Simulation of Residential Project using BIM Concept

Akash A. Patel[1] Dhruv B. Chaudhary[2] Prof. Umang Sheth[3]
[1,2]M.Tech. Student [3]Assistant Professor
[1,2,3]Indus Institute of Technology & Engineering

Abstract— In construction industry, to develop a construction schedule, visualization of 2D design documents is necessary. Planner needs to study 2D documents with their related construction activities, and then mentally visualize the construction sequence. BIM in terms of 4D modeling saves a lot of time and money over traditional scheduling processes. This paper presents Implementation of project management function with use of BIM concept in residential building. To assess the effectiveness of using 4D modeling to visualize a construction schedule, a case study research project is being performed where a 3D model is being generated and a construction schedule with the aid of a 4D learning module. The 4D modules were developed using two different 4D modeling applications. Finally, a conclusion will be made on whether it is beneficiary and practical to apply 4D scheduling in any construction project, and recommendations will be made based on the same.

Key words: BIM, 4D Scheduling, Simulation

I. INTRODUCTION

The real estate and construction industry is one of the world's larger industries but also one of the most fragmented. Advances in information and communication technology (ICT) have been put forward as a tool to deal with these coordination issues in order to improve the industries historically low productivity. During the last three decades the construction industry has seen drastic improvement of the use of IT. The latest and most promising in these developments is the use of Building information modelling (BIM).

Indian Construction sector is yet to understand the advantages and benefits of 4D planning techniques. Only 10% of the construction projects are planned according to 4D planning methods and techniques. Rest 90% of the projects is still visualized based on 2D design documents with the additional aid of 3D modelling. [1]

A 4d model is created to identify the order in which elements should be constructed or demolished. A 4D model is introduced by linking the 3D model of the project with generated schedules from suitable scheduling software. Then a 4D simulation is created in suitable software which lists the sequence of works to be carried out in a date wise manner. The simulation model determines the idleness of resources and locates any potential bottlenecks. To achieve this, the developed simulation model should reflect the real world system.

A. *Objective*

- To study current trend in application of BIM in construction industry.
- To Understand BIM concept with respect to scheduling of project.
- To generate & simulate virtual model using project design software & project management software.

B. *Scope*

- This study is limited only to activity sequencing because of time and resource constraints.
- Case study for research is limited to only residential building in Ahmedabad having area 60k to 90k sq. ft.
- In this study only Revit and Naviswork is used as design software for creating LOD 100 model and Microsoft Project as project management software.
- Due to contractor's legal binding with the consultant, steel detailing is not considering while creating BIM model.

II. METHODOLOGY

This research includes practical and theoretical research. For theoretical part literature review is done which is basically based on e papers. This study consists of 4 different phases to accomplish the aims and objective. Phase 1 include the literature review and theoretical part of study. The practical part involves Phase 2 and Phase 3. In phase 2 BIM model is being generated with help of Autodesk Revit. And also time schedule is prepared using MS Project. In phase 3 Autodesk Naviswork is being used for simulation of time schedule and 3D model to create 4D model. And the final phase is for conclusion and opportunities and limitations derive from the study.

In phase 4 conclude the research work and also discuss its outcome with opportunities & limitation for simulation of residential project.

