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RESEARCH ARTICLE

GENERATION OF 5D MODEL TO MINIMIZE CONSTRUCTION RISKS

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ABSTRACT

Now a day's construction industry is the second largest industry in world. But this industry faces many risks related to time and cost with the help of BIM we can minimize this risk. Building Information Modeling (BIM) is a technical tool that allows a project to build virtually before being built physically. By generating a 5D modelling we can manage any project related to time and cost. The BIM extends methodology into three dimensional (3D) drawings in the three primary dimensional width, height and depth. With the above, time as the fourth dimension (4D) and cost as the fifth dimension (5D). For 5D modelling we have to use some software's such as AUTOCAD, REVIT ARCHITECTURE, MICROSOFT PROJECT, NEVIS TIMELINER. Firstly create 2D plan of any project then import into Revit architecture software. In Revit arch. Software obtain 3D model of the project. Then we have to use MSP software, all information should fill in MSP software. This MSP links into Navis Timeliner software with 3D model from revit Architecture. 5D BIM makes a perfect visualization tool to monitor the project progress. It is very easy and appropriate tool to be used for construction cost and resource management. All the steps of construction could be modified and managed at any point of time by simply clicking on the element and activity. Using this technology, time, cost and labour management becomes smooth and feasible.

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INTRODUCTION

The construction industry is the second largest industry in India after agricultural industry. Now a day's construction industry is in progressing stage due to various software's available related with BIM. The primary purpose of this research project is to extend building information modeling (BIM) into the construction process and to create a single platform of facility for the owner. BIM is a primary digital representation of a 3D building and its intrinsic physical and functional characteristics which forms a reliable basis for decision making during the life-cycle of a construction project. The term BIM does no longer sound strange and has become an integral part of construction industry Construction planning, scheduling and cost estimating are important part of any construction project. To translate a design to a construction schedule involves several steps of human interpretation and requires knowledge in the planner's mind. Now the current planning process is largely manual and time-consuming process. Current construction project planning involves a number of techniques that model dependencies and sequencing of project activities. Some of the techniques involve bar charts, CPM, PERT based network diagrams, and time-changes diagram. But this techniques are time consuming process and don't have any capability of modeling.

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Defining of 3D modeling

3D modeling is the process of developing model of any construction project related with length, width and height. This model gives better idea about any project before construction physically. There are various computer software's available for generating 3D model likes AutoCAD 3D, Revit Architecture.

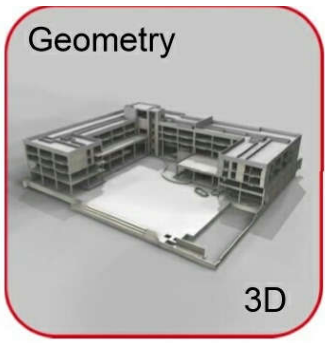

Fig.1. Pictorial view of 3D

Defining 4D modeling

The construction planning involves the scheduling and sequencing of the model to coordinate virtual construction in time and space. The schedule of the anticipated construction

progress can be integrated to a virtual construction. The utilization of scheduling introduces time as the 4th dimension (4D). There are two traditional methods that can be used to create 4D Building Information Model. These are critical path method (CPM) and line of balance. In the Critical Path Method, each activity is listed, connected to another activity, and assigned durations. By using MSP and NEVIS TIME LINER we can generate 4D model and it has better advantages than traditional methods.

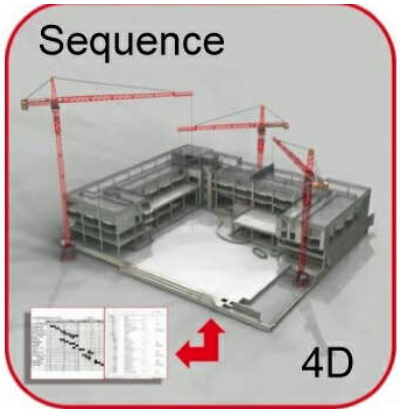

Fig.2. Pictorial view of 4D

Defining 5D modeling

The two main elements of a cost estimate are quantity takeoff and pricing. Quantities from a Building Information Model can be extracted to a cost database or an excel file. However, pricing cannot be attained from the model. Cost estimating requires the expertise of the cost estimator to analyze the components of a material and how they get installed. If the pricing for a certain activity is not available in the database, cost estimator may need a further breakdown of the element for more accurate pricing. For instance, if a concrete pour activity is taking place, the model may account for the level of detail for the rebar, wire mesh, pour stop, formwork, concrete etc., but not include it as part of the quantity take-off extraction.

