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Research Paper

BIM AN EMERGING TECHNOLOGY IN AEC INDUSTRY FOR TIME OPTIMIZATION

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The Architecture, Engineering and Construction (AEC), industries have long sought techniques to decrease project cost, increase productivity and quality, and reduce project delivery time. Effective planning is one of the most important aspects of a construction project and influences the success of a project. Traditional way of planning, scheduling and monitoring is lacking visualization and forth coming impediments in the project. Building Information Modeling (BIM) is a model-based design concept, in which buildings will be built virtually before they get constructed on site, where various database are integrated at single platform for building lifecycle which also manages the information exchange between the AEC professionals, to strengthen the interaction between the design team. BIM plays a vital role in decisions making during its lifecycle. In this paper, traditional and BIM methods of scheduling are explained taking nth dimension as time. This paper explains the Software used and their system requirements, methodology used by which 4D model of a building can be created.

Keywords: Building information modeling, Digital interface, Software used, Procedure

INTRODUCTION

In the 21st century, every evolution in technology has been achieved with advances in computer science. The result of each evolution is to provide more information to attain objectives easily. This technical evolution is also reflected in the Architecture, Engineering, and Construction (AEC) Industry. In the past 10 years, design tools in the AEC industry have been improved from 2D modeling to 3D modeling. Effective planning is one of the most important aspects of a construction project and influences the success of a project. During design and construction phase, potential spatial conflicts may arise between building components. It is not easy to identify or predict these conflicts using 2D or 3D layouts. This loophole is bridged by adding an additional dimension to the model and therefore, time becomes an additional dimension to 3D modeling giving the evolution of 4D model. This paper aims to give the methodology for creating a 4D model from the available software's in market.

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LITERATURE REVIEW

Initial Design

Until the mid-19th century, the general method of design did not change a lot. Engineers used simple tools (such as pen, paper and ruler) to describe their buildings. However, with advances in mathematics and building materials, the process of design changed and improved rapidly.

Initial 2D CAD Method

With the invention of the computer, 2D CAD as a new drawing tool was adopted completely in the AEC industry. After the Second World War, American martial technology was applied in the civil field. SKETCHPAD was first developed by Ivan Sutherland. That was the root of CAD. At the beginning, the technology of CAD was not as popular as in modern times. However, with the popularization of personal computers, the renowned software company Autodesk developed AutoCAD. Suddenly, all the architects in the world started to learn and use this type of software to design their project.

Current Design Methods

The technology development form 2D CAD to 4D simulation greatly improved the design process. 2D CAD developed into 3D modeling. This innovation changed the process of building design and the relationship between the structural engineer and the architectural designer. It did not only change the way building designs are visualized, but also signaled a paradigm drift in design thinking from pure visualization to simulation.

Building Information Modeling

Beyond the 3D modeling, BIM is emerging as a new powerful technology. Firstly, it has all the functions of 3D CAD. Whereas 3D CAD modeling was merely collections of points, lines, 2D shapes and 3D volumes, in the BIM concept, such geometric entities can also have symbolic or abstract "meaning", as well as quantitative or qualitative data. In order to compare the differences between traditional CAD documents and Building Information Modeling, a hypothetical model is created and relevant steps and software's are explained in this paper.

NEED OF BIM IN PROJECT SCHEDULING AND PROGRESS MONITORING

Due to the difficulty observed in using the traditional scheduling and monitoring methods, the construction industry has acknowledged that its current scheduling and progress reporting practices are in need of substantial improvements in quality and efficiency. Research efforts to incorporate visualization into scheduling and monitoring have been motivated by the failure of traditional methods.

Building Information Modeling (BIM) allows project managers and different people involved in the project with different backgrounds to get the accurate information of the project and monitoring of activities. The project manager and client can use the visualization aspects at any stage of the project to monitor the activities and cost flow. BIM improves the construction planning and design efficiency by integrating the 3D model and schedule of the project at one platform.

In BIM various drawing likes architectural, structural, electrical, MEP, etc., are associated to the model. Various drawing available at one

platform improve and speed up the construction planning as well as ensure data integrity and accuracy. BIM allows the user to manipulate the schedule and 3D components in a single environment, which in turn facilitates the rapid generation of alternatives. The schedule in BIM allows easier understanding of the project as well as helps to detect possible problems in it. By integrating and displaying specification/recommendation and construction resource information, the schedule in BIM promotes interaction and collaboration among the project team members from different fields.

