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MODELLING AND LAYOUT OF DUPLEX HOUSE G+2 BY USING REVIT

Gugulothu Vijay Kumar[a],Madugula Sravani[a], Muskhan Begum[a] ,Syed Amjad Peer[b]
[a]U.G. Students, Department of Civil Engineering, Guru Nanak Institute of Technical Campus,Ibrahimpatnam, Telangana, India
[b]Assistant Professor, Department of Civil Engineering, Guru Nanak Institute of Technical Campus,Ibrahimpatnam,Telangana, India

Abstract
This study focuses on designing and modeling a Ground + 2 (G+2) duplex residential building using Autodesk Revit's BIM tools. The design follows Indian building standards, including guidelines from the National Building Code (NBC) on site planning and space requirements. A BIM workflow in Revit was used to create a comprehensive 3D model, enabling generation of coordinated plans, sections, and material schedules. This integrated modeling approach facilitated efficient space utilization (through strategic room layout and circulation) and streamlined documentation. The resulting design demonstrates efficient space utilization and highlights Revit's capability to integrate architectural data, reducing errors and improving team coordination. These findings underscore the value of BIM methodology in undergraduate architectural projects and in broader practice.
Keywords: BIM, Revit, Architecture, Space, Planning, Duplex House, National Building Code (NBC)

1.Introduction
In India's growing construction sector, effective planning of residential buildings is critical for addressing space constraints and occupant needs. Indian building standards such as the National Building Code of India (NBC) provide comprehensive guidance on site selection, space planning, and safety requirements. In residential design, duplex houses (two units in one structure) are common for accommodating extended families or tenants. A duplex is defined as a home with two separate dwelling units within a single structure, which demands careful layout to ensure privacy, natural light, and adequate circulation for each unit.
Building Information Modeling (BIM) has revolutionized architectural practice by improving design quality and collaboration. Autodesk Revit, a leading BIM platform, enables architects and engineers to build detailed 3D models that embed both geometric and non-geometric data. Revit's environment allows the entire project team to share a unified model, reducing design conflicts and errors. In fact, Eastman et al. note that Revit is widely recognized as the market-leading BIM software in architecture. By applying BIM in this project, the design process becomes more efficient and transparent. BIM is often described as "the future of building design and construction" due to its 3D, object-oriented methodology. This project uses Revit to develop the architectural model and layout of a G+2 duplex house, demonstrating how BIM tools can support planning and design under Indian standards.

2.literatiure
Indian Building Standards: The NBC 2016 serves as the model code for building planning in India, covering site planning, development control rules, and general building requirements. It emphasizes functional spatial organization, including adequate room sizes, ventilation, lighting, and safe egress paths. Ensuring compliance with NBC guidelines (such as setback rules and floor area ratios) is essential in residential design.

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Duplex Housing: A duplex house contains two distinct living units in one building. Architectural literature notes that duplex layouts maximize land use while giving each household its own space (e.g. separate entrances, living areas). Efficient duplex designs group private (bedrooms, baths) and public (living, dining) spaces logically to minimize circulation and maximize usable area.

Revit and BIM Adoption: Research on BIM in architecture highlights Autodesk Revit's prominence. Eastman et al. found Revit to be the "best-known and the market leader for BIM implementation in architecture". Revit's BIM features allow architects and engineers to collaborate seamlessly on a single 3D model, improving coordination and reducing the likelihood of design errors.

BIM Workflow Benefits: Studies report that a BIM-based workflow shortens design time and improves project quality by integrating all disciplines into one digital model. In practice, Revit enables automated generation of material schedules and clash detection. For example, Revit can produce detailed quantity takeoffs (e.g. counts of bricks, doors, windows) directly from the model, and its visualization tools help teams identify and resolve conflicts early in the design phase. These advantages support efficient space planning and accurate documentation.

Z **Materials:**

1. **Software Tools:**

- **AutoCAD (2024 or later):** Used for creating detailed 2D floor plans, elevations, and sections.
- **Revit (2024 or later):** Used for converting AutoCAD drawings into a 3D model, applying textures, and generating photorealistic renderings.
- **Rendering Engines (V-Ray/Corona):** Employed within 3ds Max to create realistic lighting, shadows, and textures for accurate visualizations.

2. **Hardware:**

- High-performance computer with adequate processing power (Intel Core i7 or higher) and a dedicated graphics card (NVIDIA RTX/AMD Radeon).
- Processor: Multi-core Intel or AMD processor with SSE4.2 instruction set.
- Graphics: Certified hardware (refer to Autodesk's hardware guide).
- RAM: Minimum 4 GB (8 GB or more recommended).
- Disk Space: 9 GB free for installation.