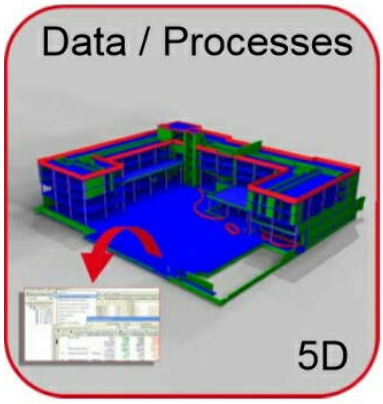

Fig.2. Pictorial view of 5D

Methodology

For generating 3D model various softwares are available such as Autocad, 3D max, Revit Architecture. We used Autocad and Revit Architecture software. First we create 2D plan in Autocad software of project. This autocad file imported into Revit Architecture software. By using commands and features we can generate 3D model. We can show all components in project such as furnitures, Electric, Plumbing, Site details etc. This model helpful for better understanding to all persons related to project. For 4D and 5D modelling we used MSP and Naviswork software. 3D model and MSP schedule is to be imported in Naviswork. When 3D file is imported into the Navisworks, the program automatically aligns rotation and origin of models, and rescales the units in each file to match display units. Now activities from the MSP schedule are linked with model elements. The amount of work done on the various work packages could be seen in the 3D view. The project is updated as progress information becomes available from corresponding MSP or Primavera schedule. Generatde 4D &5D model helps in visualization of the project, predicting the future impediments, planning, managing, sequencing which is affected on cost. By this 5D model we can comparison between Actual time and practical time also cost.

Development of 3D, 4D and 5D Model- Overview of Case Study

Case Study:- Pristine Park, Ashta naka, Islampur. Proposed Residential building project was used as a case study to understand the use and benefits of BIM in detail. The study includes the utilization of BIM for visualization, 3D model, sequencing of activity, time required for each activity and estimated cost of activites. Use of BIM Tools The primary focus of this project was the use of Building information modeling for 3D model, 4D for time integrators, 5D for cost estimation. This section provides results on the use of BIM tools. This includes formation of prototype building information model, interoperability of the model, integration of the model with schedule and BIM based scheduling.

3D Modeling of a Residential building

Firstly new Autocad 2D plan creaed of our project .in this 2D plan we show only position of wall. Student licensed version of Revit Architecture 2016 was downloaded from Autodesk's student community website to develop a 3D building model. Autocad 2D plan is to be imported in Revit Architecture. By using various commands we can show all features in 3D model such as positions of doors,windows, fernitures, all site details. The created 3D building model using the Revit Architecture 2016 showed the powerful features of BIM. The creation of an element on a view such as floor plan translated correctly to a different view such as elevation view. This saved a lot of time in comparison to if the design were drawn in traditional 2D view.

Fig. 4. Creation of 3D model by using Revit Architecture software

4D Modeling of a Residential Building

The creation of 4D model involved the transition of the model via Industry Foundation Classes (IFC) from Revit Architecture to Navisworks Manage. During the transition, several challenges were found for the building project. 4D modeling required the development of a 3D model as well as the schedule. The 3D model was created in Revit Architecture 2016. A simple schedule generated in MS Project was successfully imported to Navisworks Manage. The elements of the model listed under resources were successfully linked to schedule activities. Once the linking was complete, a simple 4D model was visualized. The visualization at any given time of the project can be enhanced at Gantt view with the drag of the timeline. The Microsoft Project used the critical path method to create the schedule. Autodesk's Navisworks Manage for 4D BIM tool was downloaded through its website. In this project, it was utilized as the integrator of the Revit model in IFC format and the Microsoft Project in xml format. Once the model and the schedule were imported in to the Navisworks Manage integration tool, the Industry Foundation Classes (IFC) resources which are a list of building elements created in BIM were linked to the activities.

