BIM-Based Planning and 3D Modelling of a School Building Using Autodesk Revit Architecture and Structure

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***Abstract*— In this project, we present a comprehensive study and execution of the planning and 3D modeling of a School Building using Autodesk Revit Architecture and Structure, which enables full integration of Building Information Modeling (BIM) technology. The objective of the project is to digitally replicate the entire architectural and structural design process, enhancing accuracy, efficiency, and visualization before actual construction.**

This project focuses on the architectural and structural design of a modern school building using Autodesk Revit Architecture and Structure, leveraging the capabilities of Building Information Modeling (BIM). The aim is to create a safe, functional, and stimulating educational environment that meets both academic and structural standards.

The proposed design incorporates essential educational spaces such as classrooms, laboratories, administrative offices, staff rooms, library, multipurpose hall, toilets, staircases, and outdoor play areas. The layout is designed for ease of circulation, natural lighting, ventilation, safety, and accessibility, keeping students' comfort and learning in mind.

Revit Architecture is used for modeling the spatial and aesthetic components, while Revit Structure is employed to design the load-bearing elements such as columns, beams, slabs, and foundations, ensuring structural integrity and stability.

By adopting a BIM-based workflow, the project facilitates accurate 3D visualization, efficient space utilization, interdisciplinary coordination, and detailed documentation. The design adheres to the guidelines specified in the National Building Code (NBC) and other relevant educational infrastructure standards.

This project showcases how BIM can enhance school design by optimizing functionality, improving design coordination, reducing errors, and preparing a model that is both buildable and maintainable.

***Keywords*— Building Information Modeling (BIM), Autodesk Revit, 3D Modeling, School Building Design, Structural Modeling, Architectural Planning, Clash Detection, National Building Code (NBC), Sustainable Design, Construction Visualization**

I. INTRODUCTION

The construction industry is changing quickly with the use of modern digital technologies, and Building Information Modeling (BIM) has become one of the most important tools in this transformation. BIM helps engineers and designers create intelligent 3D models that combine architectural, structural, and functional details of a building into a single system. This makes the design process more accurate, reduces errors, and improves coordination between different teams involved in a project

At the same time, there is a growing need for well-designed school buildings due to increasing population and urban development. A school is not just a structure; it must provide a safe, comfortable, and effective environment for learning. Proper planning is required to ensure good ventilation, natural lighting, safety, and easy movement within the building. Traditional 2D design methods often make it difficult to visualize the final structure and may lead to design errors or clashes during construction.

To solve these problems, BIM-based software like Autodesk Revit is widely used in modern construction projects. Revit allows engineers to create detailed architectural and structural models in a single platform. Any changes made in one part of the model are automatically updated throughout the project, which saves time and improves accuracy. It also helps in better visualization, quantity estimation, and preparation of construction drawings.

This project focuses on the planning and 3D modeling of a school building using BIM through Autodesk Revit. The aim is to design a building that includes all essential facilities such as classrooms, laboratories, administrative areas, and other supporting spaces. The design is developed by following standard guidelines to ensure safety, functionality, and efficient use of space.

The main objective of this study is to show how BIM can improve the overall design process by providing better visualization, reducing mistakes, and supporting effective planning. This project also highlights the importance of using modern tools in civil engineering to achieve better quality and more reliable construction outcomes.

III. OBJECTIVES

The main objectives of this project are:

- To develop a complete 3D model of a school building using BIM through Autodesk Revit.
- To create an efficient architectural plan that ensures proper space utilization, ventilation, lighting, and user comfort.
- To design the structural components such as columns, beams, slabs, and foundations to ensure safety and stability of the building.
- To integrate architectural and structural designs into a single coordinated BIM model for better accuracy and consistency.
- To identify and minimize design errors and clashes using BIM tools before the construction stage.
- To improve visualization of the building design for better understanding and decision-making.
- To demonstrate the advantages of BIM in modern construction practices, including efficiency, accuracy, and coordination.

IV.SOFTWARES USED

- AutoCAD – Used for preparing 2D drawings and layout plans.
- Autodesk Revit Architecture – Used for designing the architectural layout of the building.
- Autodesk Revit Structure – Used for modeling structural elements like beams, columns, and slabs.
- Autodesk Revit (BIM) – Used for integrating architectural and structural models.
- Microsoft Office – Used for documentation and data handling.

V. LITERATURE REVIEW

Many researchers have studied the role of Building Information Modeling (BIM) in improving the efficiency and accuracy of construction projects. The following journal studies provide valuable insights into the use of BIM in building design and planning.

S.Azhar(2011)
S. Azhar discussed the benefits of BIM in the construction industry and showed how it helps in reducing project cost and time. The study highlighted that BIM improves coordination among different teams and helps in identifying design clashes at an early stage.

