

Building Information Modeling (BIM) 4D Technique Implementation in (G+3) Residential Building Construction



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ABSTRACT

In the construction industry, Building Information Modeling is mainly seen as a catalyst for productivity and innovation. Project planning in the construction industry plays a vital role in the advancement of the development industry. As projects have become increasingly complex, there is an increasing concern about the concept of project complexity. Understanding the complexity of projects and managing contractors should improve their level of management as building complexity increases. In the construction industry, contractors have faced many challenges, including headcount, rising costs, inadequate risk management, unrealistic expectations/poor forecasting, limited skills and delay issues. The case study research approach is used to analyze the BIM tools. It includes the BIM 3D/4D/5D tools as the new method to build visualization model, perform clash detection, take off quantity, simulate construction process, graphic work schedule and finish on time of the project. This study aims to investigate construction project management through the application of the BIM tool. The BIM platform optimizes design quality and improves construction work efficiency, such as conflict detection, work schedule, quantity decrease, etc. The results are also useful for identifying research clusters and topics in the BIM community.

Keywords- Construction, Project Management, Building Information Modeling, g, development, construction, planning, project Work.

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I. INTRODUCTION

1.1 General Introduction

Construction project management becomes more complex as the construction industry evolves. There are differences in the project management results with different management methods. In general, the construction project has many subcontractors to cooperate, such as piling, structure, architecture, mechanical and electrical (M&E), landscape and others. It is a challenge to coordinate for each subcontractor. The lack of cooperation leads to a reduction in work efficiency.

The construction problems need more advanced technology to improve work accuracy and work efficiency. BIM has emerged as an opportunity to transfer various construction information. It contains the interaction of architecture, construction, mechanical and electrical (M&E) and construction information. This technology has been developed from three-dimensional (BIM 3D) to construction

time (BIM 4D), quantity survey (BIM 5D) and life cycle management (BIM 6D). Some BIM applications were gradually adopted in the construction industry, such as structural analysis, construction simulation, cost management.

A 4D model associates part of the 3D modeling with the planning of the project. This allows owners to view the project before construction of the project. Usually, civil engineering students learn to analyze the design of the projects and plan the construction of the project by reviewing the paper drawings or 2D drawings and by using CPM (critical path method) diagrams. By combining 3D models with 4D models it becomes one visualization and gives information to the owners, stakeholders of the project. Thus, visualization of the project improves communication and coordination between owners and contractors. The relevance of price is very high in the construction industry where the success of the project is highly dependent on the planning of the project.

1.2 BIM-DEFINITION

- ❑ BIM is defined as “a model-based technology linked to a database of project information and a three-dimensional”, virtual representation of the project.
- ❑ It is a strong collaborative process that allows architects, engineers, real estate developers, contractors, fabricators and other construction professionals to plan, design and build a structure or building within a single 3D model.
- ❑ It covers,
 - 1.Geometry
 - 2.Geographic information
 - 3.Quantities
 - 4.Properties of building components.

1.3 CONCEPT OF BIM

- ❑ The BIM concept helps us to understand the conditions and its effects when a particular building material like a wall, slabs, etc. are planned to introduce in the structure.
- ❑ The BIM concept also helps us to understand the alternative solution of a particular element by comparing it to various other factors.
- ❑ The BIM concept helps us to understand whether the constructed building is profitable or loss.
- ❑ The concept of BIM provides us a simulation of a 3D model by connecting all the given information related to planning, construction, operating of the project.

1.4 ADVANTAGES OF BIM

- ❑ Cost and Resource Savings.
- ❑ **Greater Efficiency and Shorter Project Lifecycles.**
- ❑ Improved Communications.
- ❑ More Opportunities for Prefabrication and Modular Construction.
- ❑ **Higher Quality Results.**
- ❑ **Improved productivity and quality.**
- ❑ Increased co-ordination and construction documents.
- ❑ **It simplifies the take-off quantity of the material.**
- ❑ **The planning of alternatives can be done in a much easier way.**
- ❑ **The problems related to safety now can be easily resolved.**
- **Who can take advantage of BIM**



1.5 APPLICATIONS OF BIM

- ❑ The major application of BIM is that helps in saving the cost and time of construction
- ❑ The other application is that the building model can be changed according to engineered preference
- ❑ The other application is that it helps in the tracking of progress of construction.