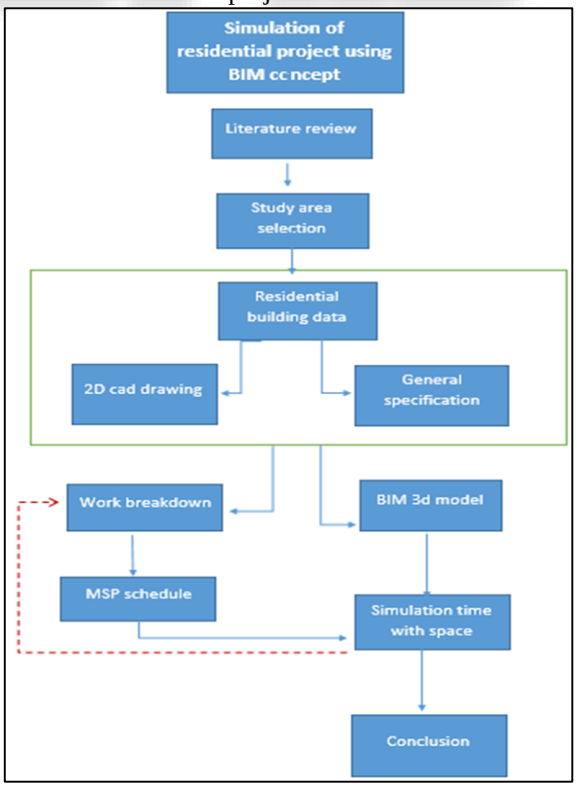

Fig. 1: Methodology

Figure shows practical part of thesis which consist 3D model making from 2D cad drawing using Autodesk Revit and scheduling using Microsoft project. Than after with the help of Naviswork linking 3D model with MSP schedule for creating 4D BIM. For this study, simulation of a residential building project will be prepared using BIM. For that building its 2D drawings and general specifications will be collected. Based on this two types of data a 3D model will be prepared in Revit. Also a basic work breakdown structure will be prepared based on which MSP schedule will be prepared. Next, the schedule will be linked with the 3D model based on which a simulation will be prepared.

III. 4D MODELING

A. A Case Study of Residential Building

The purpose of the 4D modeling for the case of residential project elite 32 is to investigate how 3D BIM models can be utilized to create schedules and sequence animation of the build-up scenario. The focus of the study is to explore, how a 3D model containing time and location information can be made useful for analyzing and optimizing an existing Gant-chart schedule.

The building is 67000 sq. ft. and having frame structure and is having mainly partition wall. Elite 32 have 7 floor with 32 flats and one basement. Each floor has 5 flats four of them 3bhk and one is 2bhk. Basement and ground floor is for parking area. This building has two lift shaft and one stair.

For 4D modeling three software tools are used: Autodesk Revit 2016, Autodesk navisworks 2016 and Microsoft project 2016.

B. 3D Model

No specific design criteria have been considered for the creation of the model, the main idea has been to have a building composed of different elements in order to carry out a logical analysis of the possibilities offered by the applications. The elements used to compose the model are generic, assuming a level of development LOD 100, representing a very initial stage of the project. In the construction stage, the LOD would vary for a greater definition of each of the elements. Figure 2 shows 3D BIM model generated in Revit. First step to generate 3D BIM model in Revit imported floor plan from AutoCAD drawings into Revit. Than after we create model in Revit according to floor plan of AutoCAD.

Fig. 2: 3D BIM Model generated in Revit 2016

Assignment of Task ID to elements: There is an interesting possibility to include a parameter to the elements in the model so as to make reference to tasks in the construction schedule and ease the mapping process in the future. For example, the ID or code for the columns contained in Level 1 is in this case "1c". This has to be done prior the model exportation to Navisworks.

C. Time Schedule

A simple construction sequence was prepared based on the BIM model. Approximated durations were given and relationships were added to all tasks. If the schedule is going to be created directly in MS Project, it is of great importance to include one extra columns: "Comments". In that column same id given which elements have in Revit according to its sequence. For example, construction of 1 floor columns have 1c task id so it would help in navisworks while creating 4D model.

D. 4D Simulation

After generating 3D model in Revit, 3D model is exported in navisworks. Than selection set is created with help of find item tools in navisworks. There are many ways to generating selection set but easy way is find item with elements id given while creating 3D model in Revit.

Figure 3 shows that find items tools, this condition is used for all task id and according to this condition selection set is created.

