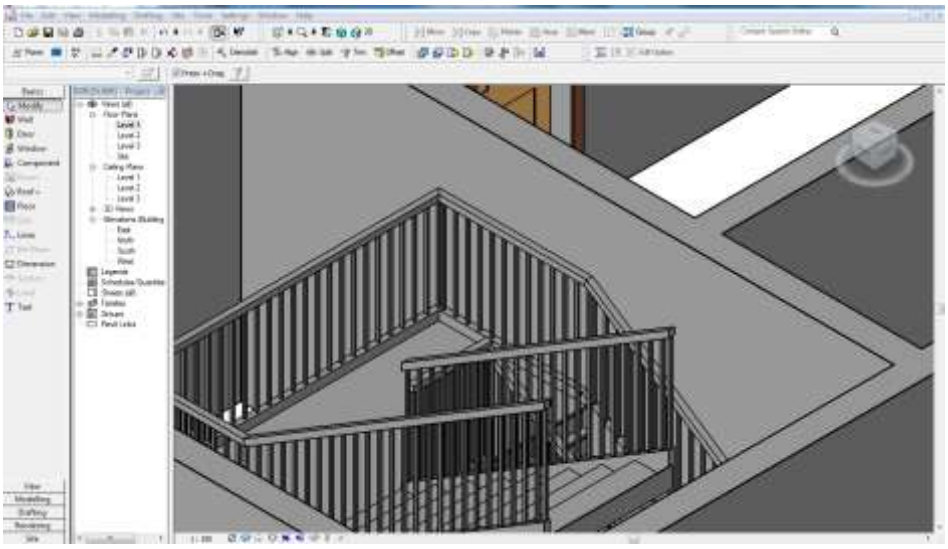

Fig 17: Stairs and Railings in 3D View

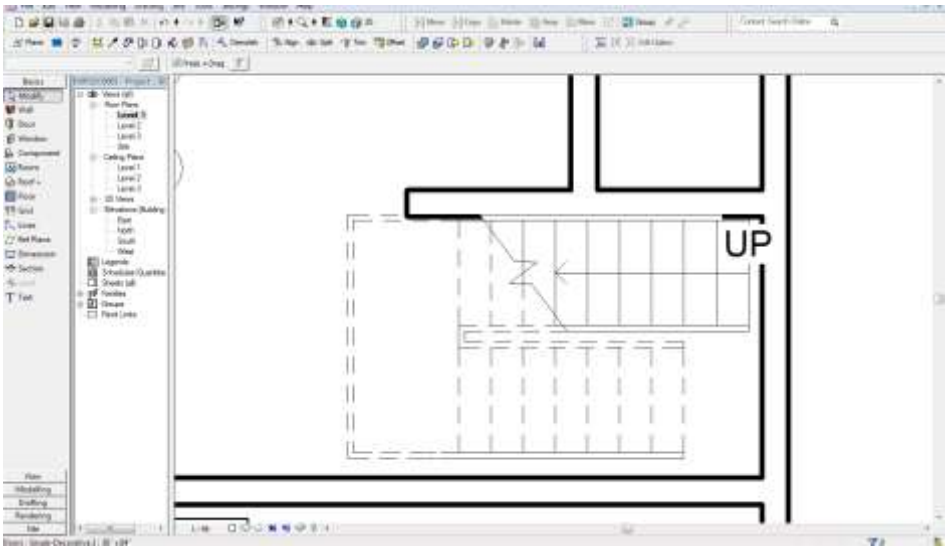

Fig 18: Staircase Detail

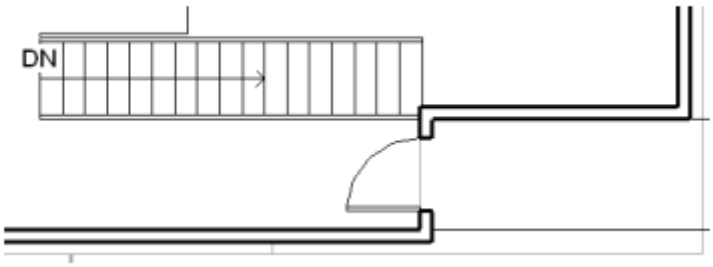

Fig 19: Railing Detail in 3D

4.16 Documenting the Project

Tags are added to the project and doors and rooms are scheduled. Changes made to an element in the door schedule are automatically made in the associated plan. Color fill is added to rooms and crop regions are modified for several views. A section view is created by opening the 02 Entry Level floor plan, clicking the View tab of the Design Bar, and clicking Section. Door and window tags are added using the Tag All Not Tagged feature. Door schedules and room schedules are created with appropriate fields including Family and Type, Width, Height, and Mark.

