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Full Length Article

Architectural Planning And 3d Bim Modelling Of A G+5 Building Using Autodesk Revit & E-Tabs Design

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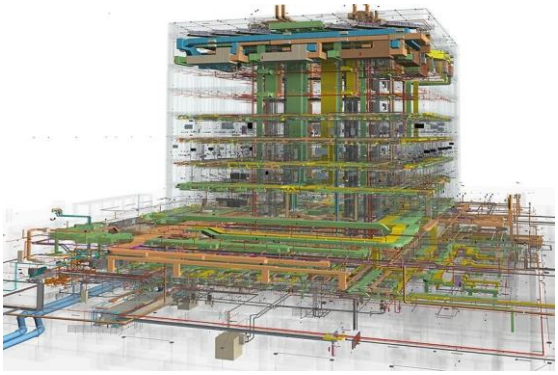
Abstract: *This project, titled "Architectural Planning and 3D BIM Modelling of a G+5 Building Using Autodesk Revit," focuses on the comprehensive planning, design, and digital modelling of a multi-story building using advanced Building Information Modelling (BIM) technology. The main objective of this project is to demonstrate the effectiveness of BIM in improving accuracy, coordination, and efficiency in modern construction practices compared to traditional 2D drafting methods. The project begins with the selection of a suitable plot and identification of functional requirements for a G+4 building. Architectural planning is carried out by considering essential factors such as space utilization, ventilation, natural lighting, circulation, and user comfort. Proper zoning of spaces including living areas, bedrooms, kitchens, and service areas is ensured to achieve an efficient and practical design. The planning is also carried out in accordance with standard building bylaws and safety regulations. After the planning phase, a detailed 3D model of the building is developed using Autodesk Revit. BIM enables the creation of an intelligent digital model where each building component such as walls, doors, windows, floors, and staircases contains both geometric and functional information. One of the key advantages of BIM is that any changes made in the model are automatically updated throughout all views, including plans, elevations, and sections, thereby reducing errors and saving time. The project also involves the generation of detailed architectural drawings directly from the BIM model, including floor plans, elevations, and sectional views. In addition, schedules for doors, windows, and materials are prepared using Revit's automated features, which help in quantity take-off and cost estimation. Visualization tools such as 3D views and renderings are used to present a realistic representation of the building, enhancing understanding and communication among stakeholders.*
In conclusion, this project highlights the importance of BIM technology in the construction industry and demonstrates how Autodesk Revit can be effectively used for architectural planning and modelling. The use of BIM not only improves design accuracy and efficiency but also supports better decision-making, coordination, and overall project management, making it an essential tool for modern civil engineering projects.
KEYWORDS: *Building Information Modelling (BIM), Autodesk Revit, Architectural Planning, 3D Modelling, G+4 Building, Multi story Building Design, Digital Construction, Space Planning and Zoning, Building Components (Walls, Doors, Windows), Construction Efficiency , E-tab.*

1.INTRODUCTION

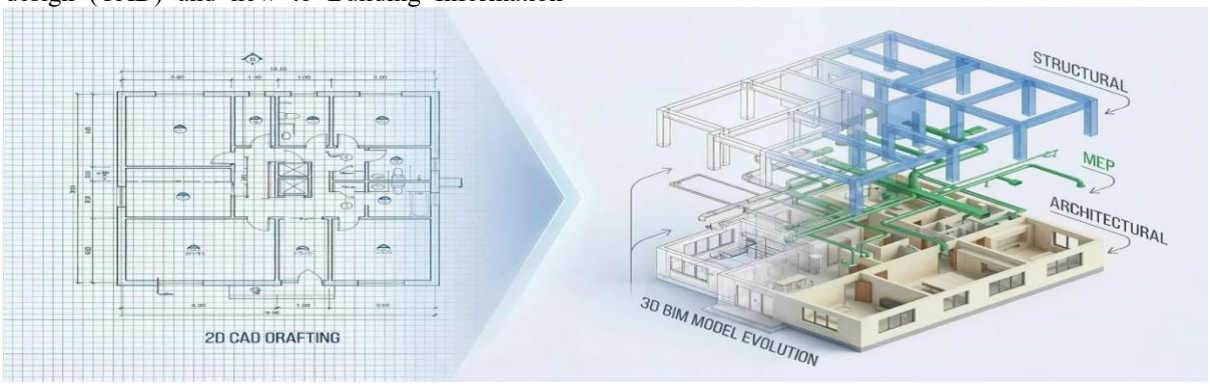
The construction industry has undergone significant transformation over the past few decades due to the rapid advancement of digital technologies. Traditional methods of planning and drafting, which relied on manual drawings and later on 2D computer-aided design (CAD), often resulted in inefficiencies, lack of coordination, and increased chances of errors. These methods required separate drawings for plans, elevations, and sections, making it difficult to manage changes and updates effectively. In recent years, the introduction of Building Information Modelling (BIM) has revolutionized the construction industry. BIM is not just a software application but a comprehensive process that involves the creation and management of digital representations of physical and functional characteristics of a building. It allows all stakeholders, including architects, engineers, and contractors, to work collaboratively on a single integrated platform. In this project, a G+5 building is planned and modelled using BIM technology through Autodesk Revit. The project demonstrates how modern tools can improve design accuracy, enhance visualization, and streamline the construction process.