Than after time liner tab have data source option to bring time schedule in navisworks from MS Project. A very useful tool for automating the linking of elements to tasks in Navisworks is the 'Auto-Attach Using Rules' option shown in figure 4. The choice 'mapping by selection sets with the same name' is the most suitable in those cases when sets were created with that purpose, but it is also possible to do it by layers or elements. Than after in simulation tab we can generate and modify simulation of project.

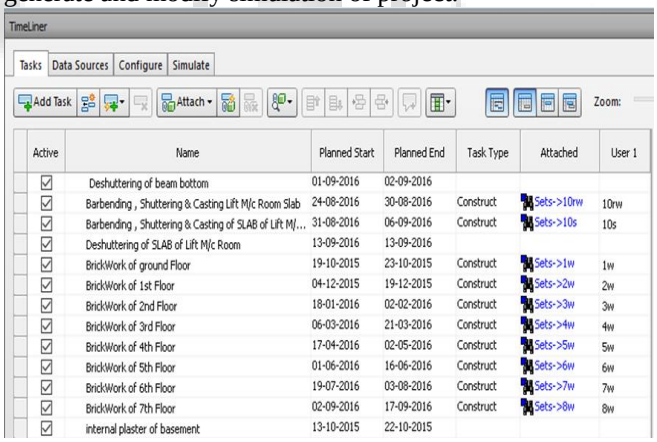

Fig. 3: Auto attach using rules

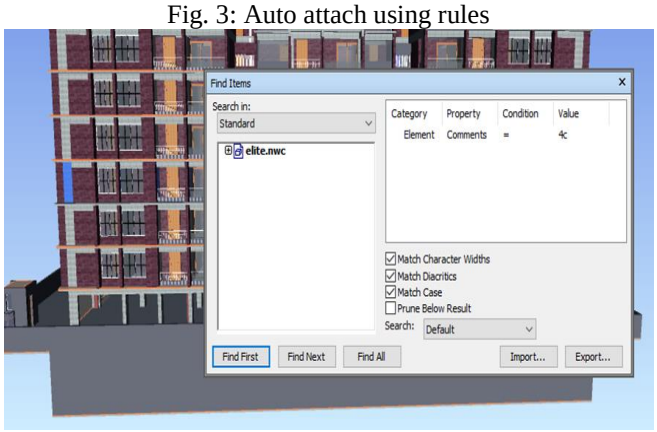

Fig. 4: Find items condition in Navisworks

IV. CONCLUSION

The capability to predict and anticipate conflicts before they become a problem is essential for effective project management. When the cost of schedule, delays and construction rework due to errors is considered, it is clear that project managers need to precisely plan and analyze construction operations down to the last detail, both in space and time.

Traditional scheduling methods are incapable of addressing the spatial aspects of the construction activities and also they are not directly linked to a building model. Traditional bar charts or Critical Path Method network diagrams can be difficult to understand analyze problems in an effective manner. Traditional 2D plans are also difficult to analyze and visualize to prepare detailed schedule of building and also having possibility to forget some activity. BIM have ability to watch the elements of a design and construction team improved accuracy in construction sequencing. Components within the model know how to act and interact with one another. Drawings, views, schedules, and so on are live views of the underlying building database. If we modify a model element, the BIM software automatically coordinates the change in all views that display that element including 2D views, such as drawings, and informational views, such as schedules.

4D BIM also helps in time-based clash analysis provides valuable insights for construction planners as they coordinate the trades, materials, and equipment that must coexist in the limited space available. Construction planning models can be integrated with the composite project model and linked to the project timeline to consider the impact of temporary items (such as work packages, formwork, cranes, installations, and so on) and check for potential time based clashes.

REFERENCES

[1] Chandar, P. and Dhivya Shree, G. "Integrating Building Information Modelling (BIM) and Construction Project Scheduling to Result in 4D Planning for a Construction Project with Relevant Illustrations" International Journal of Emerging Engineering Research and Technology Volume 3, Issue 4, PP 67-74 ISSN 2349-4395 (Print) & ISSN 2349-4409 (Online) (2015)

