APPLICATION OF BIM IN COST OF RESIDENTIAL BUILDING CONSTRUCTION

Sneha Kumbhar¹, Pratiksha Mane², Vidula Waskar³, Awati Rohan Vilasrao⁴

¹,²,³,⁴KIT’s college of engg. Kolhapur

Abstract: In this case study, shows that BIM allows a team to collaborate at a level with efficiency previously unavailable in the industry. A lots of market researches, which have been made recently, show that the future scope of building design and construction will increasingly rely on BIM. BIM is the traditional estimation and costing method which is more reliable. Autodesk Revit is one of the most popular software used for BIM in the world. In Autodesk Revit software prepare 3D building plan. 3D printing is referred as additive printing as additive manufacturing. In 3D printer we prepared 3D building model with the help of Autodesk Revit, STL file format and CURA software.

Keywords—BIM; cost estimation; 3D printing; CURA; FDM.

I. INTRODUCTION

Technology is made for good and easy life for the human being. Each and every persons talking about new technology of different sectors. Nowadays many construction companies being to use BIM (Building Information Modelling) in the construction projects. BIM is a term used to describe the process used by architect, engineers, owners and contractors to coordinate drawing between disciplines in a three dimensional environment.

Revit is the Autodesk solution for Building Information Modelling. It is one of the most popular software used for BIM in the world. Autodesk revit is building information modelling software for architects, structural engineers, designer, contractors and MEP engineers.

The term 3D printing is a form of additive manufacturing technology where a three dimensional object is created by laying down successive layers of material. It is also known as rapid prototyping, is a mechanized method whereby 3D objects are quickly made on a reasonably sized machine connected to a computer containing blueprints for the object.

II. LITERATURE REVIEW

1. Allaban and Hussien: In this study was intended to demonstrate the capabilities of the BIM to improve schedule sequencing as well as indentifying potential clashes in the construction of building.

2. Xi-Dao LUAN et.al: In this paper, the process of 3D modelling including 3D data acquisition, modelling and rendering is introduced systematically, the paper also discusses the characters and developments of laser scanning system and IBMR in recent years, introduces applications of 3D modelling including tissues engineering and heritage protection.

3. Guillermo F. Salazar et.al: This paper describes the progressive use and applications of BIM in MQPs by students at the WPI civil and environmental departments. It reviews how integrated BIM tools are used and how BIM concepts have been incorporated into the development of projects. The encouragement and gradual adoption of BIM by the industry expecting students to acquire BIM skills and knowledge is also considered to be a strong motivator.
4. Natasa Suman et.al :- This paper presents time and cost planning in construction projects using BIM approach. The aim of this paper was to give an insight into the construction project time and cost planning process using the BIM approach.

5. Eng. Parisa Esmaeili.et.al ;- This study the Architecture and Engineering firms are using Building Information Modeling (BIM) software to model their design projects three-dimensionally these days. Some of the popular modelling software platforms for Architecture are, Autodesk’s Revit Architecture, Autodesk Ecotect Analysis and Green Building Studio. In the end it can improve the aesthetics of the building, improve visual comfort and reduce the overall electrical lighting usage within the building.

6. Siddharth Bhandari.et.al (2014) :- This is a research paper on 3D printing which has become a notable topic in today’s technological discussion. In this paper, the give the detailing about manufacturing or 3D printing. The main principle of 3D printing is stereo lithography, outlined by Charles Hull in a 1984 patent as “a system for generating three-dimensional objects by making a cross sectional pattern of the object to be formed.”

III. OBJECTIVES OF PAPER
- To understand the BIM system
- To study the various application of Autodesk Revit software.
- To understand use of 3D printer.
- To find out the estimating and costing of building by BIM system.
- Making 3D building model by using 3D printer with Revit software.