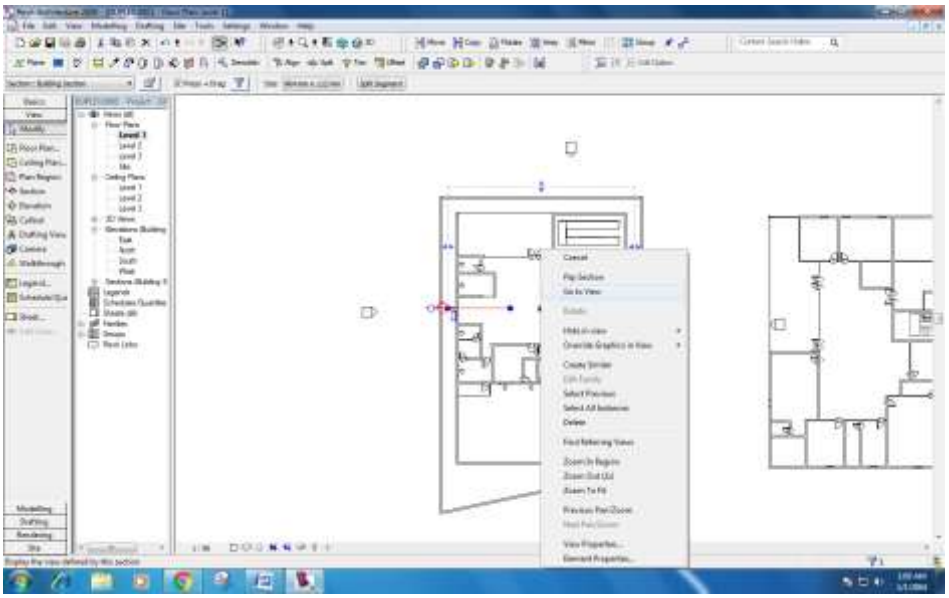

Fig 20: Section View of Building

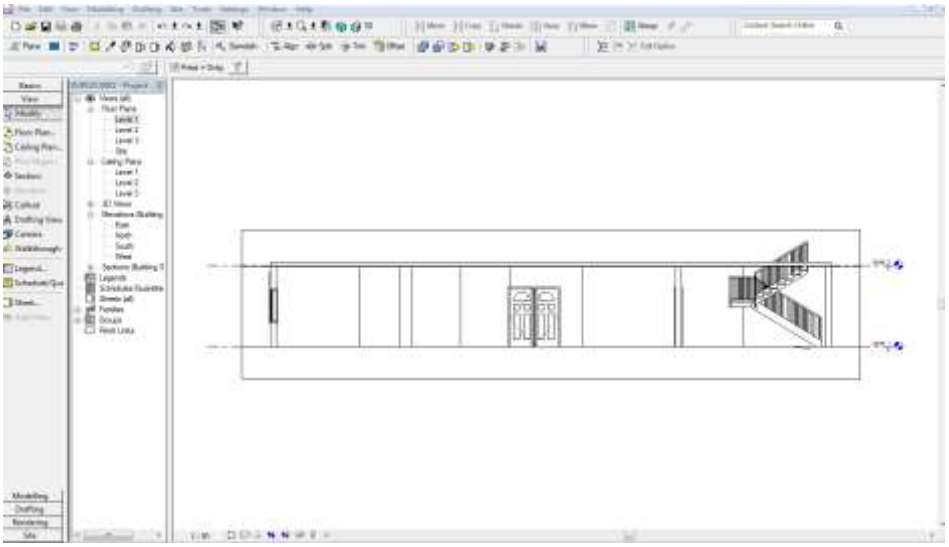

Fig 21: Section View Detail

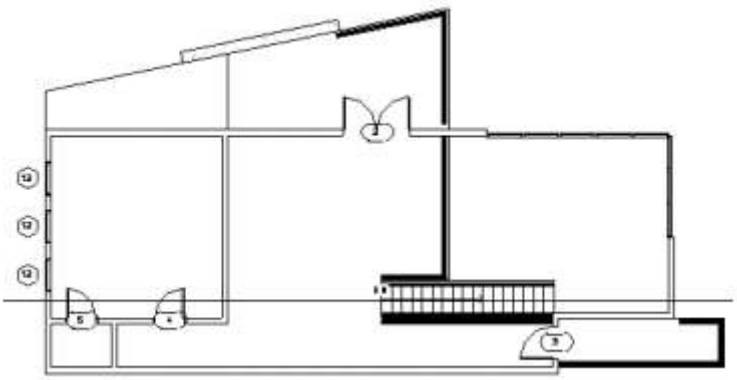

Fig 22: Door and Window Tags

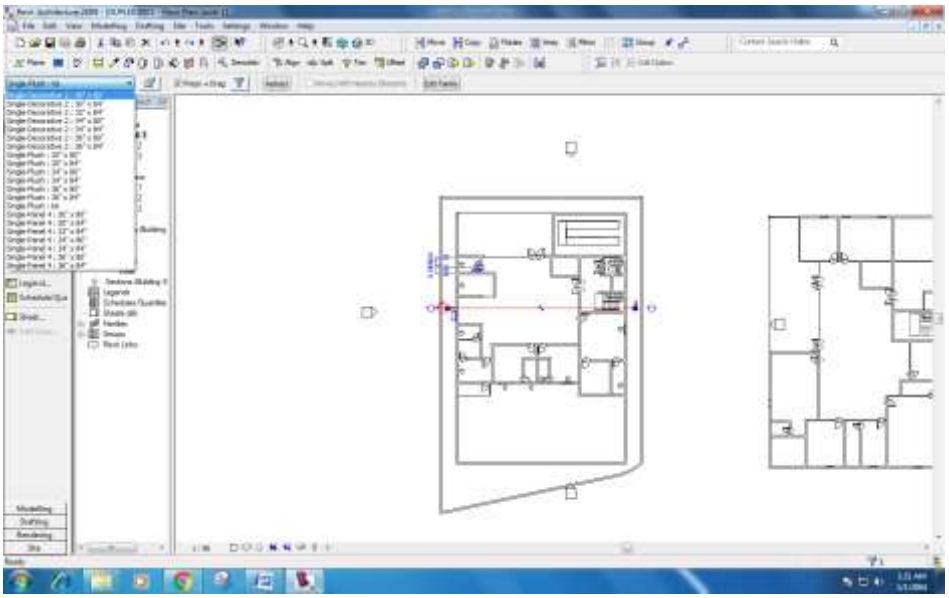

Fig 23: Door Schedule

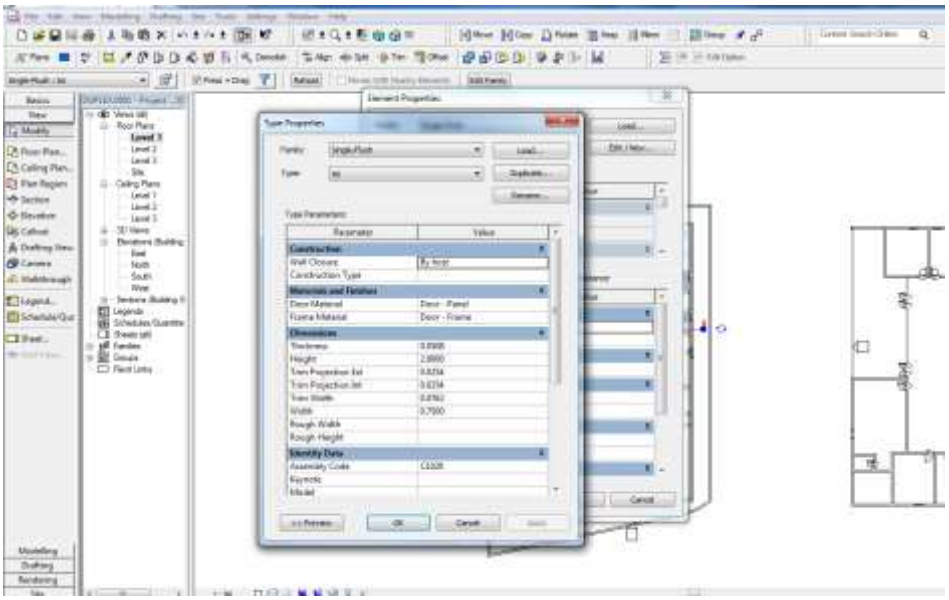

Fig 24: Room Properties

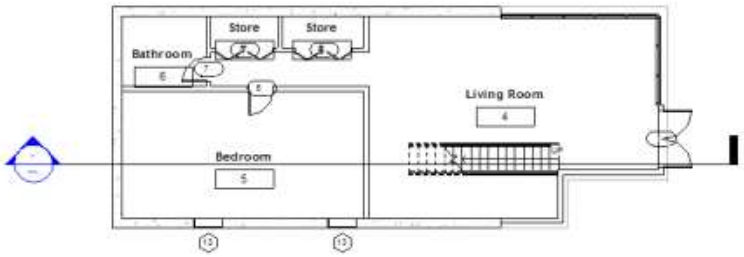

Fig 25: Room Tags on Lower Level

4.17 Living Rooms

This area is intended for general family use and common activities; therefore, the living room and drawing room should be located near the entrance, preferably facing the south-east direction. Positioning these spaces in the south or south-east direction is beneficial because, during colder days, the sun remains towards the southern side of the building. As a result, these rooms receive sufficient sunlight, creating a warm, comfortable, and welcoming environment for occupants and visitors. On the other hand, during the summer season, the sun shifts towards the northern side, helping to keep the interior spaces relatively cool and comfortable.

