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Modelling and Layout of G+1 Duplex using AutoCAD and 3Ds Max Software

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ABSTRACT

In this project, a G+1 Duplex is designed and visualized using 3ds Max for 3D modeling and rendering and AutoCAD for drafting. To ensure precise and correct representation of the building design, AutoCAD is first utilized to develop full floor plans, elevations, and structural layouts. The 2D designs are then transformed into realistic 3D models using 3ds Max, which adds textures, lighting, and materials to the visualization to create an authentic representation of the interior and exterior areas. The technical drawing capabilities of AutoCAD and the rendering capability of 3ds Max are combined to create realistic presentations and efficient design development, which aids in effectively communicating the design vision to stakeholders and clients.

1. INTRODUCTION

A G+1 Duplex design and visualization are complicated procedures that need for close consideration of both technical accuracy and visual appeal. The way architects approach the modeling and layout of residential structures has been completely transformed in modern architecture by the usage of software programs like AutoCAD and 3ds Max. Accurate floor plans, elevations, sections, and detailed drawings used as the design's basis can be created with AutoCAD, an effective 2D drafting software.It ensures that the design adheres with structural and geometric specifications. However, by converting the 2D designs into realistic 3D representations, 3ds Max, a powerful 3D modeling and rendering program, makes the design come to life. In order to improve client presentations and design communication, architects can use 3ds Max to replicate lighting, materials, textures, and spatial volumes to provide a photorealistic modeling of the building . Technical accuracy and visual impact are ensured by the smooth transition from conception to realization made possible by the combination of AutoCAD and 3ds Max in the design workflow. In addition to improving the layout for increased comfort and functionality, this method offers a powerful visual experience that supports project approval and decision-making.The combination of these two powerful tools is looked into in this project in order to model and layout a G+1 Duplex that provides a complete design solution while satisfying both practical and aesthetic needs.

2. LITERATURE

Harikrishnan et. al 2021[1] This research explores the use of virtual reality (VR) technology to enhance architectural education, specifically in building construction courses at Jordan University of Science and Technology (JUST), which traditionally rely on teacher-centered methods. The study developed BC/VR software that uses a 4D model (3D model with time) to simulate construction phases, providing immersive and non-immersive experiences for students. Through a structured questionnaire, the study evaluates the effectiveness of this VR tool in providing building construction information, increasing student enjoyment, and integrating with other courses. Results indicate that VR technology significantly outperforms traditional methods in all areas. The research also highlights VR's evolution and its potential to transform educational approaches by offering more interactive and engaging learning experiences.
Arif, F 2021[2] This study explores the use of Virtual Reality (VR) in teaching infrastructure management to civil engineering students. A bridge inspection module was developed for a Cave Automatic Virtual Environment (CAVE) system at NED University. The study involved 69 senior-year students enrolled in a structural design course, who provided feedback through structured assessments. Results indicated that students had better focus in VR environments and found the experience engaging, comfortable, and easy to use. The study suggests that more exposure to VR can improve students' learning experiences, though real-world applications

may require advanced modeling techniques, such as LIDAR scanning, to address hidden structural damages.

Juan Manuel Davila Delgado et. al 2020[3] This study provides valuable insights for both practitioners and researchers on the adoption of Augmented Reality (AR) and Virtual Reality (VR) in the construction industry. For practitioners, it offers clear use-cases, benefits, and challenges of AR/VR technologies, helping companies make informed adoption decisions and align with industry trends. For researchers, it formalizes and categorizes the current AR/VR research landscape, identifying gaps and providing a roadmap for future studies. However, the study is limited by its small sample size, restricted to UK-based professionals. Future work should include broader regional comparisons, cross-disciplinary research, and exploration of worker upskilling for successful technology adoption.

Noghabaei M et. al 2020[4] A virtual safety training system using immersive virtual environments (IVE) to enhance workers' hazard recognition skills in construction sites. Workers wear virtual reality (VR) devices equipped with eye-tracking and brainwave-sensing technology to identify hazards in simulated construction settings. The platform analyzes workers' performance in hazard recognition tasks and provides personalized feedback, identifying areas where additional intervention is needed. This approach offers new insights into how a worker’s brain and eyes function together during hazard recognition and aims to improve safety training by providing tailored, real-time feedback to workers.