1.7 EXAMPLES OF BIM SOFTWARE

- **Revit by Autodesk**



- **AutoCAD by Autodesk**



- **Tekla Structures BIM Software**



- **STAAD Pro V8i by Bentley Systems**



- **Google sketch-up**



- **E-tabs by CSI**



Autodesk BIM 360



MSP



1.8 PROBLEM STATEMENT

- ❑ This project shows how BIM is implemented in construction. In this project the planning, analysis and **design of 2D and 3D floor plan on G+3 residential building. Execution of the interior by means of software.**
- ❑ Planning the object and placing the material in the model must be done carefully during model creation. Analyze the model, apply loads to the structure and find out if it accepts.
- ❑ Own loads, active loads and wind loads are calculated or analyzed **using BIM to apply to the structure. The MEP work, mechanical, electrical and plumbing, is designed and analyzed by BIM.**
- ❑ Scheduling of the plan is also done by BIM. Then the last phase, namely rendering and checking the plan.



1.8 Aim of the Project:

- ❑ **Building Information Modeling (BIM) 4D Technique Implementation in Residential Building Construction.**

1.9 Objectives:

Following is the objective of the Project Objectives

- ❑ To collect the construction site data and prepare the layout of the proposed building using AutoCAD.

- ❑ The collected data met the requirements of the project. This data includes the drawings & specification of a building.
- ❑ Make effective use of building project data during construction, operation and maintenance.
- ❑ To display and share design studies of construction and calculate the estimated cost of the building.
- ❑ The main purpose of BIM is to improve project performance and produce better results.
- ❑ Reduce delays and errors & increase efficiency and productivity.
- ❑ Higher quality of performed work & Better communication in the project.
- ❑ Towards higher productivity and more accurate planning for the use of BIM.
- ❑ To reduce construction costs or material waste.
- ❑ To reduce the construction time of the building.

II. LITERATURE SURVEY

1. Monica.U, Ravi Kumar“Contrivancing 4d-bim In Metro Rail Project Using Power Project Software” JETIR April 2021, Volume 8, Issue 4.

The aim of this project is to overcome all types of delays and risks in Metro Projects using the new 4D-BIM tool Power Project with the Critical Chain Project Management concept over the other traditional methods and tools. And the aim was satisfied by the application and analysis of the real time problems associated in construction and management of Metro Rail Projects with 2 cases that is addition of buffer before actuals and addition of delays fragnets after actuals. These two cases have given real time solutions and it is proven automatically by the software where no human errors can be done. The 3D model, BIM, Scheduling, and the application of two cases has proven by giving new and real solutions to all the new risks and delays occurring.

2.Nehad ali khan, Niyaz ahmed shareef, Syed mohd hyder moosvi, Syed nemath uddin, “Comparison and Analysis of a Building with 4D Modeling” (IOSR-JMCE) (Mar. - Apr.) 2017

The research showed 4D modeling as a promising tool for construction planning. It gives us the positive impact and also the advantages that aren't able to achieve by the usage of the traditional methods of construction planning. The most foremost benefits of 4D modeling are found to be better visualization of construction work, easy communication between the different parties working on a project and helps in the increment of efficiency of the project. Implementation of 4D modeling helps in detection of errors and problems which could come up after starting of the construction hence in the management of cost and time of the project, besides this 4D modeling helps in the detailed planning of the project and presents a comprehensive view of even small sections of the project.

Therefore, a more dependable and detailed work plan allows us to complete the project in assumed time and cost.

3. Harsha Vardhan Tirunagari, Venkatesh Kone "Simulation of Construction Sequence using BIM 4d Techniques" (IJRTE) ISSN: 2277-3878, Volume-7, Issue-6C2, April 2019

Usually, scheduling is done by using management software like MS Project and Primavera even though, Construction Schedules don't have good eminence in the construction industry due to its complexity and uncertainties. This study identified that the 4d simulation is to improve the preconstruction planning by visualizing the construction process in a regular interval of time. BIM in construction industry supports to achieve Integrated project delivery which involves all the people and stakeholders from starting stage to finishing stage of the project to get optimized results and that increases the value of the owner

4. Sonali Pandit, Er. Bhupinder Kaur, Er. Sandeep Salotra "Building Information Modeling (BIM)-4D Visualization" (IRJET) Volume: 05 Issue: 01 | Jan-2018