Fig(a): 3D BIM Model

1.2 BACKGROUND OF STUDY

The evolution of construction design methods has progressed from manual drafting to computer-aided design (CAD) and now to Building Information Modelling (BIM). Initially, architectural drawings were prepared manually using drawing boards, which required considerable time and effort. The introduction of CAD software improved speed and accuracy but still lacked integration between different building components. BIM represents a significant advancement over CAD as it integrates all aspects of a building into a single intelligent model. Unlike traditional methods, BIM allows for real-time updates, meaning that any change made in one view is automatically reflected in all other views. This reduces errors and improves efficiency. With the growing complexity of construction projects and the increasing demand for sustainable development, BIM has become an essential tool in modern engineering practices. It supports better planning, coordination, and execution of construction projects.



Fig(b): Evolution from CAD – BIM Diagram

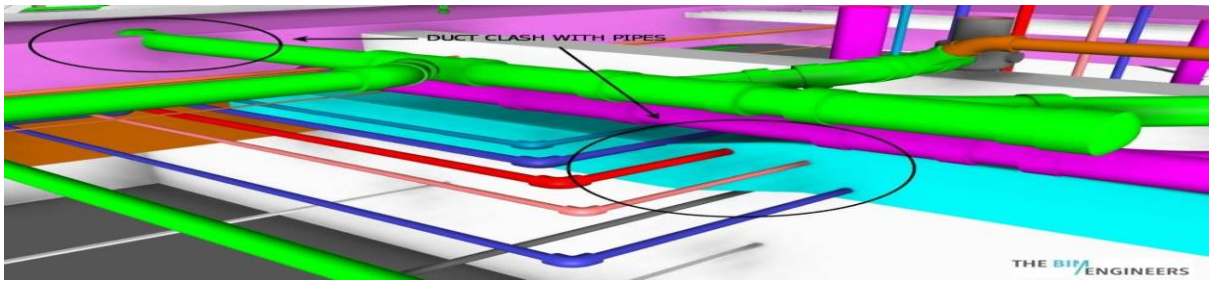
1.3 NEED FOR BIM

The need for BIM arises due to the limitations of traditional construction methods. In conventional approaches, different teams work on separate drawings, leading to miscommunication and inconsistencies. Any modification requires manual updates in multiple drawings, increasing the chances of errors.

BIM addresses these challenges by providing a centralized and integrated model. The major needs for BIM include:

- Improved coordination among different disciplines
- Reduction of design errors and clashes
- Better visualization of the building
- Efficient project management
- Accurate quantity estimation and cost control

In modern construction, where projects are becoming increasingly complex, BIM plays a crucial role in ensuring efficiency, accuracy, and quality.



Fig(c): Clash Detection and Co-ordination in BIM

1.4 PROBLEM STATEMENT

Traditional methods of building design and documentation face several challenges, such as lack of coordination, duplication of work, and increased chances of errors. These problems often lead to project delays, increased costs, and reduced construction quality.

