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A Case Study on Building Information Modeling for Residential Building

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Abstract - The design communication is gradually being changed from 2D based to integrated 3D digital interface. Building Information Modeling (BIM) is a model-based design concept, in which buildings will be built virtually before they get built out in the field, where data models organized for complete integration of all relevant factors in the building lifecycle which also manages the information exchange between the AEC (Architects, Engineers, Contractors) professionals, to strengthen the interaction between the design team. BIM is a shared knowledge about the information for decisions making during its lifecycle. There's still much to be learned about the opportunities and implications of this tool.

In this project studying BIM applying on existing building, this existing building having G+1 floor with total built up area 158.07 SQM. In this building ground floor having 2BHK and first floor having 2BHK and on terrace floor having attached toilet.

Key Words: Revit Software.

1. INTRODUCTION

1.1 General:

Building Information Modeling (BIM) and automated quantities technologies provide both opportunities and challenges for the project cost management profession. As quantification increasingly becomes automated and BIM models develop the role of the project cost manager will need to adapt accordingly to provide more sophisticated cost management services that incorporate 4D time and 5D cost modeling and sharing cost information/data with the project team as part of the BIM integrated project delivery approach.

BIM involves more than just 3D modelling and is also commonly defined in further dimensions such as 4D (time), 5D (cost) and even 6D (as-built operation). 4D links information and data in the 3D object model with project programming and scheduling data and facilitates the simulation analysis of construction activities. 5D integrates all of this information with cost data such as quantities, schedules and prices. 6D represents the as-built model that can then be used during the operational stages of the facility.

1.2 Definition of BIM :

Building Information Modeling is process supported by various tools and technologies involving the generation and management of digital representations of physical and functional characteristics of place.

1.2.1 Modeling:

A collaborative process of creating 3D geometry, connecting objects and entering required information.

1.2.2 Model:

Digital representation of a building consisting of one or more files in different formats and linked information.

1.2.3 Management:

Utilization and maintenance of models for optimization of building performance and streamlining of related workflows.

1.3 Use of Building Information Modelling:

Following are the use of Building information modelling which help primarily by purpose that they fulfill on the project along with additional attributes for each BIM.

- Virtual construction
- Design and engineering
- Construction management
- Operations and maintainance

1.3.1 VIRTUAL CONSTRUCTION :

It is the management of integrated multi-disciplinary performance model of design construction projects, including the product, work processes organization of the design construction operation team order to support explicit and public business objectives.

• 3D Modelling:

3-D modelling is the use of software to create a virtual three-dimensional model of some physical objects modeling is used in many different industries, including virtual reality, video games, marketing, TV and motion pictures, scientific and medical imaging and computer-aided design and manufacturing CAD/CAM.

- **3D Co-ordination:**

A process in which 3D coordination software is used to determine identify 3D geometric conflicts by comparing 3D models of building systems. The goal of 3D coordination is to eliminate field conflicts and coordination issues prior to installation.

- **Visualization:**

Visualization or visual is any technique for creating images, diagrams or animation to communicate a message. Visualization through visual imagery has been an affective way to communicate both abstract and concrete ideas since the dawn of humanity.

- **Quantity estimation:**

An estimate is prepared by first obtaining the quantity of the items required to complete the project and multiplied by unit cost of the items. Details of estimates depend upon the purpose of carrying out estimate.

- **Virtual reality :**

Virtual reality as the most immersive medium for visualizing a model, has the promise to become a regular part of construction industry. The virtual presence of collaborators in VR environment, eliminates the need of their physical presence. Simulation of on-site task can address a number of issues during construction, such as feasibility of operation.

1.3.2 DESIGN AND ENGINEERING :

The Engineering design process is a common series of steps that engineer in a creating functional product and process.

- a) **Structural consulting:**

Dedicated to quality, service and client satisfaction from project start through completion by providing innovative, practical, and solutions combined with high quality, attentive, responsive and pro-active service to our clients

- b) **MEP engineering:**

MEP engineering (mechanical design , electrical, and plumbing), also known as building services. This include the electrical design, mechanical design and finally the plumbing design. MEP design engineer will have the task of planning, decision making and accurately making the necessary documentation among other tasks.