BIM 4D Visualization technologies provide highly advanced or construction or industrial management skills to monitoring environment, in project scheduling and also used by project team for project control. The given task properly executed with planned and accurate dates are defined by Gantt chart Performa. Comparing with each other plans and dates the given status bar shows progress of work to the project team in a simplest form. 4D BIM gave actual representation of construction work and also provide information about construction plan. 4D model include all construction activities and also provide safety measurement against risk mitigation or actions. Design of 4D modelling software i.e., Autodesk Navisworks 2017 found very easy to adopt or learn which help AEC and construction industry for better outcome of construction project. Duration of case study also create few shortcomings for e.g., it required adequate training staff, highly skilled people, software's cost and also cost of software training program. Therefore, this review paper implements that 4D BIM model act as a promising tool in construction industry. The main aim of BIM 4D models is to provide better visualization at construction site, it is also helpful achieving accurate work plan, details, increased planning efficiency, provide communication between project and project team and also improved safety aspects.

5. Amor R. "Surveying The Extent And Use Of 4d BIM In The UK" May 2016 <http://www.itcon.org/2016/4>.

The conclusion that may be drawn from this is that the benefits of 4D BIM are those related to understanding and communication, rather than the technical aspects of assessing, creating, validating and controlling project timescales. Indeed, there was evidence of a degree of suspicion that over-reliance on accessible 4D technology could mask a lack of planning skill and experience, arousing fears similar to those aired in other disciplines, such as education (see Bennett, et al., 2008) and medicine (Goodwin, 1995). For the purposes of this investigation, the planning and control function has been divided into sub-elements on the basis that an overall improvement in the delivery of construction projects will require an improvement in each, or at least, some of these elements. Whether 4D BIM has yet

provided, or in the opinion of planners, has the potential to provide such improvements was also a major focus of the study

6. Piyush Sharma, Sakshi Gupta, Lalit Kumar "A Critical Appraisal of Integrating 4D and 5D BIM into Construction Practice" Advanced research Publications 2017.

BIM is a growing area of research, integrating multiple information sources within the engineering, construction, fabrication and manufacturing industry. Construction business is rising with proficiency and innovation. Principally, BIM and its all dimensions (3D, 4D, 5D, 6D and 7D) are becoming globally recognized.

Some of the methods that are used to study time overruns within a 4D model require full automation. • For the full command on 5D BIM, engineers and planners should synchronize methods to regulate building modules and the features related with those modules for cost estimation.

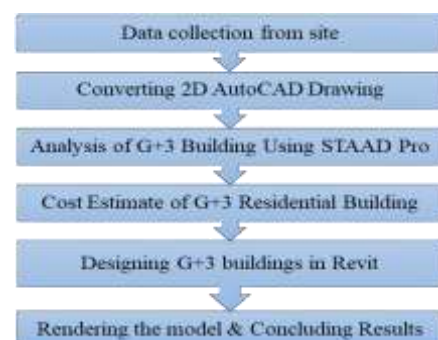
7. P. Farnood Ahmadi and M. Arashpour "An Analysis of 4D-BIM Construction Planning: Advantages, Risks and Challenges" ISARC 2020.

The study identified some noticeable advantages, risks and challenges of using BIM/4D-BIM in Construction Projects. The research concludes that the adoption of 4D-BIM in construction industry is highly recommended to improve and facilitate off-site and onsite construction works. Shortening and streamlining the procurement, design, prefabrication and construction duration and process in the project schedule are the significant advantages of 4D-BIM integration in the construction industry. Using BIM/4D-BIM can reduce coordination risks, the fabrication cycle time and risks of programming in construction industry.

8. P.C. Charlesraj and T. Dinesh "Status of 4D BIM Implementation in Indian Construction" ISARC 2020

The study aimed at assessing the extent of 4D BIM adoption and capture the perceived benefits, barriers and drivers for 4D BIM. The target population for this study was the clients and contractors in Indian construction. One third of the participants responded to the survey and the general pattern in the response revealed that there is high level of awareness on 4D BIM among the clients and contractors in India. Also, most of them plan to use 4D BIM later (after three years) than sooner. It has been found that there is no statistically significant difference between the clients & contractors on their responses.

III. METHODOLOGY



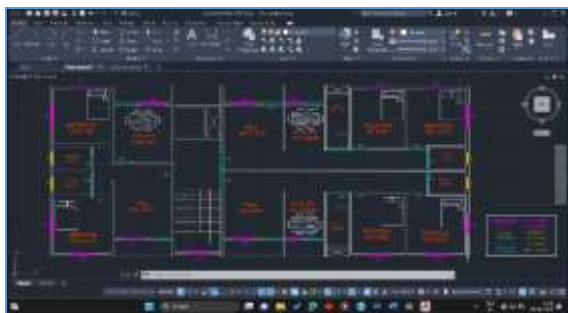


Fig-4.1 Layout of G+3 Building using AutoCAD

We express our sincere thanks to Project CO-Guide Mr. A.B. Khemalapure, Guide Mr. S.R. Thakur and HOD Mrs. P.M. Alandkar for their continuous support.