In multi-storey buildings like G+4 structures, the complexity increases due to multiple floors, services, and structural components. Managing these elements using conventional methods becomes difficult and inefficient.

Therefore, there is a need for a modern and integrated approach that can handle complex

building designs efficiently. This project addresses these challenges by adopting BIM technology to develop an accurate and coordinated building model.

1.5 OBJECTIVES

The main objectives of this project are:

- To develop architectural planning of a G+4 building
- To create a detailed 3D BIM model using Autodesk Revit
- To generate architectural drawings such as plans, elevations, and sections
- To understand the workflow and applications of BIM in construction
- To improve coordination and reduce errors in building design
- To demonstrate the advantages of BIM over traditional methods

1.6 SCOPE OF PROJECT

The scope of this project includes the planning and modelling of a G+4 building using BIM tools. The focus is mainly on architectural aspects, including layout design, 3D modelling, and visualization.

The key aspects covered in this project are:

- Preparation of floor plans from ground floor to fourth floor
- Development of a 3D model including walls, doors, windows, floors, and staircases
- Generation of elevations and sectional views
- Basic rendering and visualization of the building
- Preparation of schedules for doors and windows

However, this project does not include detailed structural analysis or MEP (Mechanical, Electrical, Plumbing) design. These aspects can be considered as future extensions.

2. LITERATURE REVIEW

Literature review is an essential part of any research project as it provides an understanding of previous studies and developments related to the topic. It helps in identifying research gaps and understanding how current technologies have evolved over time.

In this project, the literature review focuses on Building Information Modelling (BIM), its applications in construction, and the use of Autodesk Revit for architectural planning and modelling. Various researchers have highlighted the advantages of BIM in improving efficiency, reducing errors, and enhancing collaboration in construction projects.

2.2 REVIEW OF PREVIOUS STUDIES

Several researchers and organizations have contributed to the development and implementation of BIM in the construction industry.

Eastman et al. (2011) explained BIM as a digital representation of physical and functional characteristics of a building. Their work highlighted how BIM improves coordination among project stakeholders and reduces design conflicts. They emphasized that BIM enables better visualization and supports decision-making throughout the project lifecycle.

Azhar (2011) studied the benefits of BIM in construction projects and found that BIM significantly reduces project cost and time. The study also showed that BIM helps in clash detection, minimizing errors during construction.

Succar (2009) discussed the framework of BIM and its implementation stages. According to the study, BIM adoption improves productivity and enhances collaboration among different disciplines involved in a project.

Hardin and McCool (2015) explained the practical applications of BIM in construction and project management. They highlighted that BIM can be used for scheduling, cost estimation, and facility management.

Kymmell (2008) described how BIM supports integrated project delivery and improves communication between architects, engineers, and contractors. The study emphasized the importance of BIM in modern construction practices.

These studies clearly indicate that BIM is a powerful tool for improving efficiency, reducing errors, and enhancing overall project performance.

2.3 FINDINGS FROM LITERATURE

From the review of previous studies, the following key findings can be summarized:

- BIM improves coordination between different disciplines
- It reduces errors and design clashes
- BIM enhances visualization through 3D modelling
- It supports accurate quantity estimation and cost control
- BIM improves project efficiency and reduces construction time
- It enables better communication among stakeholders

The literature also shows that Autodesk Revit is one of the most widely used BIM tools for architectural modelling and documentation.

However, despite its advantages, the adoption of BIM requires proper training and understanding of the software. There is also a need for awareness and implementation of BIM in developing countries.

This project builds upon the findings and demonstrates the practical application of BIM in designing a G+4 Building using Autodesk Revit.