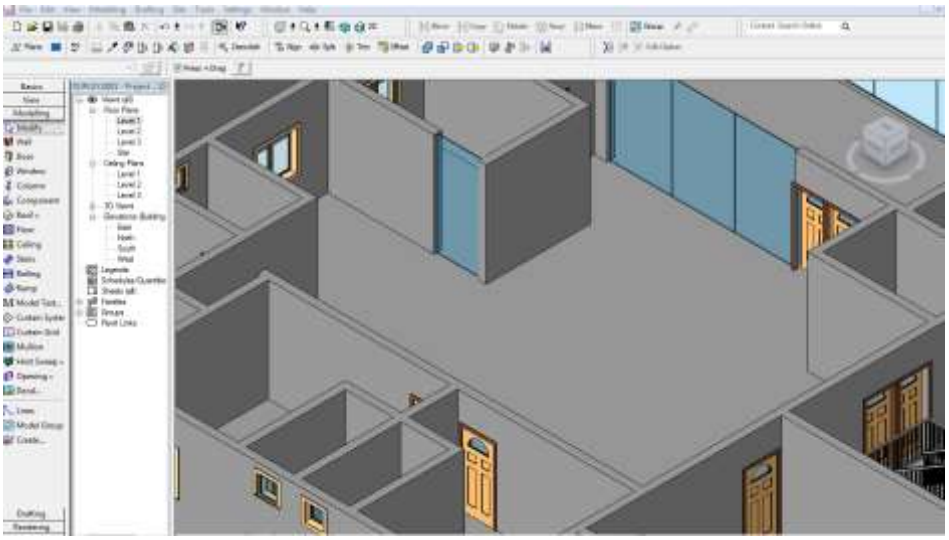

Fig 26: Living Room View

4.18 Kitchen

The kitchen should have an eastern aspect to admit morning sun to refresh and purify the air. The kitchen is an essential functional space in any residential building and should be planned with proper ventilation, natural lighting, and adequate working space. The layout should allow easy access to dining areas while maintaining separation from living spaces for hygiene and comfort.

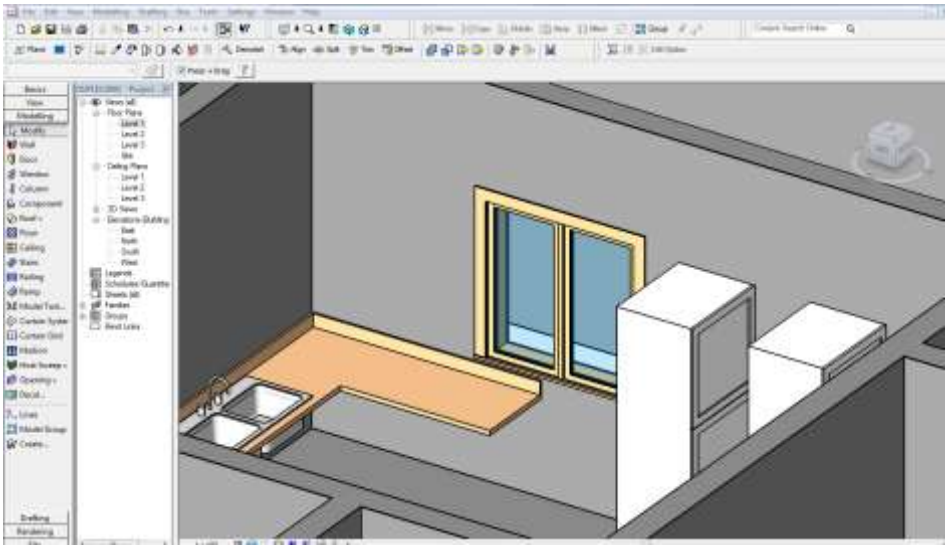

Fig 27: Kitchen View

4.19 Reading Room / Classroom

The reading room should have a north aspect as this makes more suitable sense since there will be no direct sun from the north side for most part of the year. This provides consistent, glare-free natural lighting that is ideal for reading and study activities.