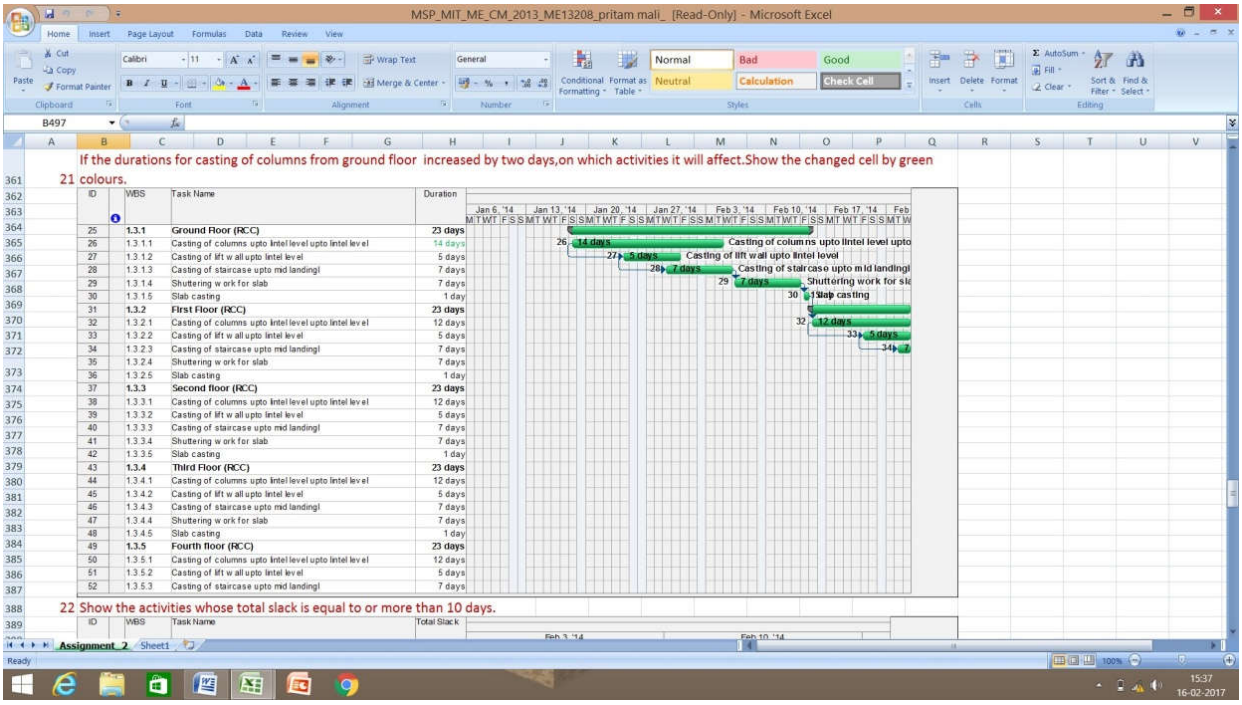

Fig.5. Preparation of work breakdown structure for the project and creation of task schedule using the quantity data from REVIT in Microsoft project