PROCEDURES FOR PROJECT SCHEDULING AND MONITORING SYSTEM USING BIM

This paper gives the information about the various software used, methodology adopted for the making a 4D model. Various software used for making a 4D model are AutoCAD (2013), Autodesk Revit (2013), Microsoft Project (2007), Autodesk Navisworks Manage, 2013.

AutoCAD 2013 is used for creating and studying the 2d CAD drawings. Autodesk Revit 2013 is used for creating 3D model and collaborating drawings related to other field of the project. Microsoft Project 2007 is used for creating a schedule for the activities involved in the project. Autodesk Navisworks Manage 2013 for dynamic linkage of 3D model and MSP schedule activities creating a 4 D model. Figure 1 shows the steps for making a 4D model.

PILOT STUDY

3D model is created by using Autodesk Revit 2013; it's a hypothetical model of G+5 storey building comprising of concrete elements like column, beam and slab as shown in Figure 2. Model is perceived from the perspective of a construction manager and therefore model is restricted to civil works only, however other

Figure 1: Design and Information Flowchart

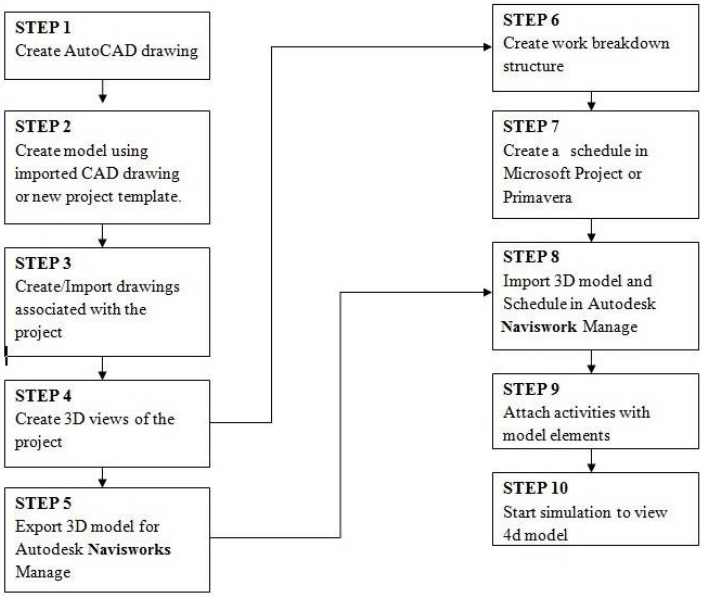
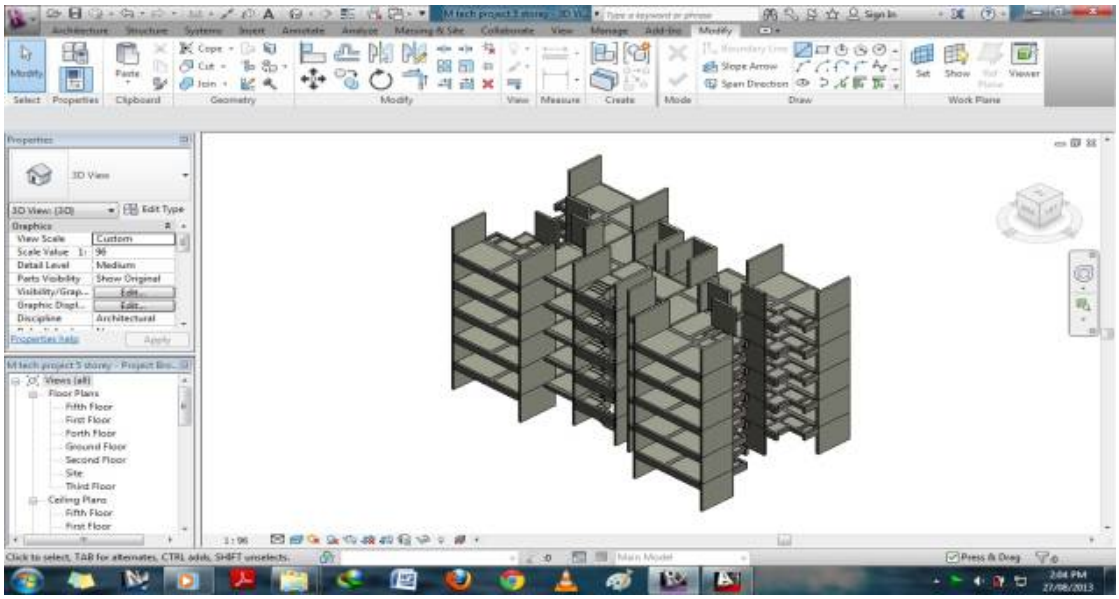