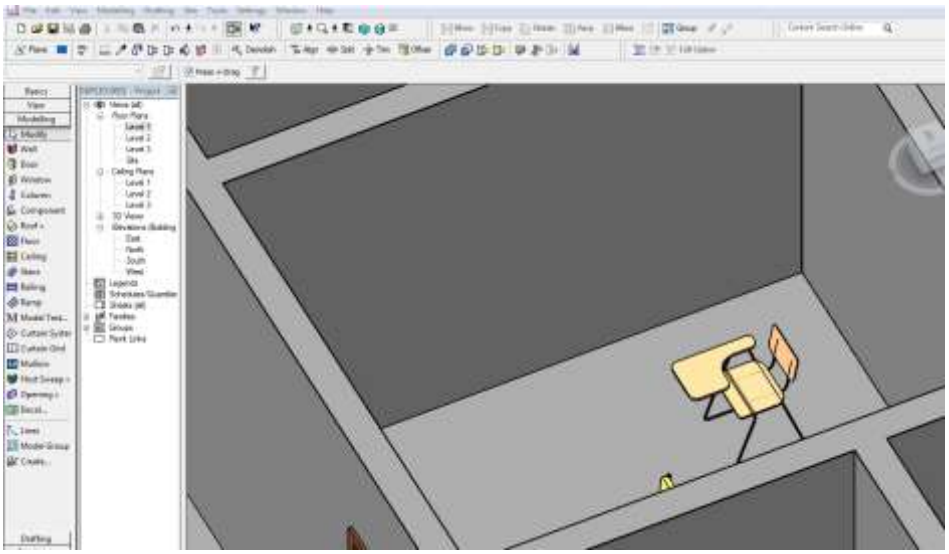

Fig 28: Reading Room View

4.20 Bedroom

Bedrooms may also be provided with attached toilets. Their size depends upon the number of beds. They should be located so as to give privacy and should accommodate beds, chairs, cupboards, etc. They should have north or north-west to south-west aspect.

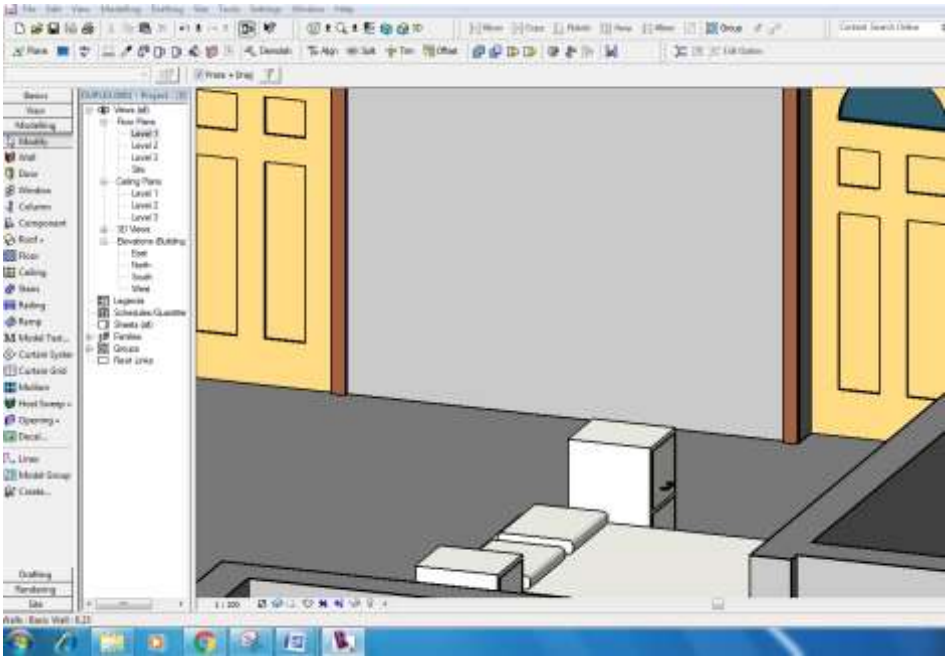

Fig 29: Bedroom View

4.21 Bath & W.C

Bath and W.C are usually combined in one room and attached to the bedroom and should be well finished. This should be fitted with bathtub, shower, wash-hand basin, W.C, shelves, towel racks, brackets, etc., all of white glazed tiles. Floor should be mosaic or white glazed tiles. Instead of providing all bedrooms with attached bath and W.C, separated baths and latrines may also be provided.