Tang et. al 2020[5] The increasing use of virtual reality (VR) in architecture, engineering, and construction (AEC), focusing on its application in both the industry and educational environments. VR has become a valuable tool for training architecture and civil engineering students, helping them navigate the complexities of construction projects. The paper reviews recent VR systems and evaluates their impact through a literature review and interviews with Master of Project Management (MPM) students. It aims to offer insights and a roadmap for integrating VR into AEC education and industry practices.

Pratama et. al 2019[6] investigates how Architecture, Engineering, and Construction (AEC) firms integrate virtual reality (VR) technology into their workflows, particularly during design and pre-construction phases. The study identifies the main use of VR in AEC as building walkthroughs, supported by a variety of software tools ranging from quick, off-the-shelf solutions to in-house developments tailored to specific needs. Through semi-structured interviews, the authors analyze the challenges and workflows of VR implementation, highlighting how modern VR systems enhance visualization while requiring customized solutions for features like model annotation and multi-user environments.

Bouska et. al 2019[7] This paper explores the use of Virtual Reality (VR) in teaching Building Information Modelling (BIM) in civil engineering education. VR is an effective visualization tool, enhancing interaction with virtual models in various project stages. It is commonly used in architectural visualizations, structural design optimization, and model error checking in civil engineering. The paper focuses on how VR can be integrated into university curricula to teach BIM, allowing students to navigate models and extract information. The goal is to prepare students for the use of VR and BIM technologies in their future careers as civil engineers and project managers.

Jad Chalhoub et. al 2018[8] The use of mixed reality (MR) for delivering design information in the assembly of prefabricated electrical conduit, comparing it with traditional paper documentation. An experiment involving industry participants revealed that MR offered significant performance benefits, such as faster assembly, fewer mistakes, and better comprehension of assembly tasks. Notably, participants with no prior conduit assembly experience performed best with MR, outperforming even the most experienced users using paper plans. While participants agreed that MR was easier to use than paper plans, many still preferred having paper plans as part of the design process. The study suggests MR's potential for training and improving understanding of paper plans, though future research will focus on optimizing MR's application for specific construction tasks and training techniques.

Fan Xue.et. al 2018[9] A novel approach for generating as-built Building Information Models (BIMs) from 2D images, addressing the limitations of manual and error-prone automatic segmentation methods. The proposed method treats BIM generation as an optimization problem, focusing on fitting components according to architectural and topological constraints. Additionally, the semantics of the BIMs are enriched by linking components with existing semantic sources. Tested in two experiments (outdoor and indoor cases), the approach successfully generated BIM components with high accuracy and efficiency. The method is segmentation-free and utilizes open BIM component data, improving the handling of semantic information in BIM development.

Fogarty et. al 2018[10] This study examines the use of virtual reality (VR) tools to help students understand the complex spatial behaviour of structural buckling, a difficult concept to teach traditionally. The mixed-methods research includes pretest and posttest evaluations, along with surveys and interviews. Quantitative results show that students improve in identifying and visualizing buckling modes after using VR tools. Qualitatively, students report a better understanding, increased interest in the topic, and a desire for more VR-based learning experiences. Both students and instructors recognize the benefits of VR in explaining complex structural deformation concepts, with students showing significant improvement in their posttest scores.

Wang et. al 2018[11] The Virtual Reality (VR) applications in construction engineering education and training (CEET). It highlights the different VR technologies used, such as desktop-based VR, immersive VR, 3D game based VR, BIM-enabled VR, and Augmented Reality (AR), noting the transition from desktop to mobile-based VR with enhanced interaction and immersion. The review identifies key benefits of VR in CEET, including increased student participation, interaction, and spatial understanding, especially with BIM-enabled VR. It also discusses the shift from teacher centered to student-centered learning in virtual environments. Future research directions include exploring VR's compatibility with emerging educational methods like flipped classrooms and its integration with technologies like BIM and Smart Cities. The study concludes that VR hold significant potential in transforming construction engineering

Park et. al 2016[12] Traditional methods in building construction education often fail to provide students with practical experience and knowledge to meet industry demands. To address this, a study proposes the Interactive Building

Anatomy Modelling (IBAM) system, a virtual reality-based tool designed for experiential learning. Inspired by medical anatomy, IBAM allows students to interact with virtual models by detaching, attaching, and dissecting building components, enhancing engagement and understanding. A prototype was tested through a case study, showing that IBAM effectively facilitates experiential learning and provides sufficient interaction to improve knowledge transfer, though further studies are needed to refine its capabilities.