3. Methodology

This research adopts a Building Information Modeling (BIM) approach using Autodesk Revit to design and develop a duplex residential structure (G+2). The methodology followed is described below:

3.1 Requirement Analysis and Planning

- Site dimension assumed: **40 ft × 60 ft**
- Functionality: Duplex layout with living spaces, bedrooms, kitchen, and terraces
- Design complies with local municipal regulations including setbacks and height limits

3.2 Architectural Modelling

- **Levels** created for Ground, First, and Second floors
- Walls, doors, and windows modeled using Revit families
- **Room tags and dimensions** assigned to define spaces
- **Staircase and balconies** designed for vertical circulation and aesthetics

3.3 Structural Design

- RCC columns and beams placed according to architectural load paths
- Slabs defined using floor components, with structural floor types

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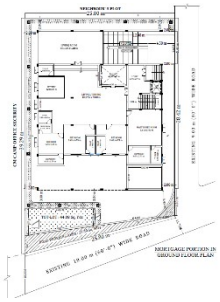
- Footings modeled and placed under column grids

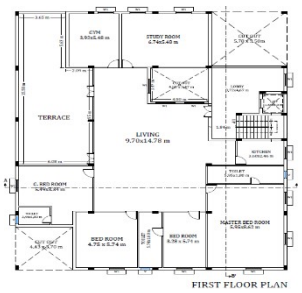
3.4 Model Coordination

- Architectural and structural models were coordinated in 3D
- Sections and elevations were used to check alignment
- Clash detection was performed manually

3.5 Schedule and Sheet Creation

- Auto-generated **door/window schedules**, **area analysis**, and **BOQ**
- Final plans, sections, elevations, and schedules plotted on drawing sheets





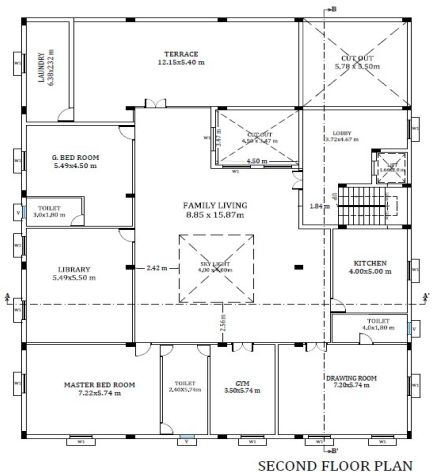


Fig1 :- 1 LAYOUT OF GROUND FLOOR, 1st FLOOR, AND 2nd FLOOR

4. Results and Discussion

4.1 Architectural Layout Outputs

Using Autodesk Revit, the complete architectural model of a G+2 duplex house was successfully developed. The layout includes:

- Ground Floor: Living room, dining area, kitchen, guest bedroom, and a common toilet.
- First Floor: Master bedroom with attached bath, two additional bedrooms, a shared bathroom, and balconies.
- Second Floor: Multipurpose hall, utility room, terrace garden, and service area.

All floor plans were generated automatically in Revit, along with door/window schedules and room area calculations.

Figure 1: Floor Plan – Ground Floor
Figure 2: Floor Plan – First Floor
Figure 3: 3D Axonometric View of the Model

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4.2 Structural Modelling

The structural components such as columns, beams, slabs, and foundations were added using Revit's structural tools. Reinforced concrete (RCC) framing was adopted, with beam-column connections visualized in 3D. Schedules for quantities of concrete, steel, and reinforcement were extracted using the Schedule/Quantities tool.

Table 1: Concrete Volume for Columns and Slabs

Table 2: Steel Reinforcement Estimates

4.3 Rendering and Visualization

High-quality 3D views and realistic renders were generated. Both exterior and interior renderings were prepared using Revit's in-built rendering engine and enhanced using Lumion (optional).

Figure 4: Exterior Day Render

Figure 5: Interior Render of Living Room

4.4 Quantity Takeoff and Cost Estimation

The BIM model enabled automated generation of bill of quantities (BOQ). Using schedules, quantities for walls, floors, doors, windows, and finishes were calculated accurately. This can be exported to Excel for cost estimation.

Component	Quantity	Unit
Brickwork	45.2	m^3
RCC Concrete	36.8	m^3
Steel Reinforced	3.2	tonnes
Floor Tiles	320	m^2

4.5 Discussion

Accuracy and Efficiency

The use of Revit significantly reduced manual drafting errors, ensured consistency across views (plans, sections, elevations), and facilitated real-time coordination between architectural and structural elements.