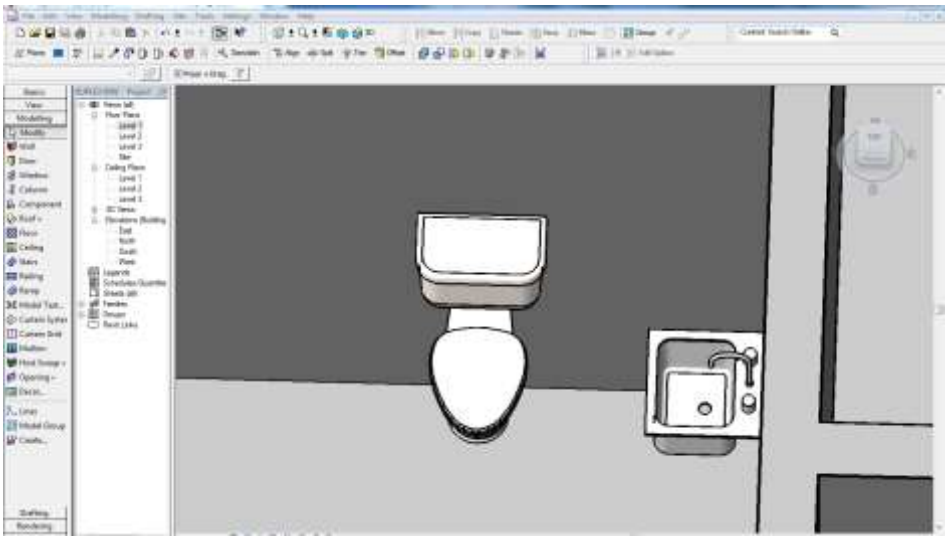

Fig 30: Bath & W.C View

4.22 Verandah

There should be a verandah in the front as well as in the rear. The front verandah serves as a sitting place for male members and waiting place for visitors. The back verandah serves as a ladies' apartment for their sitting, working, and controlling kitchen works. Verandahs protect the rooms against direct sun, rain, and weather effects. They are used as sleeping places during the summer and rainy season. The area of verandah may vary from 10% to 20% of the building area.

Orientation means proper placement of rooms in relation to sun, wind, rain, topography and outlook, while providing convenient access both to the street and back yard. The factors that affect orientation most are: solar heat, wind direction, humidity, rainfall, intensity of wind, site conditions, and lighting and ventilation.

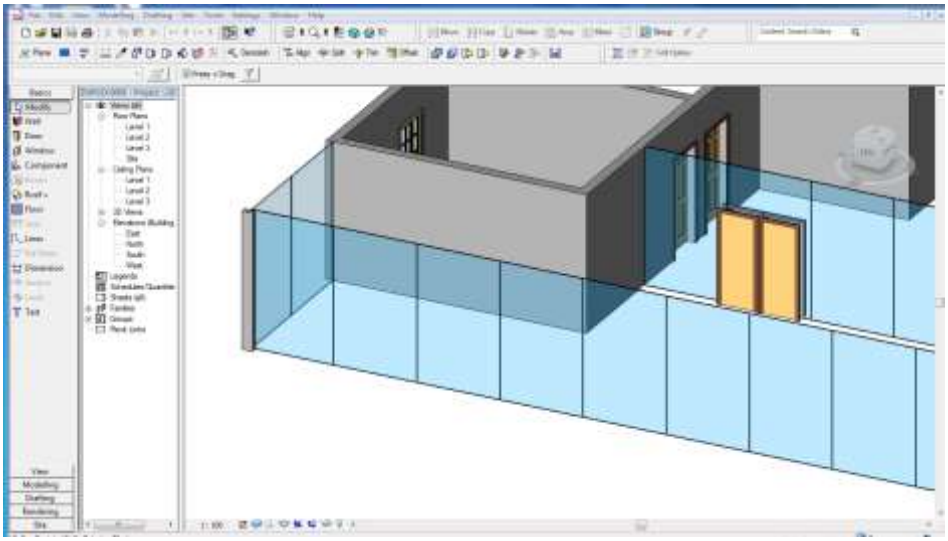

Fig 31: Verandah View

4.23 Solar Plate

Solar heat means sun's heat; the building should receive maximum solar radiation in winter and minimum in summer. For evaluation of solar radiation, it is essential to know the duration of sunshine and hourly solar intensity on exposed surfaces. Location of site in rural areas, suburban areas or urban areas also affects orientation. Sometimes to achieve maximum benefits, the building has to be oriented in a particular direction.

Fig 32: Solar Plates

4.24 Lighting

Good lighting is necessary for all buildings and has three primary aims. The first is to promote the work or other activities carried on within the building. The second is to promote the safety of people using the buildings. The third is to create an environment of interest and well-being.