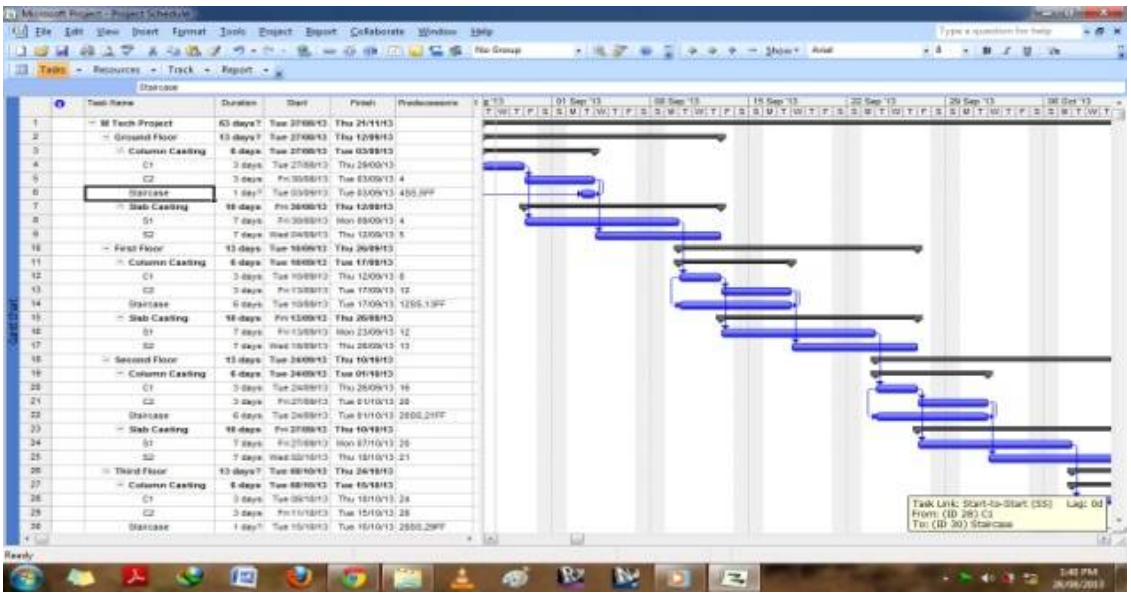
Figure 2: G+5 Storey Model



database like mechanical, electrical and plumbing can also be integrate in the model. Model prepared in Revit is exported as Navisworks file format using export option.

Elements are listed out by creating a work breakdown structure of the 3D model and accordingly a Construction schedule is prepared in Microsoft project 2007 as shown in Figure 3.

Figure 3: MSP Schedule



Model exported from Autodesk Revit (2013) and schedule prepared in Microsoft Project (2007) are imported in Autodesk Navisworks (2013). Schedule is synchronized and hierarchy is developed automatically by clicking synchronize option in the timeliner. Model elements are selected and attached with the schedule giving commands for construction as shown in Figure 4.

In the simulation tab of timeliner, color coding for construction phases is done to distinguish the view of different phases of model. Finally the 4D model can be visualized virtually by starting the simulation in timeliner as shown in Figure 5.