J.WongandJ.Zhou(2015)
Wong and Zhou analyzed the adoption of BIM in sustainable building design. Their study explained that BIM supports energy-efficient design and helps engineers make better decisions by providing detailed building information during the planning stage.

M. Abanda, L. Vidalakis, and A. Oti (2015)
This study focused on the use of BIM for construction management and decision-making. The authors explained that BIM improves project visualization and enhances communication among stakeholders, leading to better project outcomes.

R. Sacks, L. Koskela, B. A. Dave, and R. Owen (2010)
The authors examined the interaction between BIM and lean construction principles. Their research showed that BIM helps in reducing waste, improving workflow, and increasing efficiency in construction projects.

E. Bryde, M. Broquetas, and J. M. Volm (2013)
This study evaluated the impact of BIM on project performance. The authors concluded that BIM improves productivity, enhances project quality, and supports better control over time and cost.

VI.METHODOLOGY

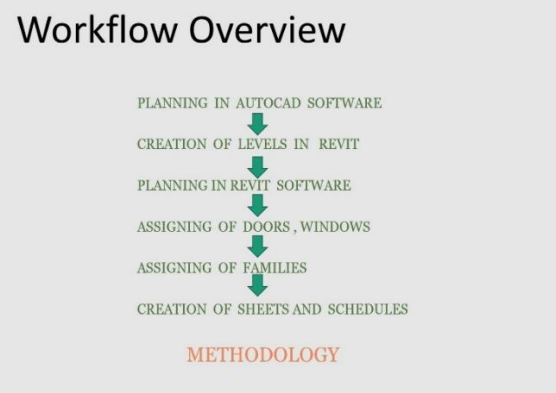

Figure 1. FLOWCHART

AUTO CAD PLANNING

- The first step of the project involves preparing the 2D layout of the school building using AutoCAD. In this stage, the overall plan is developed by identifying the required spaces such as classrooms, corridors, administrative rooms, and other essential areas. The layout is designed carefully to ensure proper arrangement, easy movement, and efficient use of space.
- Accurate dimensions are provided for all elements including walls, doors, and windows to maintain precision in the design. Standard guidelines are followed to ensure practicality and safety. Proper attention is given to ventilation and natural lighting by placing windows and openings in suitable locations, creating a comfortable environment for students and staff.
- Various AutoCAD tools and commands are used to create a clear and organized drawing. Layers are used to separate different components, making the plan easy to edit and understand. Once the layout is completed and verified, it is used as a reference for developing the 3D model in the next stage.

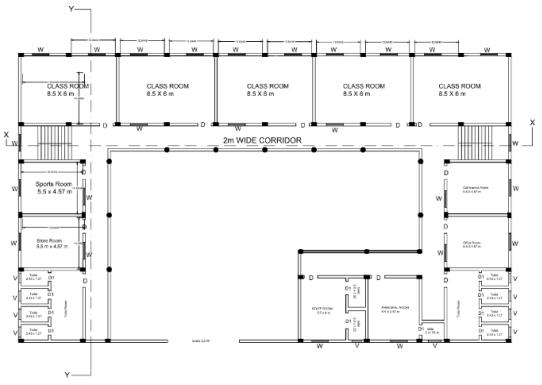

Figure 2 . GROUND FLOOR PLAN

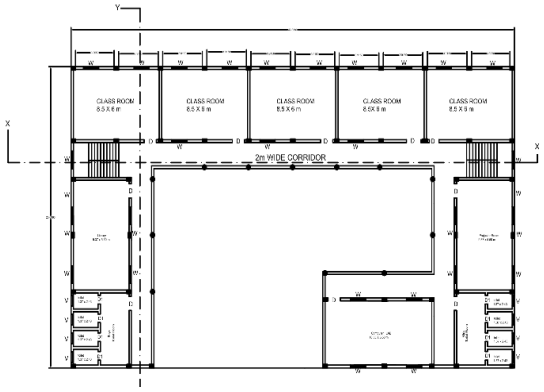

Figure 3 .FIRST FLOOR PLAN

REVIT ARCHITECTURE

- After completing the 2D plan in AutoCAD, the next step involves developing a 3D model of the building using Autodesk Revit. The AutoCAD drawing is used as a reference to create the model accurately. In this stage, architectural elements such as walls, doors, windows, and floors are developed based on the planned layout.
- Revit also allows the creation of structural components such as columns, beams, and slabs within the same model. This helps in combining both architectural and structural elements in a single platform. The software automatically updates changes across the model, which improves accuracy and reduces the chances of errors during the design process.
- The 3D model created in Revit provides a clear visualization of the building, making it easier to understand the design. It also helps in identifying any issues before construction begins. This step plays a key role in improving coordination, saving time, and ensuring a well-organized design for further analysis.

VII.RESULT AND DISCUSSIONS

The developed BIM-based model of the school building was analyzed to evaluate the effectiveness of planning, spatial arrangement, and overall design integration. The transformation of the 2D AutoCAD layout into a 3D Revit model enabled clear visualization of both architectural and structural components.