IV. LAYOUT OF G+3 BUILDING USING AUTOCAD

AutoCAD or Computer Aided Design is a very helpful tool in drafting and designing any structure. AutoCAD uses a Graphical User Interface for the purpose of drafting and designing any structure. The software has various inbuilt tools for complex drafting. Also, AutoCAD can be used for 2D, 3D and for perspective design. With the help of AutoCAD all the drafting for the project has been done.

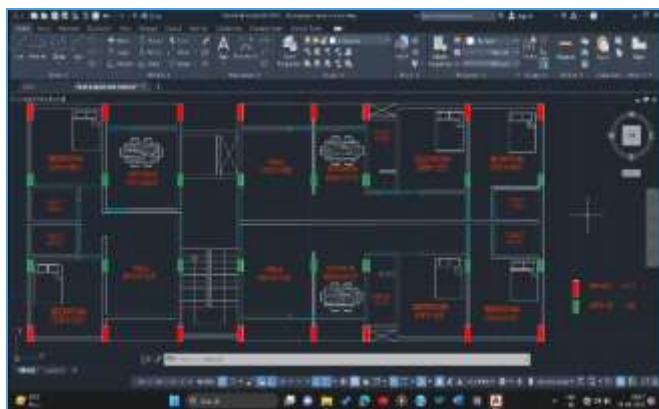


Fig-4.2 Column plan of G+3 Building.

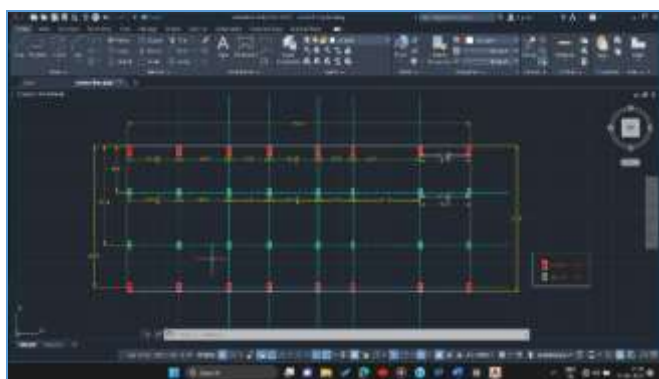


Fig-4.3 Centre Line Plan of G+3 Building

Area of Plot	75'X32'
Plot details	Front – service road left & right side – private residential buildings
Number of floors	G+3
Number of Rooms	48
Type Apartment	2BHK
Area of Each Apartment	630sq.m

ANALYSIS OF G+3 BUILDING USING STAAD PRO

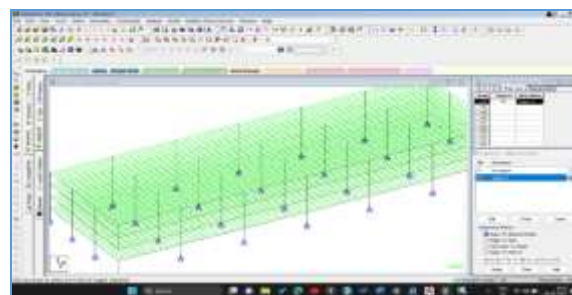


Fig-5.1 Plan of the G+3 Structure

Length of Building	72'4"
Width of Building	30'6"
Height	47'
Live Load on the Floor	3.0 KN/m ²
Grade of Concrete	M30
Steel	Fe 415
Column Size (09"X18") (09"X24")	(09"X18") (09"X24")
Beam Size	(09"X18")
Slab Thickness	6"
Total No Columns	128
Total No Beams	208
No of Footing	32

The above figure shows the beam and column layout that has been transferred from AutoCAD. The total width of the building is 30'6" feet while the lengths around 72'4". The live load acting on each floor was considered to be 3KN/ sqm. The live load is generated in the same way as dead load.

V. COST ESTIMATE OF G+3 RESIDENTIAL BUILDING

The cost estimate includes the quantities of the various materials that have been used and also an abstract cost for the construction of the building. The cost estimate has been prepared using Microsoft Excel. Centre line method has been followed for the calculation of the various quantities.