3. PLANNING AND BUILDING CONSIDERATIONS

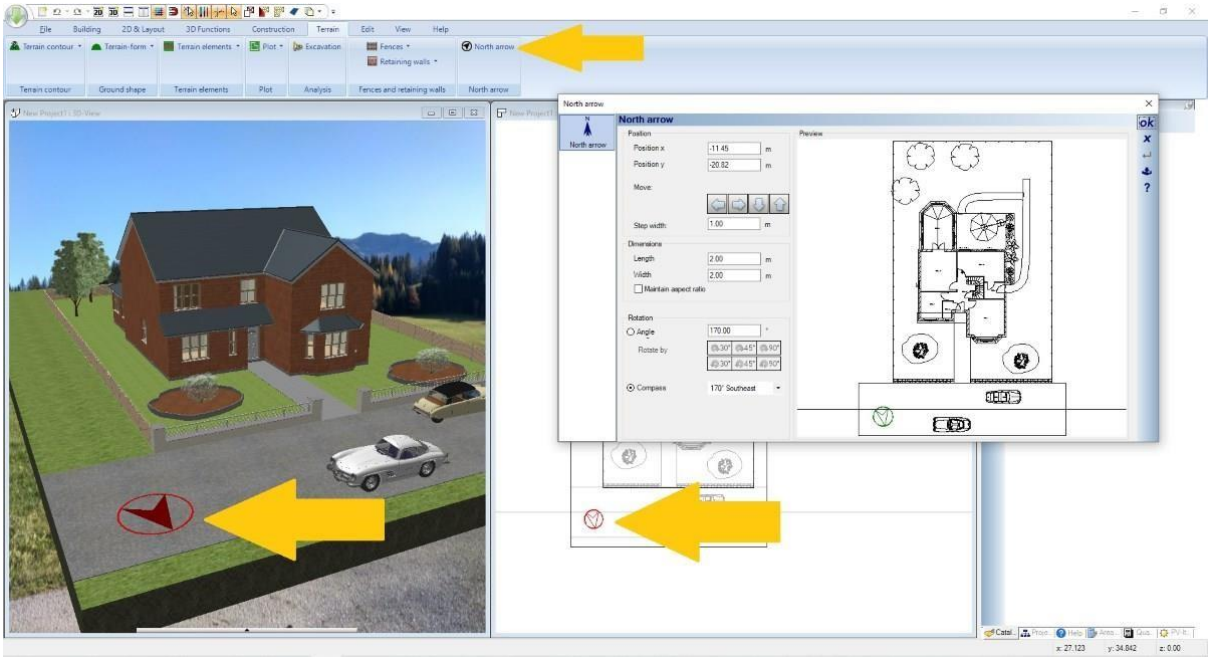
3.1 STUDY AREA AND DATA COLLECTION

The planning of any building begins with a proper understanding of the study area and collection of relevant data. In this project, a hypothetical plot is considered for designing a G+4 building. The design is based on standard dimensions and general building requirements suitable for urban residential or mixed-use development.

The data collected for this project includes:

- Plot size and dimensions
- Orientation of the site (north direction)
- Client requirements and functional needs
- Climatic conditions affecting ventilation and lighting
- Local building regulations and bylaws

Proper data collection ensures that the building design is efficient, functional, and compliant with regulations. It also helps in avoiding future design errors and ensures smooth execution of the project.



Fig(f) Plan with north direction

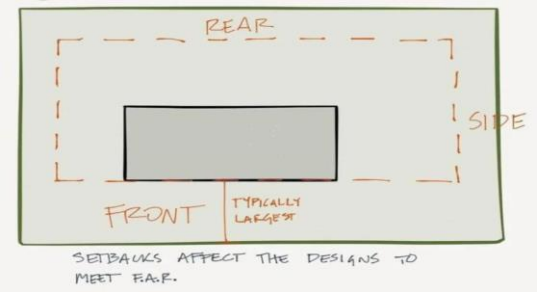
3.2 BUILDING BYLAWS AND REGULATIONS

Building bylaws are rules and regulations that must be followed during the design and construction of a building. These regulations ensure safety, proper planning, and standardization in construction.