3. METHODOLOGY AND EXPERIMENTAL RESULT

Gathering client requirements, site analysis, and initial layout sketching are the first steps in designing a G+1 duplex with AutoCAD and 3ds Max. Create 2D floor designs for the first and ground floors using AutoCAD, making sure that all sections and elevations meet to local construction rules and specifications for dimensions and operation. After everything is finished, Import the designs to 3ds Max in order to create walls, floors, and roofs can be extruded and architectural features like stairs and home furnishings can be added to the 3D model. Use V-Ray to apply realistic materials and textures, adjust lighting and surroundings, and generate excellent graphics. Present the design for remarks and finalize 2D drawings and 3D visuals for construction and presentation. Analyzing site specifics, architectural preferences, and any other design guidelines that affect the finished product are also included in this phase. AutoCAD, which is perfect for producing accurate 2D architecture drawings, is used to draft the layout in the following stage. Prior to creating complete floor plans for the ground and first levels, the procedure entails establishing the proper units and scales. These blueprints make sure every component is precisely dimensioned and include wall, door, window, staircase, and room layouts. To improve clarity, annotations like labels and measurements are added, and layers are utilized to arrange the drawing's various elements. For usage in the 3D modeling stage, the finished layout is subsequently saved as a.DWG file.

The 2D layout is imported into 3ds Max for 3D modeling after it is complete. The proper scale and orientation are carefully maintained while importing the DWG file into the software. Layer-based organization of imported data makes processing easier. Making walls and defining structural components like floors, ceilings, and staircases are the next steps in establishing the buildings base geometry. Boolean operations are used to incorporate door and window openings, and architectural elements like columns and moldings are added to improve the buildings appearance. Texturing and the application of materials are done after the 3D structure has been modeled. Using 3ds Max's Material Editor, realistic materials are applied to different duplex components, and UV mapping is applied to ensure textures appear seamless. Because it adds depth and realism, lighting is a crucial component of this stage. Both artificial and natural lighting configurations are used, and sophisticated renderers like V-Ray or Arnold are frequently used to produce photorealistic results.

Rendering and visualization come next after the model and textures are ready. Key views of the duplex exterior and inside are captured by strategically placed cameras. The produced photos clearly display the buildings intricate design, and the render parameters are adjusted to guarantee high-quality output. To give a live view of the area, walkthroughs or animations can also be made if necessary.Software such as Photoshop is used to post-process output photos. To improve the visual quality, brightness, contrast, and color balance must be adjusted. Other effects like vegetation, sky, and ambient elements may be addad to make the scene more lifelike.

Lastly, the results are checked against the original requirements. After rendered images and walkthroughs are reviewed and shared with stakeholders for advice. To make sure the finished design reflects the client's vision, any necessary changes are made in response to their feedback. High-resolution photos, animations, and 3D model files that are prepared for presentation or additional work are usually included in the deliverables. This thorough process ensures a precise and eye-catching representation of the G+1 Duplex design.

The following figures shows the result of the layout of G+1 Duplex worked out in AutoCAD Software.