- c) **Sustainable design:**

Sustainable design seeks to reduce negative impacts on the environment, and the health and comfort of building occupancy , thereby improving building performance. The basic objectives of sustainability are to reduce consumption of non renewable resources, minimize waste, and create healthy, productive environments

- d) **Architecture:**

A general terms to describe buildings and other physical structures. The art and science of designing buildings and (some) non building structures. The style of design and method of construction of a buildings and other physical structures.

1.3.3 CONSTRUCTION MANAGEMENT :

The BIM concept envisages virtual construction of a facility prior to its actual physical construction in order to reduce uncertainty, improve safety, workout problems, and simulate and analyze potential impacts.

- a) **Shop drawing generation:**

The shop drawings are generated using 3D BIM Models and hence are consistent with no scope of manual errors. If there are any updates to the model, the plans, sections, details and schedules all update in real time, ensuring correct data in every construction document.

- b) **4D & 5D Simulation:**

Time and costs can be remotely monitored and acted upon. The 4D and 5D Simulations act as dashboards to manage entire projects. These can be further integrated with legacy technologies like ERPs to manage procurement and other tasks in an efficient manner

- c) **Construction scheduling:**

The construction schedule for any project can be used to plan all the activities in a time based manner, which can help manage the entire in a much better manner.

- d) **On-site BIM management:**

When there is a team on site using BIM, there are many aspects of construction that can be optimized. Pour wise quantities of concrete, bar bending schedules, procurement costs management and a lot of other benefits can be leveraged through BIM Management.

1.3.4 OPERATIONS AND MAINTAINANCE :

Use of BIM goes beyond the planning and design phase of the project, extending through out the building life cycle the processes of building management includes cost management, construction management, project management, facility operation.

- a) **Facility management:**

For many years the issue of how to run buildings efficiently and effectively has posed a considerable challenge. This debate has had renewed significance since the emergence of Building Information Modelling (BIM) processes and the proposition that BIM information, captured during the facilities lifecycle, can help improve the efficiency of Facility Management (FM). Using this proposition as a starting point, the overarching aim of this paper is to investigate the value-adding potential of BIM and the challenges hindering its exploitation in FM.

- b) **Laser scan to BIM:**

Even if there are no drawings or plans available, laser scanning devices can capture the real world in 3D. This information can further be utilized to develop as-built BIM Models which can be further linked to CMMS and FM systems.

- c) **As-built BIM modelling:**

The model is a central source for all kinds of documents. One can easily access as-built drawings as well as move around in the 3D environment and understand the space. Even the manufacturer related information can be embedded in various 3D elements.

1.4 Softwares used for BIM:

There are many software for BIM process, in this project includes the following software used:

Revit

Navisworks

1.4.1 REVIT :

Revit BIM Software is a building information modelling tool for structural engineering, Construction design and Architectural Design. It is one of the most popular software packages developed by the CAD giant Autodesk. Designed for MEP engineers, architects, designers, contractors, and landscape architects, among others. The robust platform offers an intelligent model based approach for planning, designing, and constructing infrastructures and building. It is compatible with Microsoft Windows only.

1.4.2 NAVISWORK :

Navisworks is also built by Autodesk. The difference between Navisworks and Revit is that Navisworks specializes as a project review of software tool for AEC professionals. This 3D design review package is compatible only with Microsoft Windows. It complements other Autodesk 3D design packages for opening and combining 3D models, reviewing the model, and navigating around it in real time.

1.5 Existing Building Information :

Built up Area :

