

# APPLICATION OF 4D CAD BIM TECHNOLOGY IN CONSTRUCTION SCHEDULING

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**Abstract** - Construction scenario is changing from 2D based drawings to 3D models. Building Information Modeling (BIM) is a model based design concept in which buildings are built virtually before the actual construction work starts. Construction projects are information intensive. Having access to accurate information at the correct time and in the precise place is essential for decision-making and also for ensuring a project to be delivered within time and budgeted cost. In order to introduce the basic concepts of BIM, researchers presented how BIM can be utilized by project managers as a good tool to simulate project condition. Their team stated the various advantages of BIM, its adoption in India, usage of BIM software's in India, also the challenges faced in BIM adoption. BIM is a new and promising approach in India which is gradually gaining acceptance. The value proposition of BIM is that it integrates all lifecycle phases of the project and has the potential to benefit all project stakeholders. The proper understanding of change in business processes and practices that come with BIM implementation, along with the project management aspect of BIM, is still a young area of academic inquiry. The purpose of this study is also to analyze how BIM can be utilized by construction managers. The case study was conducted on the residential bungalow to analyze the use of BIM. The study revealed that BIM can help construction manager in the task of delivering successful projects. A focus is placed on analyzing 3D and 4D BIM as Well as BIM based scheduling. The research was conducted through literature review & case studies. Thus, Building Information Modeling (BIM) is an emerging technology in AEC industry & it provides users with more accurate and consistent project information throughout the lifecycle.

**Key Words:** Visualization, 3D model, Scheduling, 4D simulation, Project Management, Benefits of BIM

## 1. INTRODUCTION

Building Information Modeling is a process consisting of information about different phases of any project like design, construction planning, construction, facility management and operation. It is one the documentation process beneficial for visualization, and construction application such as estimating, scheduling and design. Main advantage of implementing BIM application is the visual coordination of the building systems such as MEP (Mechanical, Electrical, and Plumbing) systems and it also identifies the possible conflicts between the building systems. By detecting the

conflicts, problems can be resolved before actual construction which in turn saves money and time invested. BIM is helping with better visualization of design by minimizing design errors better planning of construction activities, supporting the construction process and providing a data-rich platform for facility operation and maintenance. It is also a strong collaboration tool that helps the project team to work together and collaborate for delivering better built environment assets. In India, the BIM application is not widely practiced till now has scope to use this technology in a much wider scale.

## 1.1 The Building Information Model

The building information model refers to the combined model where the models from the different disciplines have been merged. According to the BIM handbook the building information model is characterized by the following features: 1- "Building components that are represented with intelligent digital representations (objects) that know" what they are, and can be associated with computable graphic and data attributes and parametric rules. 2- Components that include data that describe how they behave, as needed for analyses and work processes, e.g. takeoff, specification, and energy analysis. 3- Consistent and non-redundant data such that changes to component data are represented in all views of that component. 4- Coordinated data such that all views of a model are represented in a coordinated way.

## 1.2 4D CAD BIM

BIM allows use of a parametric 3D model to auto generate traditional building documents such as plans, sections, elevations, details, and schedules. It is a platform to share knowledge and communicate between project participants. In other words, Building Information Modeling is the process of developing the Building Information Model. High quality 3D renderings of a building can be generated from Building Information Models. In recent years, there has been a significant improvement in the tools available to model a construction project using 3D and 4D technologies. Current 3D Modeling tools offer predefined objects that facilitate the development, routing, and connection of building systems in 3D, and provide conflict detection mechanisms that help to automatically identify physical interferences between components. However, implementing 3D and 4D modeling on an actual project in a multidisciplinary and multi-

organizational environment is a complicated process that requires co-ordinate efforts. Implementation of constructability ideas in the construction industry has a potential return on investment concerning time and money. Scheduling and simulations plays an important role in this project. A schedule is a listing of a project's milestones, activities, and deliverables, usually with intended start and finish dates. Those items are often estimated in terms of resource allocation, budget and duration, linked by dependencies and scheduled events. Simulation is the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed. The model represents the system itself, whereas the simulation represents the operation of the system over time.

## 2. LITERATURE REVIEW

Nam Bui et al., (2016) [1] presented an overview of BIM research in developing countries and the focus of their present work was limited to China, India, and Malaysia. Han Yan and Peter Damian [2] conducted a research which outlines the historical evolution of design tools. Their paper describes questionnaire data from a survey of about 70 individuals from the AEC industry on BIM adoption, perceived benefits, and perceived barriers. Abdulsame Fazlia et al., (2014) [3] presented how Building Information Modeling can be utilized by project managers as a good tool to simulate project condition to avoid redundant works and waste of time and cost. Moiz Tarar (2012) [4] concluded 4D modeling as a promising tool for construction planning. Sheryl Staub-French and Atul Khanzod (2007) [5] provided guidelines to help project teams implement 3D and 4D modeling on building construction projects. Anil Sawhney & Research team stated the various advantages of BIM, its adoption in India, usage of BIM software's in India, the challenges faced in BIM adoption and the future of BIM in India. RistoTulenheimo (2015) [6] analyzed the wide range of obstacles generated by customers, company's own organization, social behavior and immature technologies in construction engineering industry. As a result of this study, different key challenges were identified that can alone stop a successful implementation of a BIM technology.