Some important bylaws considered in this project include:

- Setbacks: Minimum open space to be maintained around the building
- Floor Area Ratio (FAR): Ratio of total built-up area to plot area
- Building Height: Restrictions based on zoning regulations
- Ventilation and Lighting: Proper openings for air and natural light
- Staircase Requirements: Minimum width and safety provisions
- Fire Safety Norms: Emergency exits and accessibility

Following these regulations ensures that the building is safe, legal, and suitable for occupancy

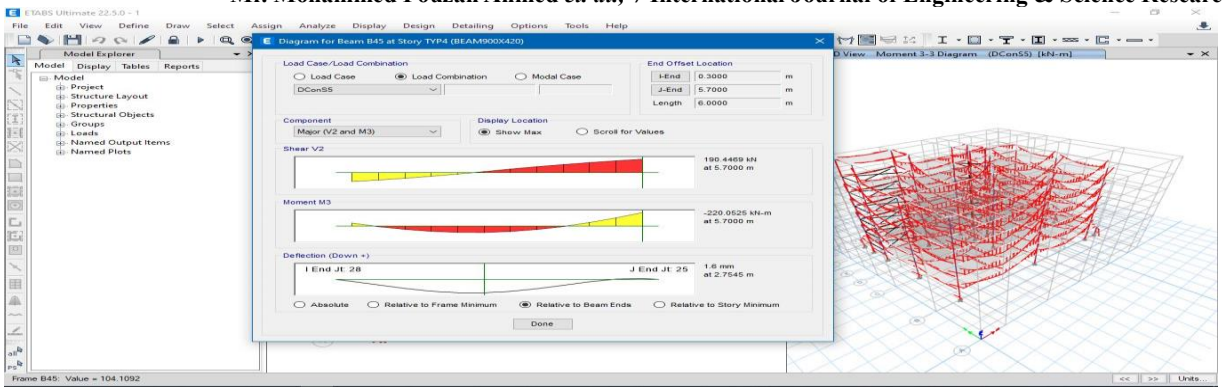


Fig(g) Setbacks

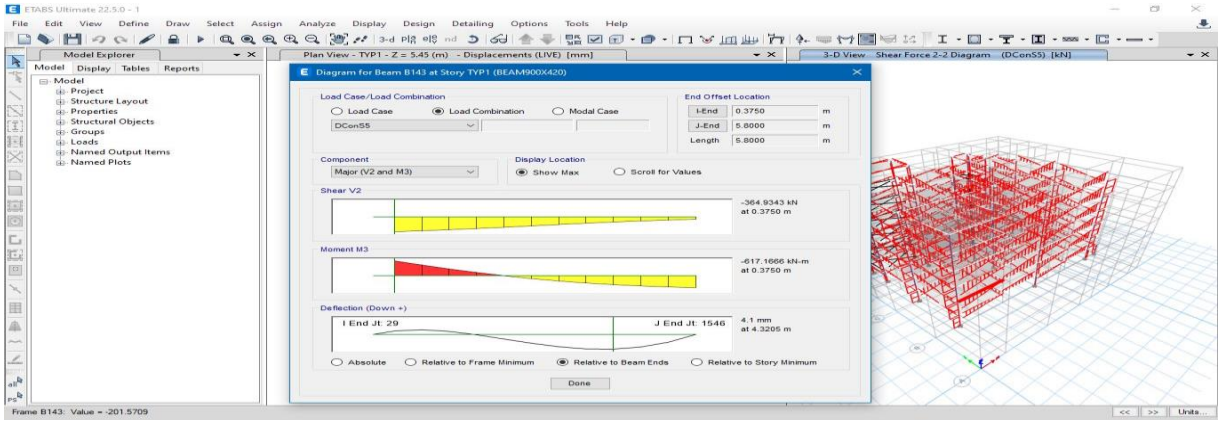
4. ANALYSIS AND RESULTS

The present structure is modelled and analyzed and analysis using ETABS. For the analysis of gravity load and seismic loads. The live load of the structure is considered 2 kN/m2. For the lateral load analysis (earthquake) parameter are considered as per Indian code basis.