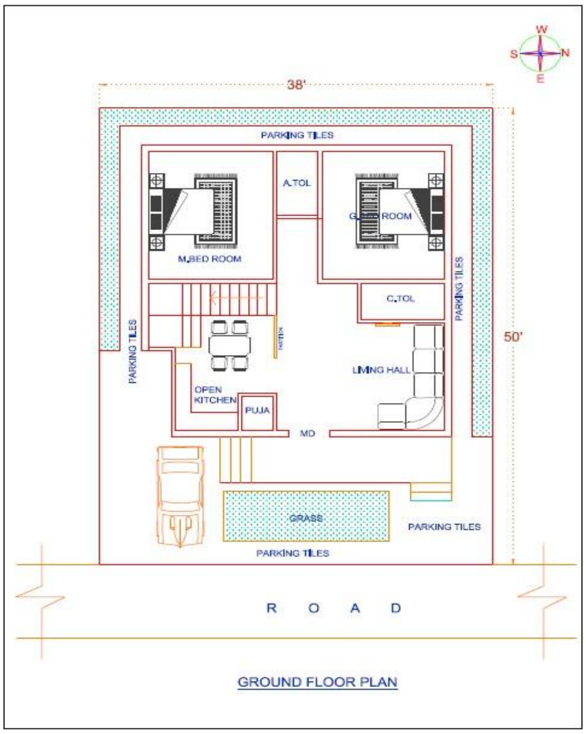

Figure 1. Ground floor plan of our project

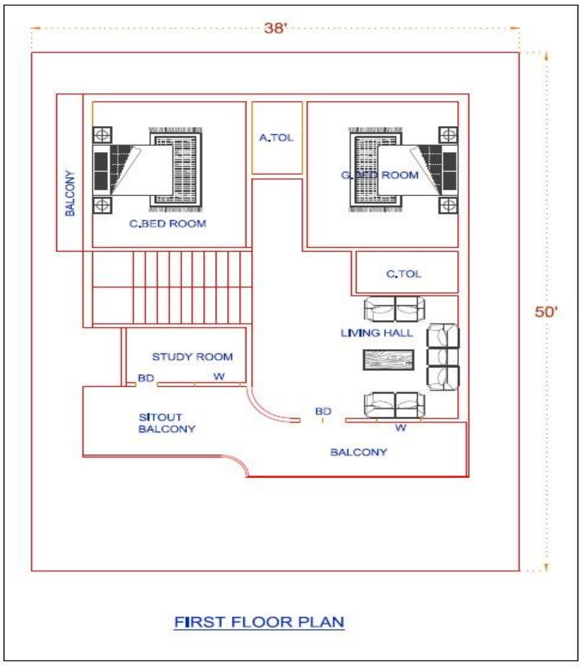

Figure 2. First floor plan of our project

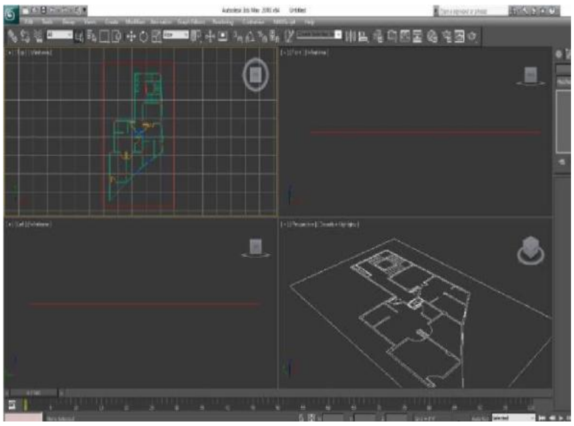

Figure 3. Layout of our project after importing AutoCAD layouts to 3Ds max software

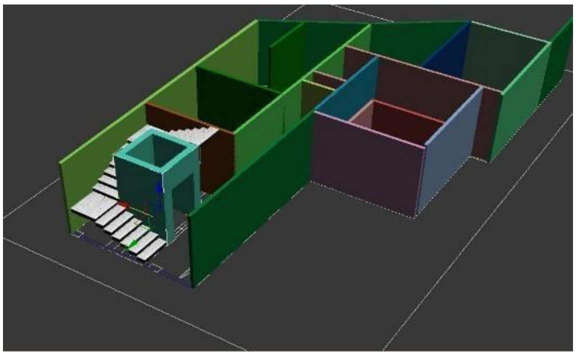

Figure 4. Inner walls and staircase of our project in 3Ds max software

Figure 5. Front elevation of our pro

4. CONCLUSION

The process of designing and visualizing a G+1 Duplex using AutoCAD and 3ds Max combines precision, efficiency, and creativity. AutoCAD plays a critical role in ensuring accurate 2D layouts, which serve as the foundation for the Duplex house design. On the other hand, 3ds Max brings the design to life with realistic 3D modelling, texturing, and rendering. This workflow not only delivers precise and visually compelling results but also enhances communication with clients and stakeholders through high-quality visuals and walkthroughs. The flexibility to make iterative changes ensures the final output aligns with the client's vision. Together, AutoCAD and 3ds Max provide a powerful platform to create designs that are both functional and aesthetically impressive.

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