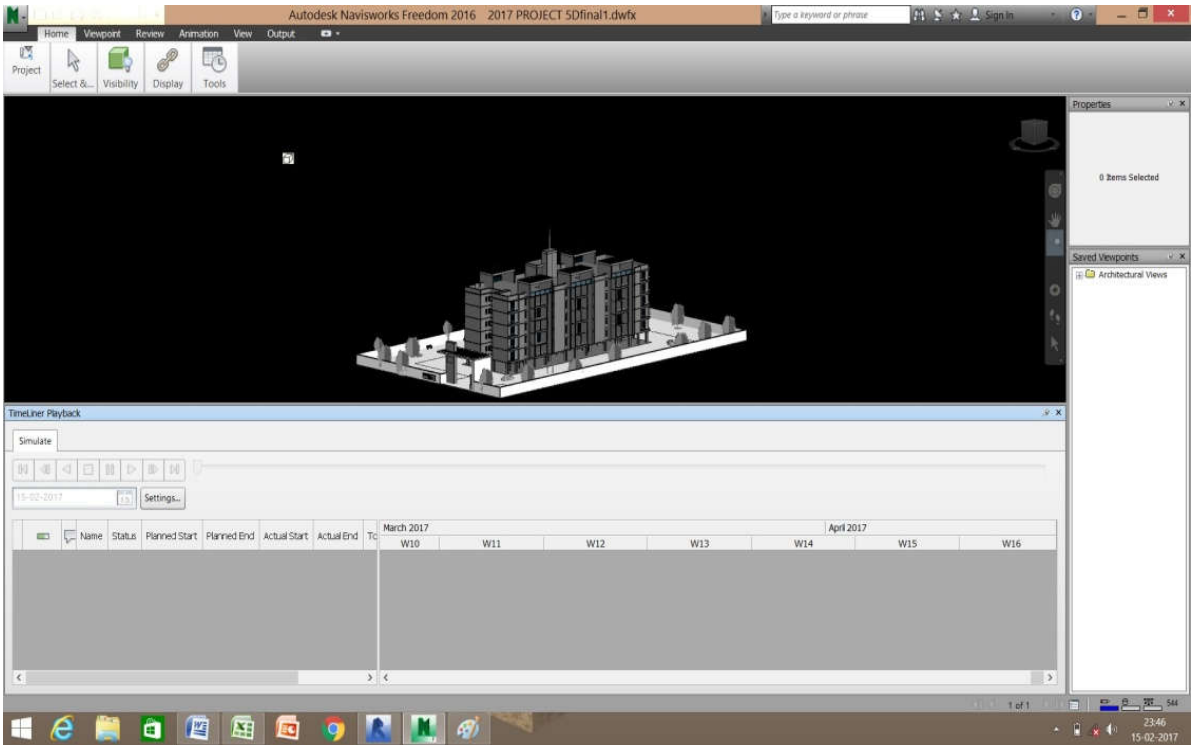

Fig.6. 5D Design model generated in Naviswork

5D BIM model based estimation of a Residential Building

BIM produces accurate quantities for the efficient estimation of architectural, structural and services components. These quantities can be extracted at various stages: at concept stage for generating budgets, at the end of design development stage for floating tenders, at Good for Construction (GFC) stage for verifying contractor bills. Creation of 5D model by importing and attaching 3D model and the MSP schedules (time and cost) in Naviswork software (Fig. 5).

Scope of the study

The traditional scheduling and monitoring methods which are employed quite frequently in the construction industry have proved to be challenging, and it has been realized that such implemented practices need significant improvements in both quality and efficiency. The failure of current scheduling and progress reporting methods has encouraged the researchers to put an effort to incorporate visualization into scheduling and monitoring. Therefore, various technologies such as 5D BIM technique have been introduced to fill these voids. To monitor the activities and cash flow of the project, stakeholders with different backgrounds involved can use the visualization features at any stage of the project. These features of 5D BIM allows all stakeholders to get the accurate information of the project and monitoring of activities.

Conclusion and future work

5D BIM is very helpful in the integration of information that could be visualized on the day-to-day basis on computer monitors. Therefore, 5D BIM makes a perfect visualization tool to monitor the project progress. It is very easy and appropriate tool to be used for construction cost and resource management. All the steps of construction could be modified and managed at any point of time by simply clicking on the element and activity. Using this technology, time, cost and labour management becomes smooth and feasible. This technology also allows the integration of different sophisticated software's which are very instrumental and appropriate in generating the outputs for a particular type of task. This technology enables the collaboration and allows the integration of information from all the fields on a single platform, hence generating the most accurate outputs. Since the 5D BIM is a complex process involving the contribution of people from different fields to work on a single model, therefore, this technology fosters collaboration among different project teams. These techniques are user friendly and could be easily adopted by quantity surveyors, engineers, project managers etc. 5D BIM utilizes the dynamic linkage between the 3D elements and the corresponding activities in the schedule thus, detecting the problems and logical errors in the schedule sequence prior to the construction, which is not possible in traditional methods. Although, 5D BIM technology employed in this project considered time as 4th and cost as 5th dimension, further other dimensions are also described as the subsets of BIM such as 6D as operation, 7D as sustainability and even 8D as safety. Furthermore, the BIM modelling could be modified using resources, materials, site conditions, global information system (GIS), etc. as one of the dimensions to create nD models.

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