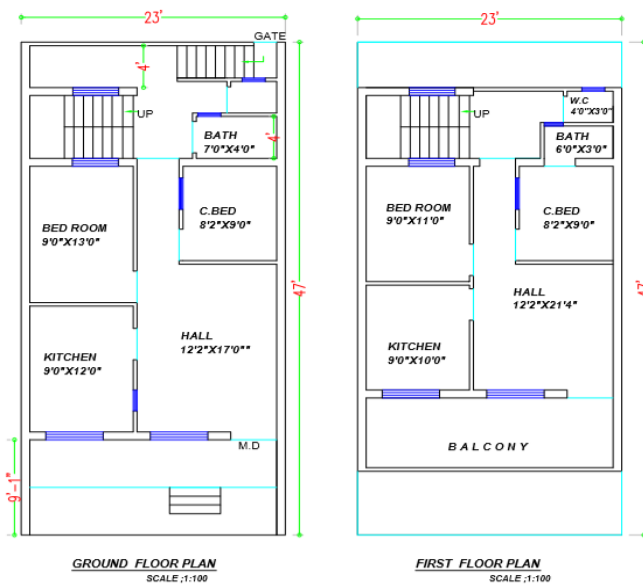
Ground Floor : 1081 sqft.

First floor : 943 sqft .

Terrace floor : 120 sqft.

In Ground floor provided 2BHK & in First floor provided 2 BHK. Total estimated cost 32 lakhs for this building.

• Building Plan for case study :



• Building 3D View for case study :



1.5.1 Status of BIM in India :

The construction industry is rapidly going digital, with BIM becoming an important part of it. BIM is allowing more intelligent use of resources and optimization of workflows, leading to productivity and probability.

In India a few companies are delivering BIM services to the global sectors, but they are being delivered only through subcontracts. Things should happen way behind this, like adopting BIM for the complete project lifecycle. BIM adoption

is seeing an increasing trend as more and more decision makers are able to understand how by virtually prototyping the building to be constructed, they are reviewing the design more easily, achieving more accuracy in construction and if need be, evaluating alternatives in terms of cost and other parameters. However, a few challenges limit the permission.

Figure 2 (a). Disciplines practiced by the respondents Firm.
Figure 2 (b). Firm Size of the respondents.

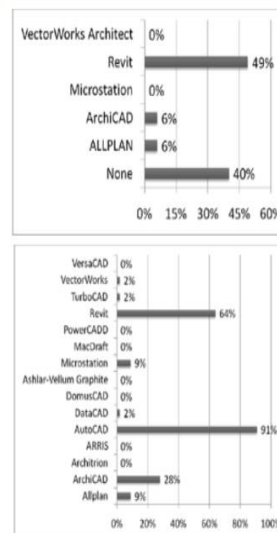


Figure 2 (c). BIM Application used in the Firm.
Figure 2 (d). Primary CAD Application practiced in the firm.

Figure 3 (a). Causes for starting BIM.
Figure 3 (b). Reasons for not using BIM.

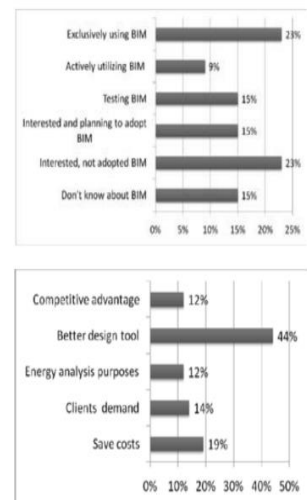


Figure 3 (c). Firm Leaders interest towards BIM.
Figure 3 (d). Reasons for the interest towards BIM.

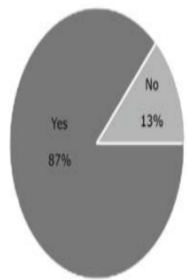


Figure 3 (e). Interested in adopting BIM workflow.

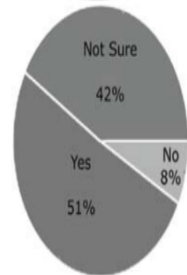


Figure 3 (f). Adopting BIM in Architecture field leads to better pay.