Figure 4: Dynamic Linkage of MSP Schedule with 3D Model

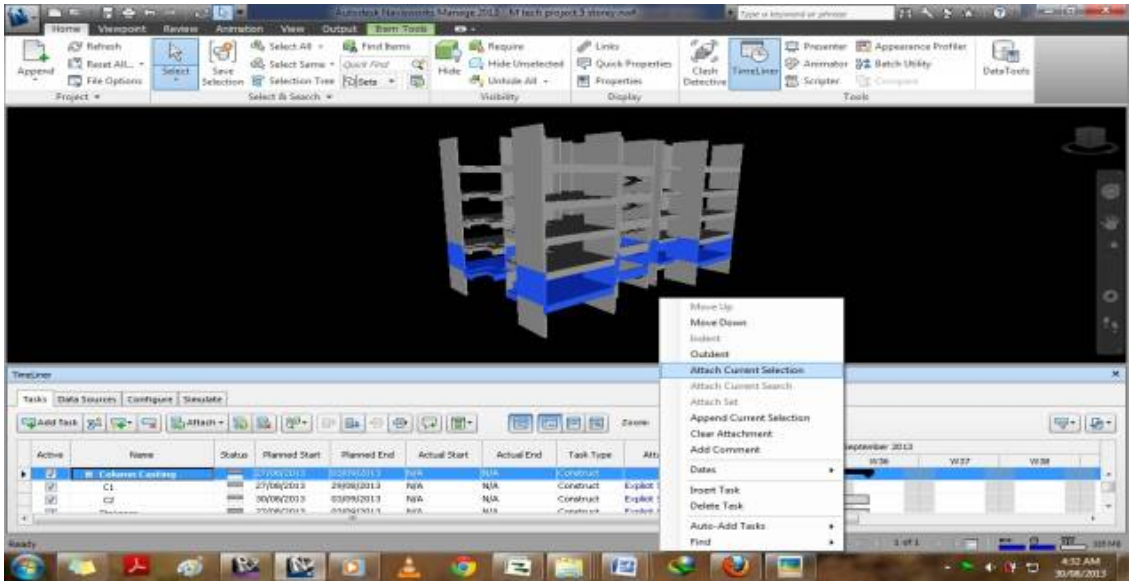
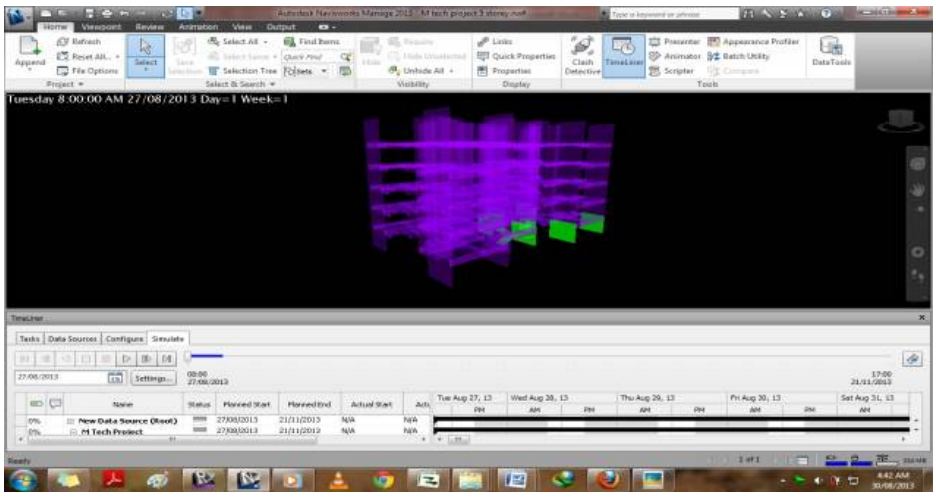


Figure 5: Simulated 4D Model



CONCLUSION

The proposed methodology utilizes the dynamic linkage between the activities in the schedule and corresponding 3D components and help to detect the incompleteness and logical errors in the schedule sequence. This is because, BIM provides the user with a real time representation of the project which may improve and speed up the construction planning as well as ensure data integrity and accuracy.

BIM, thus is not only a visualization tool but can be utilized as a project scheduling and monitoring tool at any stage of the project in which the schedule and the 3D components can be manipulated in a single BIM environment. The schedule in BIM allows easier understanding of the project as well as helps to detect possible problems in it. Therefore, by integrating and displaying specification/recommendation and construction resource information, the schedule in BIM promotes interaction and collaboration among the project team members from different fields.

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