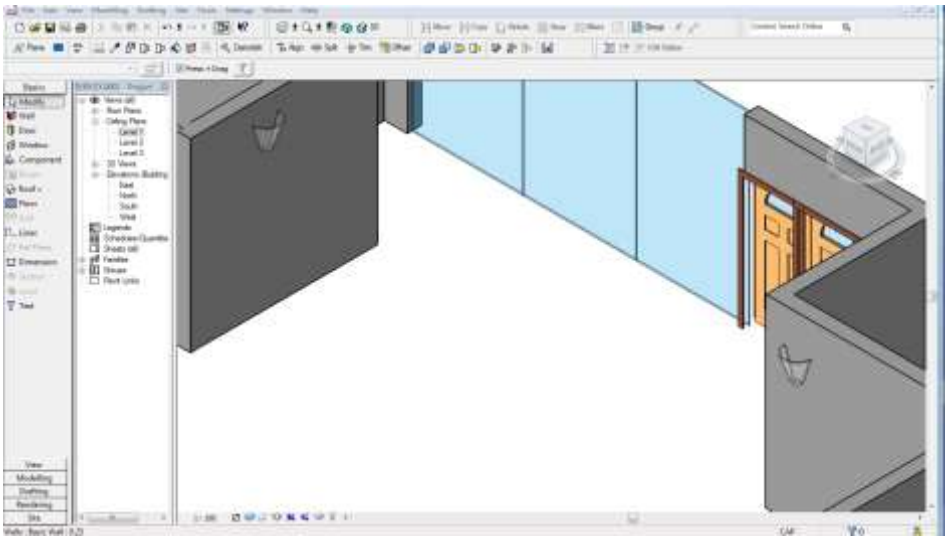

Fig 33: Lighting Design

4.25 Driveways

Amount of pavement on the front yard should be as limited as possible and therefore driveway widths should be minimized. Where a driveway leads to a double garage, it should be narrowed near the street, and the wider portion near the garage should be screened with landscaping. In certain instances, such as where the two garages of a side-by-side duplex building are adjacent, a shared driveway access from the street should be used. Access to parking should be accommodated off a laneway if it exists.

Fig 34: Driveways

5. RESULTS AND CONCLUSION

The modelling and layout of a G+2 duplex house using Autodesk Revit has successfully demonstrated the capabilities of Building Information Modelling (BIM) in modern architectural design. Through this project, a comprehensive approach was taken to plan, design, and virtually construct a residential building that meets both functional and aesthetic requirements.

Revit enabled efficient design development, precise 2D drafting, and highly detailed 3D visualization within a single platform. The incorporation of architectural elements such as walls, floors, stairs, and roofs, along with structural components, allowed for seamless coordination between design disciplines. The project also integrated furniture layouts, material schedules, and rendered views to create a realistic and client-friendly presentation.

Moreover, the use of Revit facilitated: improved accuracy in floor plans and elevations, generation of automatic schedules (doors, windows, materials), real-time design updates, and easy extraction of construction documentation.

This project not only enhanced technical skills in Revit but also reinforced an understanding of spatial design, building standards, and practical aspects of residential planning. It proves that BIM tools are essential for architects and engineers aiming for efficiency, accuracy, and better collaboration in the AEC (Architecture, Engineering, and Construction) industry.

In conclusion, the G+2 duplex house model serves as a practical and professional example of how Revit can streamline the design process from concept to construction documentation.

3D View (Revit Plan):