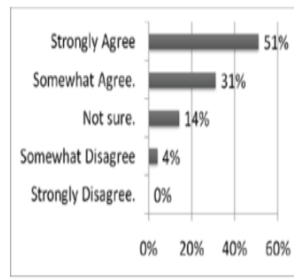


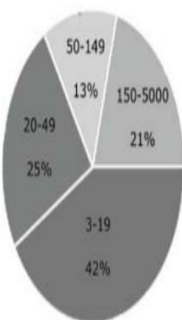
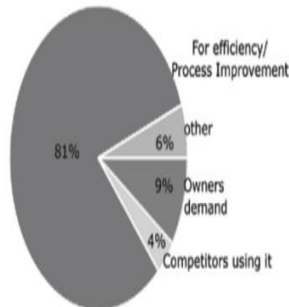
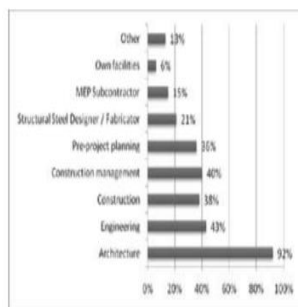
Figure 4 (c). Adopting BIM leads to greater efficiency.



Figure 4 (d). 2D is inefficient to true BIM workflow in the working drawing.

Fig. no. 2(a), (b), (c) and (d) provide base information about the respondents.

Fig. no. 3(a), (b), (c), (d), (e) and (f) provide information on reasons for non-adoption of BIM at present.



Dr. Peter Smith :-

The need for Project Cost Managers to embrace and evolve with BIM is inevitable but the rate of adoption and implementation remains to be seen. Government mandates to use BIM on public sector projects, such as has occurred in the United Kingdom and the United States, would certainly accelerate BIM implementation by the profession should not be waiting until their clients require it. It also places the project cost manager in a powerful position to maintain and control key information the virtual model and drive cost performance on projects. The longer firms delay their entry into the BIM and automated quantities world the further other firms with these capabilities will progress and add to their competitive advantage. The ability to simulate a range of design options with real-time cost advice and continue that real-time cost advice throughout the detailed design, construction and operational stages will arguably place the project cost manager at the top of the 'value chain' for project clients.

Mehmet F Hergunsel :-

The project studied six BIM utilization activities: visualization, 3D coordination, cost estimation, prefabrication, construction planning and monitoring, and record model. The visualization is generally the simplest use of a Building Information Model such as renderings. As soon as the Building Information Model are produced, the quantity takeoffs can be generated to provide cost estimations on a construction project. Once the drawings are designed to build, the prefabrication of the components of the construction facility can be built to design. BIM based 4D scheduling helps understanding of the construction components and schedule progress that in turn results better construction planning. Finally, the record model can be generated as the final progress of the construction as the as-builts are completely updated in the Building Information Model.

Saeed Reza Mohandes:-

Due to numerous steps of construction industry and its complicated and extensive structure, errors and reworks often might happen in this section. As such, BIM (Building Information Modeling) is regarded as a beneficial tool in minimizing the waste and improving the efficiency of building construction. This paper reviews and summarizes a substantial amount of requisite information relating to BIM from the literature reviews between 2005 and 2012. It has discussed the concept, explained the history, planning and implementation process and the benefits of using BIM in construction industry. Furthermore, the application of BIM in construction process of two specific projects has been explained. Additionally, the importance of BIM for architects, engineers and construction industry has been taken into consideration.

2.Literature Review:

J Vinoth Kumar :-

In India 49% of the respondent use Revit as measure Revit tool. The BIM is new & promising approaching India which is gradually gaining acceptance by the owners, Architects, Engineers & Builders. BIM is in field to better communicate & integrate construction information. The study concentrated on the deployment of the model to support planning scheduling & tracking of the job site operation in India. The survey has supported authors' expectation that BIM has remarkable acceptance potential among the AEC firm in India.

3. OBJECTIVE & SCOPE :

3.1 Problem Statement:

Solving the inefficiencies in planning, designing, scheduling, estimation, execution, etc. of present day 2D CAD approaches using building information modelling in residential building.

3.2 Objective and Scope:

Planning of residential Building according to building bye-laws in BIM.

Making of model by using different software in BIM.

To use BIM for visualization, 3D co-ordinates, Planning, scheduling, estimation & record of a Residential building.

4. Methodology:

General :

The BIM methodology involves the coordination of different technologies for project management through a single 3D digital model that shortens the times of both the design and the production, and therefore it reduces costs. It also implies a new way of coordinating the different teams involved, improving the quality of the engineering projects, architecture and construction.

In this article we will disaggregate the changes that have taken place in the working and project development methods, optimizing the process, streamlining phases of the project workflow.