IV. METHODOLOGY
BUILDING INFORMATION MODELLING ( BIM)
Building Information Modelling (BIM) is a process in which different actors work together, efficiently exchange information (data and geometry) and collaborate to provide a more efficient construction process but also more efficient buildings that produce less waste and are cheaper but also easier to operate. In this project we will show how to BIM process is useful for architect, structural engineer, designer, and contractors for many purposes. Such as design, construct, modelling, scheduling, cost estimation and so on. BIM process is providing accurate project data and information as per requirement. BIM is not just figuring out the cost of building and not just figure out what the building looks like BIM is about both of these items and its about information. By using this BIM process, the architect, designer, engineers create more efficiently, sustainable, accurate designs with fewer errors, less waste and more comfortable to clients. BIM is a traditional method to estimate the cost of whole building. It is more reliable method.

BIM tool: Revit, AutoCAD, MEP, Archicad, Navisworks, Microstation, etc.

The Building Information Modelling is depends upon 5D technical drawing such as Length(1D), Width(2D), Height(3D), Time(4D), Cost(5D).
In order to achieve the objectives, the methodology adopted as follows:
1. Study and understanding of research on building information modelling.
2. Study of Autodesk Revit software and prepare 3D building plan.
3. Understand the use and working of 3D printer.
4. Prepare the estimation and costing of whole building project.
5. Prepare the costing by using Revit software.
6. Comparing the calculated costing by using traditional method and costing calculated by using Revit software.
7. Prepare the 3D building model by using the 3D printer.

In this printer we can use polycrystal material to making the 3D building model.

**AUTODESK REVIT**

Autodesk Revit is a Building Information Modelling tool. The architect, civil engineer, MEP Engineer, designer are use for making 3D building model.

In Revit software we create 3D building model by using Revit families i.e. Door, window, Wall, plastering, ceiling, furniture’s and various materials. There are main groups in Revit. Revit structure and Revit architecture and Revit MEP. The various architecture firms are use Revit software for designing 3D building model, estimation and costing etc. The Revit software adopting the BIM process, it can be use the consistent information throughout the lifecycle of building. This process to design and documents, innovative projects, visualize appearance, better performance, good understanding of cost and estimation and environmental impact.
Fused deposition modelling is additive manufacturing technology commonly used for modelling prototyping and production application. The plastic materials are used for making models. This plastic material extruding in nozzle. The nozzle is heated to melt the material and can be moved in both horizontal and vertical direction. The model is produced by extruding small beads of thermoplastic.
material to form layers as the material hardens immediately after extruding from the nozzle. Then the model is created layer by layer. Many different materials can be used for 3D printing. Such as ABS plastic, polycrystal, polumide(nylon), glass filled polimide, glass filled polimide, stereolithography materials(epoxy resins), silver titanium, steel-wax, photopolymers, and polycarbonate.

Flowchart 2: Procedure of 3D printing

Fig. 3: FDM 3D printer
First of all we create 3D building design by using Revit software. In Revit software we can draw 3D building plan with required specification. Then this 3D building design file convert into stereolithographic file format with the help of STL file converter.

- This STL file format support in Cura software. In Cura software we can adjust machine setting according to printer and material which is use for making 3D model. Cura software generate “G” coding of the given STL file format.
- In machine setting adjust bed level of machine or printer, temperature, adjust nozzle, material temperature etc.
- The printer accept input in the form of “G” coding.
- After giving input to the printer in memory card. The material is provide to printer, which is fixed in nozzle.

Fig.4: 3D building model

Fig.5: Final model of 3D building
V. CALCULATIONS AND RESULTS

In Revit we design 2D and 3D plan of residential building. Area of all components calculated manually in measurement sheet. For example: excavation, column, beam etc. Then taking current rate from district schedule rates (DSR) and multiplied by area. We get total cost of project. Sample calculation sheet is given below