## 3. STATEMENT OF PROBLEM

BIM technology has already started to benefit the designers with model-based design and owners with a more feasible and accessible project and schedule is a key parameter for the construction management process. In some developing cities like Dhule, BIM is not applied yet. So it is essential to know if the information in BIM model can help for the time and schedule controls and the developments that can be made with BIM technology.

## 4. METHODOLOGY

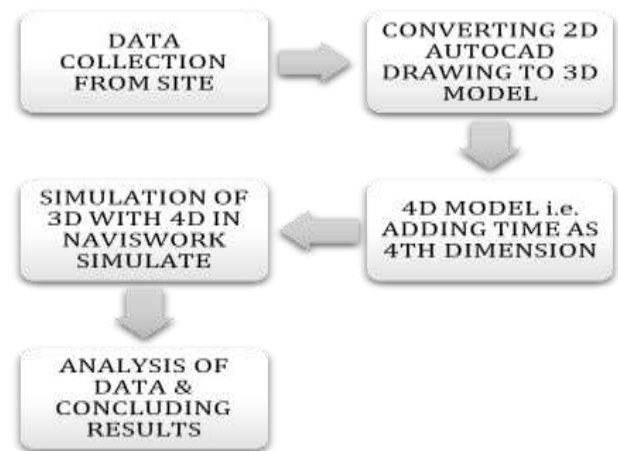


Chart -1: Flowchart of methodology

The goal of this project is to examine the uses and benefits of BIM for construction manager and analyze BIM based scheduling. First, it includes the definition and the use of BIM and its tools & a case study. The case study, a bungalow project, examined the 3D and 4D Building Information Modeling as well as BIM based scheduling. Collection of the data from the site like AutoCAD drawings, designs etc. the 3D model of the project is developed for the same. The various benefits of the model are taken into consideration. The building simulation model with the help of Navisworks simulate software is developed. By importing the 3D model to the Navisworks software from 3Ds max and then the schedule i.e. time with the help of Microsoft project has been linked to it to generate the simulated model in 4D. The role of the construction manager on BIM based project & traditional project will be defined.

### 4.1 DATA COLLECTION

The primary focus of this project is the use of Building information model, 4D simulation and its various parameters on a G+1 bungalow. In this chapter, the case study on the effective utilization of BIM for the residential building will be shown. The 3D modeling of residential bungalow is shown. The data was collected to fulfill the requirement of the project. This data include the drawings and specification of a building. Their Sections and Elevations are prepared by using the 3D AutoCAD. The aspect of the company for implementation of the project is studied thoroughly & all the information of the site like, who is owner, Structural consultant & site engineer etc. is collected. Also its intelligent model is developed by using BIM tool. The 2D AutoCAD drawing and 3D max file of the project are then taken from the site. The specifications of the all material of the site are also taken and studied.



Fig -1: Site plan 2D



Fig -2: 3D CAD model



Fig -3: 3D modeling by 3Ds Max

#### 4.2 DATA ANALYSIS

With time estimation, often also called 4D, the objects in a building information model are linked to the time plan with the help of Microsoft project 2013. The linkage to time plan makes it possible to graphically visualize the projects schedule. After that simulation is done by linking all the components of 3D model with time with the help of navisworks simulation software 2018. This type of

simulation provides considerable insight and allows for early detection of planning errors. Instead of realizing planning mistakes later on in the construction phase, and having to resolve problems on site which can be very costly, mistakes can be eliminated already in the design phase.