4.1.1 Building selection:

Building information modeling (BIM) is the future of building design and construction. BIM is a 3D, object-oriented, CAD approach for architecture and engineers. While the number of architects and building designers using BIM is modest the number will continue to increase. One of the most valuable functions of BIM is its ability to improve the coordination between multiple design disciplines, thus reducing errors. BIM has the potential to respond to an owner's need for predictable costs, quality and on time delivery.

4.1.2 3D Modeling by using Revit:

Design collaboration between architecture, engineering, and construction disciplines using AutoCAD software industry-specific products and Revit software is possible with the proper workflows. This class outlines best practices for exporting and importing models between AutoCAD Plan 3D software and Revit software, managing design changes, and optimizing models. This session features Revit and AutoCAD Plant 3D.

4.1.3 Implementing BIM:

The Building Information Modelling (BIM) more quickly with a strong vision, leadership and a BIM implementation plan that reaches across your business from executive sponsorship, to the individuals applying BIM day-to-day.

4.1.4 BIM Modelling:

Building information modeling (BIM) is a process supported by various tools, technologies and contracts involving the generation and management of digital representations of physical and functional characteristics of places. Building information models (BIMs) are files (often but not always in proprietary formats and containing proprietary data) which can be extracted, exchanged or networked to support decision-making regarding a built asset.

4.1.5 CAD Drawing:

CAD is Computer-Aided Design. You can also add another D and have Computer-Aided Design and Drafting. CAD is simply the use of computer systems to assist with design. While BIM tools such as Revit are technically CAD programs, the term "CAD" is used more for drafting programs. In terms of building design, CAD is essentially using a drafting tool, such as AutoCAD, to create lines and arcs to represent a building design.

4.1.6 Clash report:

A clash report is a document shared with stakeholders on a given project using PDF, XML, HTML or another type of format. It is the "traditional" way of sharing issues found with the clash detection software and requires some extra time to set up and track problem-solving over time.

4.1.7 Clash detection & resolution:

A 'clash' is the result of two elements in your design taking up the same space. In Building Information Modeling (BIM), Clash Detection is the technique of identifying if and where or how two parts of the building (e.g., plumbing, walls, etc) are interfering with one another.

4.1.8 Coordinated BIM model:

BIM Coordination is a great process that helps in resolving recurring issues such as clashes, design constraints etc. during construction. The BIM Model now is the single source of all data including the 3D geometry of all disciplines which should be accessible to everyone involved in the project.

4.1.9 Shop drawing:

A shop drawing is a drawing or set of drawings produced by the contractor, supplier, manufacturer, subcontractor, or fabricator. Shop drawings are typically required for prefabricated components. The shop drawing normally shows more detail than the construction documents.

4.1.10 BOQ management:

The bill of quantities is issued to tenderers for them to prepare a price for carrying out the works. The bill of quantities assists tenderers in the calculation of construction costs for their tender, and, as it means all tendering contractors will be pricing the same quantities (rather than taking off quantities from the drawings and specifications themselves), it also provides a fair and accurate system for tendering.

4.1.11 As built model :

As built drawings and models are developed by physically measuring the existing facility for the purpose of developing CAD or BIM documentation. Architects and engineers use as-builts to understand existing conditions prior to renovation or retrofit.

4.1.12 FM & OM Information :

Frequency modulation (FM) is a method of impressing data into an alternating current (AC) wave by varying the instantaneous frequency of the wave. This scheme can be used with analog or digital data. In analog FM, the frequency of the AC signal wave, also called the carrier, varies in a continuous manner.

Operational maintenance is the care and minor maintenance of equipment using procedures that do not require detailed technical knowledge of the equipments or systems function and design.

5. Conclusion:

- The BIM is a new and promising approach in India which is gradually gaining acceptance by the owners, architects, engineers, and builders.
- BIM is an innovative way to virtually design & manage projects. Predictability of building performance & operations is greatly improved.
- The study includes utilization of BIM for visualization, 3D co-ordinates, Planning, scheduling, estimation & record.

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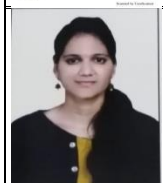


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