The model was used to assess space utilization, circulation, ventilation, and functional distribution of various facilities such as classrooms, corridors, administrative areas, and open spaces. The integration of different components within a single

BIM environment improved coordination and helped in identifying potential design issues at an early stage.

The following figures illustrate different aspects of the developed model, including plan view, structural framework, internal layout, and overall rendered visualization of the school building.

Figure 4 shows the top view of the school building model developed using Autodesk Revit. The layout clearly represents the arrangement of various functional spaces such as classrooms, corridors, and open areas. The design follows a systematic grid pattern, ensuring proper alignment and efficient space utilization.

The building is planned with adequate circulation space, allowing smooth movement between different sections. Open areas and surrounding spaces are also incorporated to enhance ventilation and provide a comfortable environment. Landscape elements such as trees and open grounds are included to improve the overall aesthetics and functionality of the campus.

The model demonstrates the integration of architectural planning using BIM, enabling better visualization and understanding of the spatial arrangement before construction.

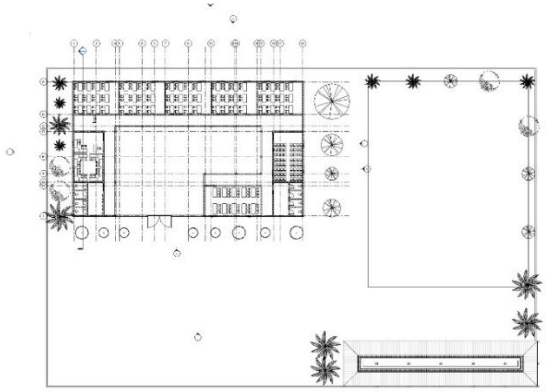

Fig. 4. Top view of the BIM-based school building model developed in Autodesk Revit

Figure 5 shows the three-dimensional structural model of the school building created using Autodesk Revit. The model illustrates the arrangement of structural components such as columns, beams, and slabs forming the load-resisting framework of the building.

The structure follows a framed system, where loads are transferred from slabs to beams and then to columns. The uniform spacing and alignment of structural members ensure stability and proper load distribution throughout the building. The G+1 configuration of the structure is clearly visible, representing both ground and first floor levels.

This 3D structural model helps in visualizing the overall framework, identifying potential design issues, and improving coordination between structural and architectural elements. It enhances understanding of the building system before actual construction, making the design process more efficient and reliable.

Fig. 5. 3D structural model of the school building developed in Autodesk Revit

Figure 6 presents the three-dimensional sectional view of the school building developed using Autodesk Revit. The model clearly illustrates the internal arrangement of spaces across both ground and first floors.

The sectional view highlights important functional areas such as classrooms, administrative rooms, meeting spaces, and sanitation facilities. Furniture elements like desks, chairs, and office setups are included to provide a realistic representation of the interior environment. The arrangement ensures proper space utilization, comfortable seating, and efficient movement within the building.

The design also demonstrates adequate ventilation and lighting through the placement of windows and open corridors. The inclusion of circulation spaces such as corridors and stair access improves connectivity between different sections of the building.

This view enhances understanding of the internal planning and helps in visualizing how different spaces interact within the structure, making it easier to identify design improvements before construction.

Fig. 6. 3D sectional view of the school building showing internal layout and facilities

Figure 7 shows the complete three-dimensional rendered view of the school building along with the surrounding site developed using Autodesk Revit. The model provides a realistic visualization of the building, including its external appearance, layout, and overall spatial arrangement.

The building is designed in a G+1 configuration with a central open courtyard, which enhances natural lighting and ventilation. The surrounding area includes open green spaces, landscaping elements, and pathways that contribute to a comfortable and aesthetically pleasing environment. The inclusion of trees and open ground areas supports a healthy and interactive atmosphere for students.

The layout also provides sufficient open space for outdoor activities and future expansion. The boundary and site planning ensure proper utilization of land while maintaining safety and accessibility.

This rendered view helps in better understanding of the final appearance of the project and demonstrates the effectiveness of BIM in visualizing both the building and its surroundings before construction.

Fig. 7. 3D rendered view of the school building with site layout and landscaping

VIII. CONCLUSION

- A complete BIM-based 3D model of a G+1 school building was successfully developed using Autodesk Revit.
- The 2D layout prepared in AutoCAD was effectively converted into a detailed and accurate 3D model.
- The integration of architectural and structural components in a single model improved coordination and consistency in design.
- The developed model provided clear visualization of both external and internal building features, enhancing understanding of the project.
- Proper space utilization, ventilation, lighting, and circulation were achieved through effective planning.
- The use of BIM tools helped in identifying and minimizing design errors at an early stage.
- The project demonstrates that BIM-based modeling is an efficient and reliable approach for modern building design and planning.

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