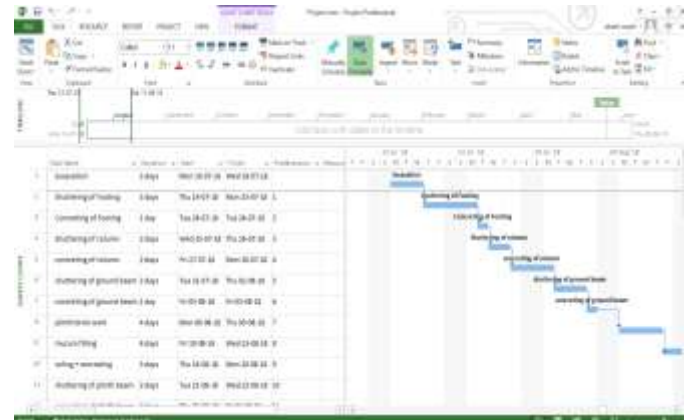


Fig -4: Microsoft project schedule

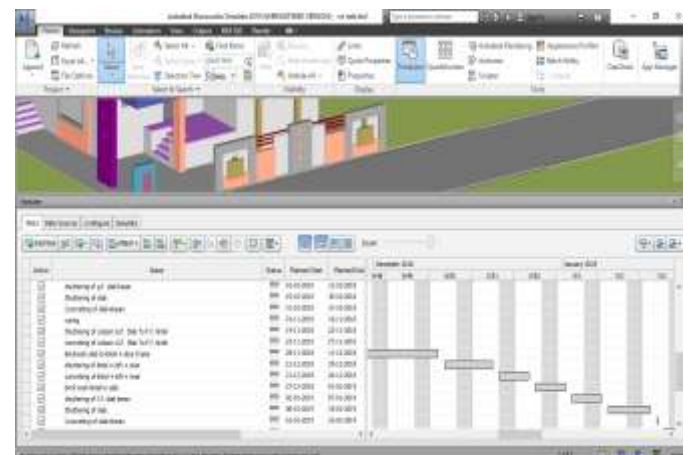


Fig -5: Naviswork activities screenshot

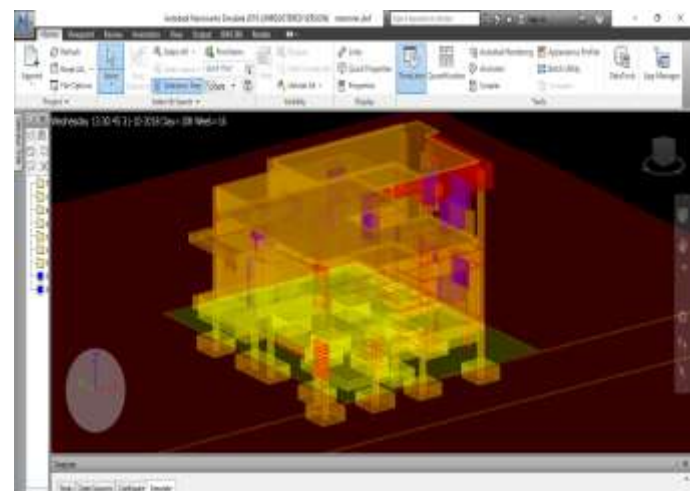


Fig -6: Naviswork simulation

## 5. RESULTS

Use Of BIM	Benefits
Early and efficient clash detection in location and sharing.	Early clash detection is possible in case of BIM use & also scheduling of same is possible which saves the time & cost.
Early and continual close Coordination with all players.	Results in proper coordination for entire project.
Allows flexibility in scheduling and sequencing.	According to requirements of clients or any other, the schedule or cost of the project can be updated at any point required. This gives flexibility to the project.
Better visualization	3D views of the project give the better visualization of project.
Better documentation with less errors.	As BIM is the digital process very less documentation is required for the project, this results in less errors and better coordination.
Enables increased offsite prefabrication.	With the help of 3D & 4D Simulation prefabrication of the activities can be done offsite.
Modifications are quickly visualized, shared, estimated and resolved.	All the project related work can be viewed at a time by the various persons involved in the project. This results in early detection & solving of the problem.

## 6. CONCLUSION

In our case study we utilized BIM for visualization, 3D coordination, construction planning, and simulation. Visualization consisted of rendering of exterior, structural components of the construction. Overall, visualization helped to understand the expectancy and needs of the project before construction. Construction planning was implemented for the project. This will easily avoid schedule delays and cost during construction. Lastly, a Simulation of the model is done. By simulation actual progress vs. planned progress is visualized by construction manager easily. BIM based 4D scheduling helps understanding of the construction components and schedule progress that in turn results better construction planning. The Construction Manager's role will remain the same in BIM projects as in traditional projects. However, the Construction Manager might be required to learn some new skills related to working with BIM. Regarding the Construction Manager's relationships to other stakeholders within BIM projects, there are many barriers keeping project participants from

using the latest technology and BIM. The barriers include fears of too low success low or big failure, high initial investment costs, the time to learn how to use the software. The obstacle in BIM implementation is the lack of information about the strict BIM implementation standards and rules for certain project participants, contract obligations in certain countries or unified documentation for regions. The use of BIM and its benefits have proven to be a value to construction projects. These benefits are achieved by the collaboration of the construction team and the utilization of BIM tools. However, these tools have some setbacks especially with interoperability which require further attention by the construction industry.

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