Application of Building Information Modeling (BIM) to Civil Engineering Projects

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Abstract : There are various draw backs in conventional method used for planning, scheduling & monitoring projects in Architecture, Engineering, and Construction (AEC)industry which fails to provide a clear view of the on-going actual work at the project site. Building Information Modeling (BIM) is Single file concept collaborating various database of the project at one platform. It is a data repository for building design, construction & maintenance information combined in one convenient model to share with all the stakeholders. 3D visualizations allow customers to see historic preservation & site context with respect to the new project. This paper focuses the perspective of a planning engineer with respect to Conventional method & B I M and gives a methodology to prepare a 4D simulated model of a Gr. (Stilt) + 16th Floor residential building taking 4th dimension as time.

Keywords—AEC Industry, Building Information Modeling, Conventional method, Data Repository

I. Introduction

In the Architecture, Engineering, and Construction (AEC) industry, diverse people, processes and materials are brought together to construct projects that are becoming increasingly complex. Effective planning is one of the most important aspects of a construction project and influences the success of a project. Recently, a quiet revolution has been taking place which will fundamentally change the very fabric of the audio-visual design and integration business. This revolution is the increased utilization of Building Information Modeling (BIM). 4D modeling is the integration of a 3D model with a construction schedule in order to visualize the sequence of construction. 4D models can be created to various levels of detail, from high-level zone analysis during the design phase, to detailed subcontractor coordination during construction. The same model can be updated and maintained throughout the project based on the updated schedule and 3D model. This paper gives the information about the various software used, methodology adopted for the making a 4D simulatedmodelof aGr. (Stilt) + 16th Floor residentialbuildingtaking 4th dimension as time.

II. Resource and Methodology

The software's used for this Project are AutoCAD 2013 for designing and viewing 2DCAD drawings, Microsoft Project/Primavera for Construction Schedule, Autodesk Revit 2013 for creation of 3D model, Autodesk Navisworks Manage for compiling 3D model and construction schedule
Thereby creating 4D model. Autodesk Software's are available from Autodesk student community site.

Features of BIM:
1. Collaboration
2. Design
3. Documentation
4. Visualization

Methodology:
Step 1: Creating Architectural Design
The design of the construction project is created using AutoCAD, a widely used software package in architectural design practice.

Step 2: Creating 3D model
Project model can be directly designed in the Autodesk Revit. However if the architect is using AutoCAD for designing the architectural drawing than 2D CAD drawing can be imported to the Revit using link cad option and later model is created.

Step 3: Creating or merging various drawings
Autodesk Revit facilitates merging of various components like HVAC, Mechanical, plumbing& piping, electrical etc. under one platform. If drawings are made separately than they are imported in the Revit using insert option. Revit plays a vital role in detecting clashes between various components of the project, which in turn helps in managing, planning & getting forecast of project at planning stage.

Step 4: Creation of 3D view
An orthographic 3D view is created by pressing a home shape button in the view tab different 3D views can be viewed by rotating the cube. 3D view shows the various components attached with the project. This enables the user to view the project in real virtually.

Step 5: Export 3D model for Autodesk NavisworksManage
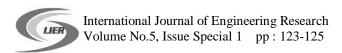After creating the 3D model in the Autodesk Revit it is exported for the Autodesk Navisworks Manage for preparation of 4D model. Model is exported while 3D view is open in Revit.

Step 6: Creating Work Breakdown Structure
This is done to make project control effective and manageable. It defines and groups a project's discrete work elements in a way that helps organize and define the total work scope of the project.

Step 7: Initiating Scheduling Process
Microsoft Project or Primavera Project Planner is used as the scheduling tool. The project is scheduled based on the activities identified in the work breakdown structure. MSP or Primavera is

used to schedule the project, showing the start and completion dates, locating the critical paths and float times of activities, and also showing the sequence and interrelationships between the activities**.**

Step 8: Creation of 4D model

In Autodesk Navisworks Manage 2013 is the platform for making the 4D model. 3D model and MSP or Primavera schedule is imported. 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. If the rotation, origin, or file units are incorrect for the scene, we can manually adjust them for each of the opened files.

Step 9: Linking the activities with 3D model

In Autodesk Navisworks Manage, project schedule is imported through data source in time liner tab. For creation of 4D model, activities from the MSP schedule are linked with model elements.

Step 10: Simulation of the project

The 4D visualization of project is seen through the starting the simulation. 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. 4D model helps in visualization of the project, predicting the future impediments, planning, managing etc.

III. Study Area

Table 1: Project Case Study Details

Name of Project	Proposed redevelopment property of plot bearing C.S. no. 2031
Structure details	Gr. (Stilt) + 16th Floor Residential Building
Location	Building no. 162-164-166, 2nd Fanaswadi at SitaramPoddar Marg, Bhuleshwar division- 'C' ward, Mumbai, 400002
Name of Client (builder)	M/s Gini Citycorp Realty LLP
Name of Architect	Jangid Architects
Name of Structural Consultant	Con Arch India
Name of Contractor	M.R Construction
Project start & end	September 2014 to January 2016
Project Duration	16 months

IV. Expected Outcome

1. Understanding the application of user-friendly BIM based tool for visualizing construction progress in three dimensions, side by side with a work schedule.
2. A management tool that can be used in all phases of the construction process, including planning, design and most importantly day-to-day decision making during construction.
3. A 4D model developed by applying BIM for a particular case study in Civil Engineering projects by using AutoCAD 2013, Autodesk
4. Revit 2013, Microsoft Project 2007 and Autodesk Navisworks Manage 2013.

V. Discussion and Suggestion

In the construction industry a higher productivity rate in the field will lower costs for the entire project. Productivity on the site is affected by the amount and quality of planning and coordination done before any work begins on site. Projects vary in complexity, team experience, budgets and other factors such that each has differing planning and coordination needs.

Knowing how various BIM process elements affect these rates will enable owner and contractors to intelligently and responsibly plan the appropriate amount of time and money to be spent at the project level. The purpose of this work is to make a decision making model that will help in this process.

However, Building Information Modeling is a team based work; in this paper study is restricted to civil engineering construction planning & scheduling by creating a 4D model. Current model can be further enhanced by adding various databases from other fields also like Mechanical, Electrical and Plumbing (MEP) etc. In this paper 4th dimension is considered as time, further other dimensions like cost, resources, materials etc. can be taken as nth dimensions and thus creating a 5D model.
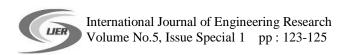
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