Table 1: Measurement sheet

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Description</th>
<th>No.</th>
<th>Length</th>
<th>Breadth</th>
<th>Depth</th>
<th>Quantity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Site cleaning</td>
<td>1</td>
<td>21.45</td>
<td>25.87</td>
<td></td>
<td>554.91</td>
<td>554.91</td>
</tr>
<tr>
<td>2</td>
<td>Excavation</td>
<td>21</td>
<td>0.9</td>
<td>0.9</td>
<td>1</td>
<td>17.01</td>
<td>29.768</td>
</tr>
<tr>
<td></td>
<td>Back filling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>It should be 75% of excavation quantity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.758</td>
</tr>
<tr>
<td>3</td>
<td>P.C.C. For footing</td>
<td>21</td>
<td>0.9</td>
<td>0.9</td>
<td>0.2</td>
<td>3.402</td>
<td>3.402</td>
</tr>
</tbody>
</table>

Table 2: Abstract sheet

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Description</th>
<th>Quantity</th>
<th>Rate(Rs)</th>
<th>Per unit</th>
<th>Total rate(Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Site Cleaning Labour charges For removing grass, thorny shrubs, Jungli shrub, Kubabul and alike grass along roadside making the ground clean by shovel and pavers etc. Complete.</td>
<td>554.91</td>
<td>10</td>
<td>sqm</td>
<td>5549</td>
</tr>
<tr>
<td>2</td>
<td>Excavation for foundation in earth, soil of all types, sand, gravel and soft murum, including removing the excavated material up to a distance of 50m. beyond the building area &amp; stacking and spreading as directed, dewatering, preparing the bed for the foundation and necessary back filling, ramming, watering including shoring and strutting etc. Complete. (lift up to 1.5m) by manual means.</td>
<td>29.768</td>
<td>139</td>
<td>cum</td>
<td>4138</td>
</tr>
<tr>
<td>3</td>
<td>Plain Cement Concrete Providing and laying in situ, cement concrete in M10 of trap/ granite/ quartzite/ gneiss metal for foundation and bedding including bailing out water, formwork, compacting and curing complete, with fully automatic micro processor based PLC with SCADA enabled reversible Drum type mixer, with natural sand.</td>
<td>3.402</td>
<td>3700</td>
<td>cum</td>
<td>12587.4</td>
</tr>
</tbody>
</table>

Table 3: Face sheet

<table>
<thead>
<tr>
<th>FACE SHEET PHASEI(SUBSTRUCTURE)</th>
<th>TOTAL COST</th>
<th>167183.746</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total construction cost (TC)</td>
<td>+</td>
<td>13374.69</td>
</tr>
<tr>
<td>8% water and sanitary supply or plumbing(5% to 20%) on TC</td>
<td>+</td>
<td>13374.69</td>
</tr>
<tr>
<td>8% Electrification(5% to 10%) on TC</td>
<td>+</td>
<td>8359.18</td>
</tr>
<tr>
<td>5% contingencies (3% to 5%) on TC</td>
<td>+</td>
<td>20229.23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESTIMATED COST(EC)</th>
<th>TOTAL COST</th>
<th>202292.306</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% contractor profit (8% to 10%) on EC</td>
<td>+</td>
<td>20229.23</td>
</tr>
<tr>
<td>2% work charged on EC</td>
<td>+</td>
<td>4045.84</td>
</tr>
<tr>
<td>1% tool and plant (1% to 2%) on EC</td>
<td>+</td>
<td>2022.92</td>
</tr>
<tr>
<td>TOTAL COST OF SUBSTRUCTURE</td>
<td>+</td>
<td>228590.296</td>
</tr>
</tbody>
</table>
VI. CONCLUSIONS
In BIM process saving the time and cost of construction project. BIM get the better quality products. Autodesk Revit is best BIM tool. It can be generating 3D building model directly. By using 3D printer, we get the actual 3D building model. This 3D model having the idea about what we get after construction. In other words, By using 3D printer we can visualize what we get after construction.

REFERENCES
V. Sarita Patil, Prof. Manish Khandare, “Application of BIM for Scheduling and Costing of Construction Project, IRJET Vol 04 Issue:12 2017