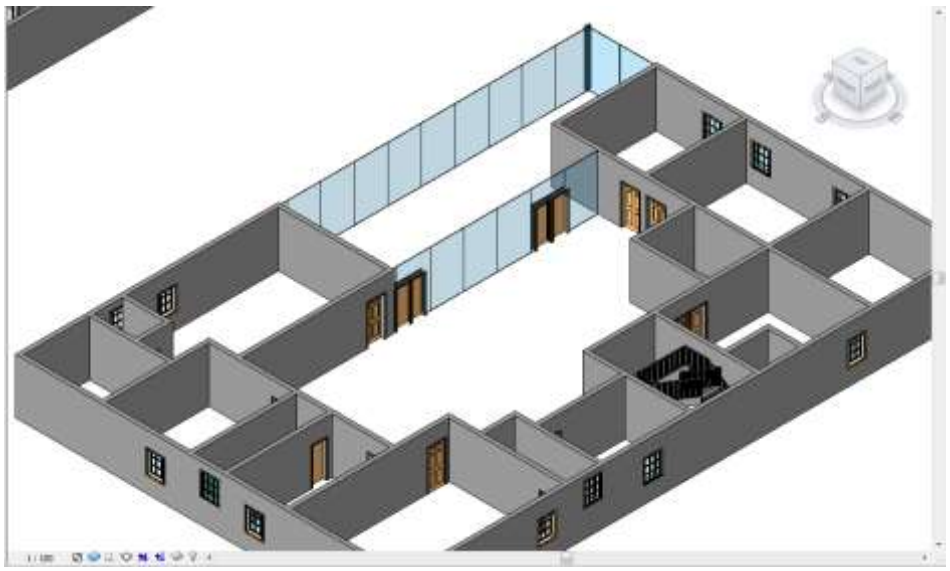

Fig 35: Ground Floor in 3D Plan

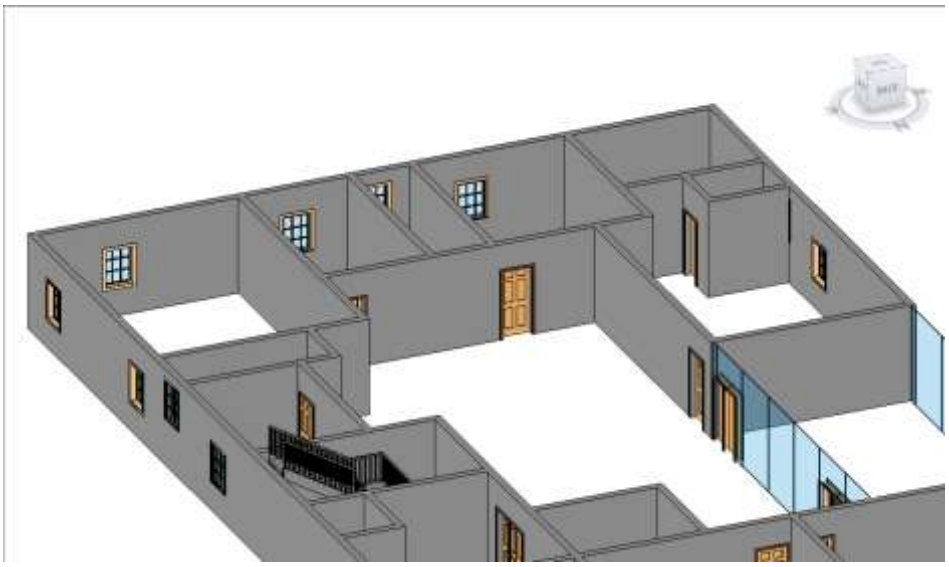

Fig 36: First Floor in 3D Plan

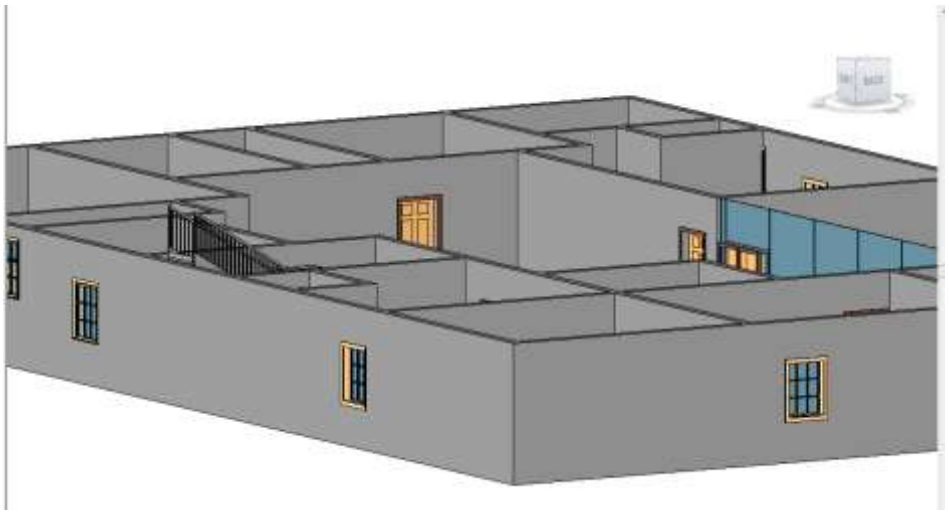

Fig 37: Second Floor in 3D Plan

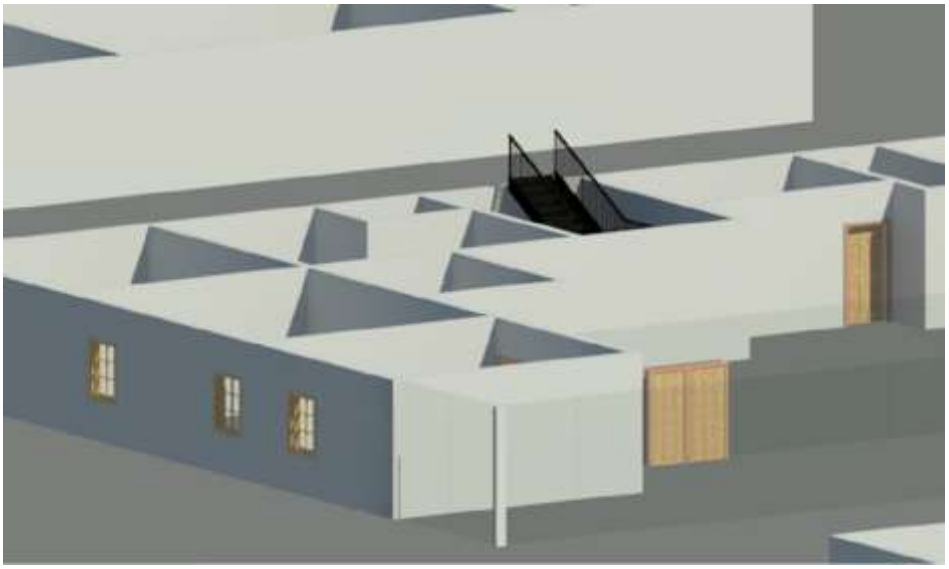

Fig 38: Before Render

Fig 39: After Render

3D Views:

Fig 40: 3D Rendered View - Front Elevation

Fig 41: 3D Rendered View - Perspective

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