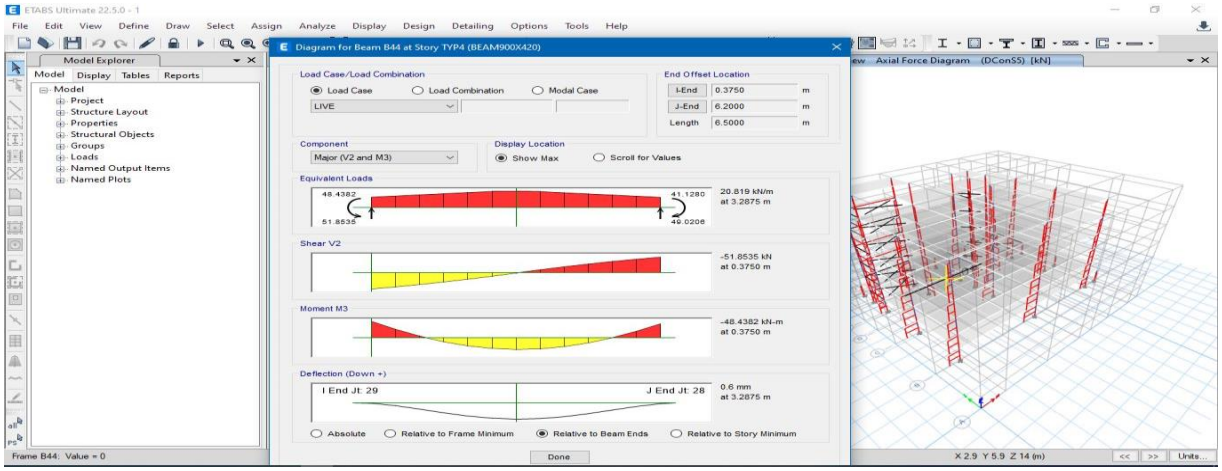
Analysis structure:



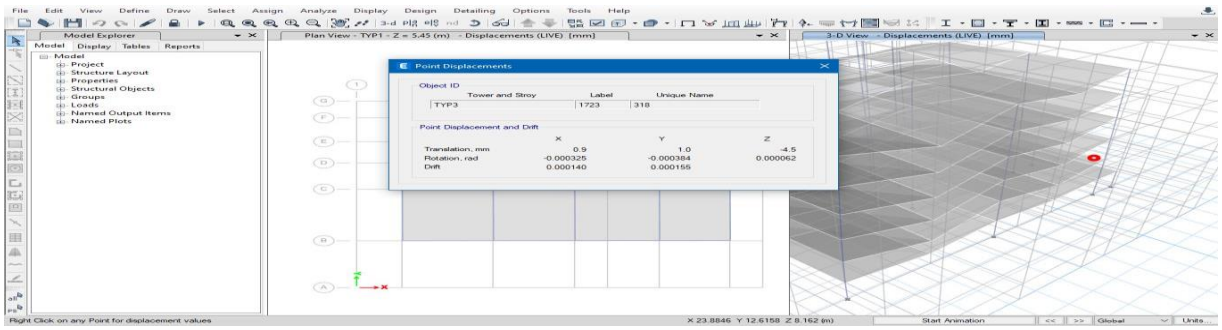
BENDING MOMENT WHOLE STRUCTURE



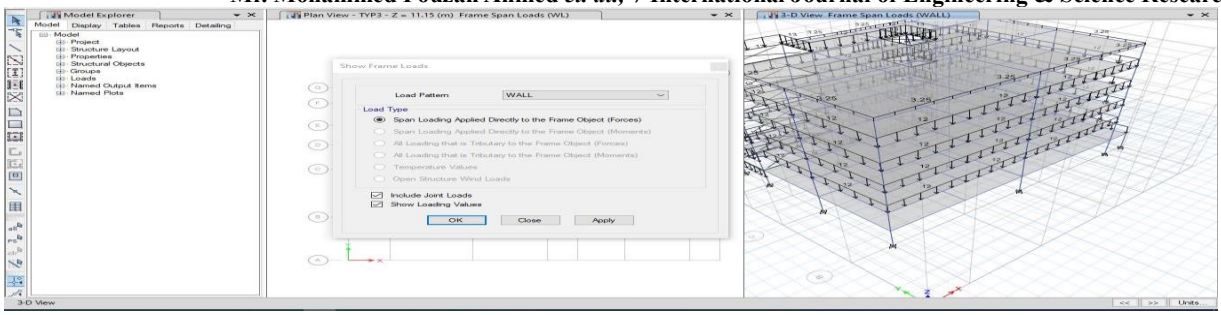
SHEAR FORCE WHOLE STRUCTURE



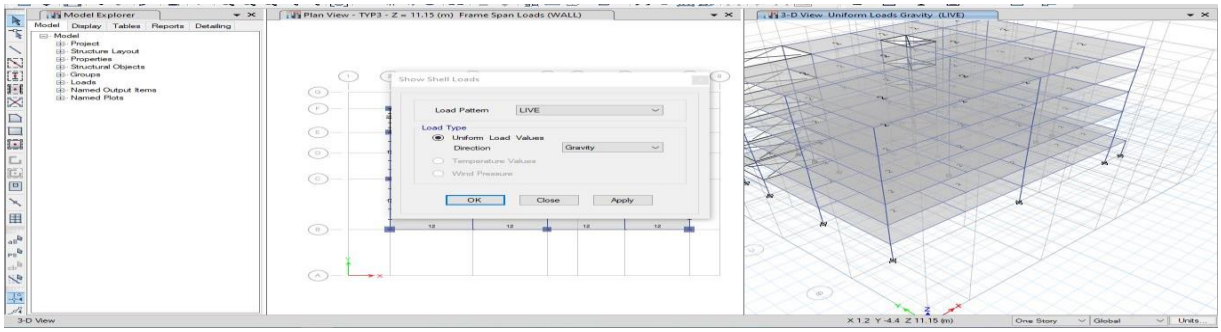
AXIAL WHOLE STRUCTURE



DISPLACEMENT OF WHOLE STRUCTURE
LOADS ASSIGNED STRUCTURE



DEAD LOAD



LIVE LOAD

RESULTS AND DISCUSSIONS

The project successfully achieved the planning and modelling of a G+4 building using BIM technology. The results obtained include:

Detailed architectural floor plans

Elevation and sectional views

Complete 3D BIM model

Rendered views for visualization

Accurate schedules for building components

The use of BIM significantly improved coordination and reduced errors compared to traditional methods. The project demonstrates that BIM is highly effective in managing complex building designs.

From analytical results, it is observed that base isolation technique is very significant in order to reduce the seismic response of both symmetric as well as asymmetric models as compared to fixed base building control the damages in building during strong ground shaking.

By comparing the dynamic properties of buildings, we can conclude:

As story height increases, the story drifts in dampers provided building model drastically decreases as compared to model provided without dampers.

From analytical study, it is observed that for both models of symmetric as well as asymmetric, at base of the building there will be zero displacement and for damper provided model there will be considerable value. Also, it has been observed that as floor height increases, lateral displacements increase drastically in fixed base buildings as compare to building model provided with dampers. By providing dampers to the structure the lateral displacement caused during earthquakes can be minimized for structural as well as non-structural elements when compared conventional model.

Use of seismic control systems has increased but choosing best damper and installing it into a building is very important for reducing vibration in structures when subjected to seismic loading.

Therefore, the deflections of buildings can be reduced by providing dampers to the structure. Finally, it is concluded that base isolation technique is significantly effective to protect the structures against moderate as well as earthquake ground motion

7. CONCLUSIONS

This project demonstrates the successful application of Building Information Modelling (BIM) in architectural planning and 3D modelling of a G+5 building using Autodesk Revit. The use of BIM technology has improved the accuracy, efficiency, and coordination of the design process.

The integration of all building components into a single model ensures consistency and reduces errors. The ability to generate automatic drawings and schedules further enhances productivity. Overall, the project highlights the importance of adopting modern digital tools in the construction industry for better project outcomes.

From the data revealed by the manual design as well as Software analysis for the structures following conclusions Are drawn:

Analysis was done by using ETABS software and successfully verified manually as per IS456.

Calculation by both manual work as well as software analysis gives almost same result.

Further the work is extended for a 5-story building and found that the results are matching

As per 5-story building has similar floors ETABS is the perfect software which can be adopted for

Analysis and Design Usage of ETABS software minimizes the time required for analysis and design

FUTURE SCOPE

The project can be further extended in several ways: Integration with structural design and analysis

- Inclusion of MEP (Mechanical, Electrical, Plumbing) systems
- Cost estimation and project scheduling (4D and 5D BIM)
- Advanced rendering and simulation
- Use of BIM for facility management

These advancements will further enhance the efficiency and effectiveness of construction projects.

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