VII.

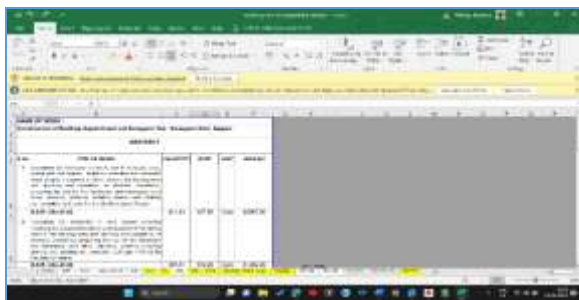


Fig-6.1 Calculating Quantity of the Structure.

The second part of the cost estimate includes the Abstract Cost of the building floor wise.

The rates used in the abstract have been taken from the CPWD Schedule of Rates for Pune. Below is the Complete Cost Estimate including the quantity estimate and abstract cost of the proposed G+3 Residential building in Pune.

VI. DESIGNING G+3 BUILDINGS IN REVIT

Revit is a 3D parametric modelling software package for building information modelling (BIM). Parametric modelling means you can create each of the following from within the tool, providing a single database for all the elements involved in your design:

- Parameters
- Relationships
- Properties
- Model data

Revit has changed the engineering configuration, drafting and demonstrating forms by achieving considerable upgrades in exactness and proficiency.

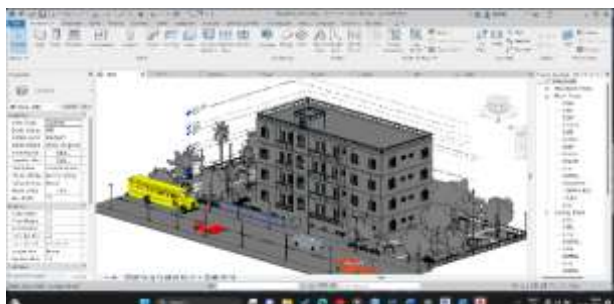


Fig-7.1 The exterior of the building prepared using Revit

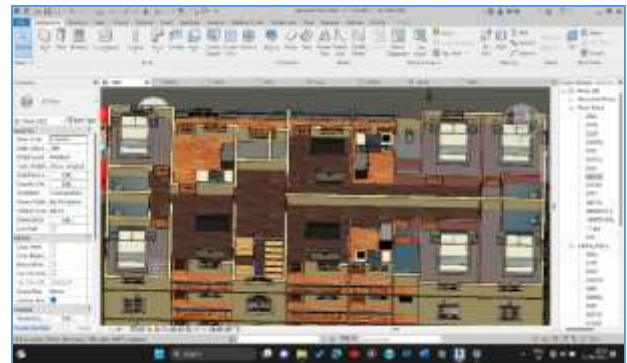


Fig-7.2 Floor plan of the building using Revit

DESIGNING G+3 BUILDINGS IN REVIT

The 4D CAD model is very useful to match the design of the different co-builders with their advanced construction activities and planned construction schedules. **4D CAD models to support the coordination of construction activities between contractors. 4D modeling to advance construction visualization in engineering education.**

Revit is a very useful tool that ensures consistency and helps coordinate while working on each drawing/model in the design phase. AutoCAD just draws lines that we used to make by hand, but digitally,

AutoCAD you can draw whatever you want and it will give you the results and according to your drawings.

Modeling the building in Revit software gives a beautiful, realistic 3D representation of the building.

Prepared Cost Estimate G+3 Building By using Excel, you avoid last-minute expenses, unforeseen costs and blocked working capital using estimates, resulting in lower project costs for you.

If the estimate is correct, the project will run smoothly and without interruption. You can complete your project faster and better.

A construction estimate helps estimate the cost of the work before it is completed,

It gives an idea of the need for controlled quantities of materials such as cement, steel, brick, etc.

This project includes the layout of G+3 residential building with AutoCAD, Analysis and Design with STAAD Pro, 3d with Revit and concludes with the cost estimate for the entire project. The layout of the proposed residential building G+3 is based on a plot of 75' x 32'. Previously, the plot was used as a business center, but according to the new plan it will be used as a multi-storey residential building. 4 floors will be divided into 2BHK, each apartment has an area of 630 sqm. All drawings are done using AutoCAD. Also, these drawings created in AutoCAD also served as the basis for transferring the structure to STAAD Pro for analysis and design.

VIII. REFERENCES

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