Benefits Observed

- Parametric design: Any change in the floor plan automatically updated all related views and schedules.
- Visualization: Enabled better client communication through 3D renders and walkthroughs.
- Time-saving: Floor plans, sections, and elevations were generated instantly from the model.
- Scheduling: Quantities were automatically calculated, helping in quick cost estimation and material planning.

Challenges Faced

- Initial learning curve for working with families and constraints.
- Rendering inside Revit was time-consuming; external rendering software like Lumion gave better output.
- Coordination with MEP (if included) required careful management of visibility settings.

Future Enhancements

- Incorporating solar analysis for passive design optimization.
- Adding energy analysis and structural load simulations for performance evaluation.
- Using Revit plugins for clash detection and construction sequencing (4D BIM).

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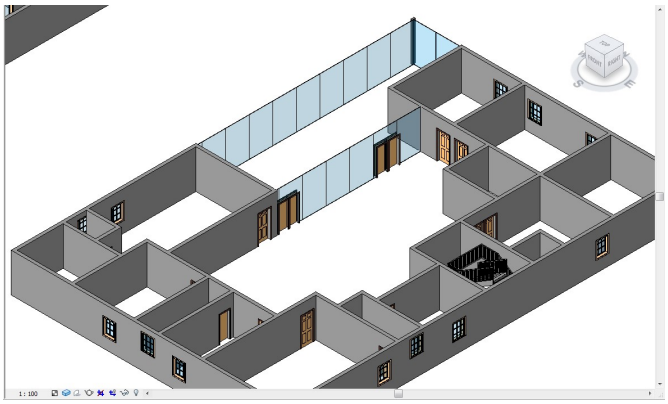

Fig 2:- GROUND FLOOR 3D VIEW

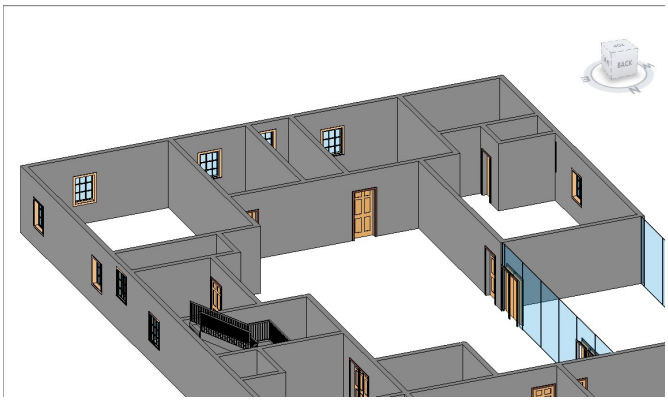

Fig 3:- 1st FLOOR 3D VIEW

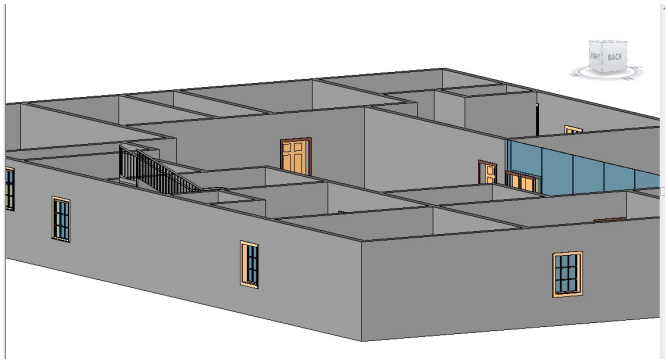

Fig 4:- 2nd FLOOR 3D VIEW

5.CONCLUSION

This project successfully demonstrated the use of Autodesk Revit for the comprehensive architectural modeling and layout planning of a G+2 duplex residential building. Through the application of Building Information Modeling (BIM) tools, we were able to produce a highly detailed and coordinated design that integrates architectural, structural, and basic MEP components.

The Revit environment enabled accurate 3D modeling, floor plan development, elevation views, and realistic rendering, allowing for better visualization and improved decision-making in the

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design phase. Space utilization, circulation, and functional zoning were optimized based on standard residential design guidelines and user requirements. The parametric capabilities of Revit also facilitated efficient modifications and consistency across all views and schedules.

In addition, the project highlighted the practical benefits of BIM in reducing design errors, improving interdisciplinary coordination, and preparing for future construction documentation. By integrating all aspects of the design in a single digital model, this approach promotes sustainable and cost-effective housing development.

The study validates that Revit is an effective tool for modern architectural design and can significantly enhance productivity, accuracy, and communication in residential building projects. Future work can include structural analysis, quantity take-off, energy simulation, and integration with other BIM platforms for a more comprehensive project lifecycle approach.

Fig 5 :- DUPLEX HOUSE G+2 3D VIEW

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