

A STUDY ON BIM-BASED 5D SIMULATION IN WEB ENVIRONMENT

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ABSTRACT: Building Information Modeling (BIM) is an effective decision-making platform that helps to save project cost and enhance quality of construction. By generating and linking a wide variety of objects data, BIM can be effectively utilized, and it should be ensured that object properties maintain consistency throughout the project period of design, estimates, construction, maintenance and repair.

This study examined how to utilize BIM data in a construction project, by linking cost and schedule data in web environment, to better utilize the information and maintain consistency of the BIM information. To do so, the model integrated WBS data and CBS data, linked them with BIM model to realize 5D simulation in web environment. As a result, cost and schedule data could be simultaneously acquired, and object properties—cost, schedule, location—as well. These are expected to contribute to developing a BIM-based automatic data-processing system in web environment.

Keywords: BIM(Building Information Modeling), Schedule and Cost Integrated Management, WBS-CBS, 5D Simulation

1. INTRODUCTION

Building Information Modeling (BIM) is an effective decision-making platform that helps to save project cost and enhance quality of construction. By using 3D object data, the model is making progress to N-dimension in terms of managing project schedule, cost, resources, quality and safety. 3D BIM enables systematic project management to save time, cost and manpower from the initial design stage throughout the project period. Also, it can be a useful reference for future projects (Kwon, 2009).

By generating and linking a wide variety of objects data, BIM can be effectively utilized, and it should be ensured that object properties maintain consistency throughout the project period of design, estimates, construction, maintenance and repair.

The objective of this study is to propose how to use BIM information generated in the design stage, share and link information on project cost and schedule in web environment during the construction period, in order to efficiently utilize the information and ensure its consistency.

2. ESTABLISHMENT OF BIM-BASED INFORMATION

BIM is a technology that maximizes efficiency in design, construction, maintenance and repair stages in a construction project by converting object data to 3D CAD. It enables integrated use of information such as quantity calculation, estimate, schedule planning, energy analysis, structural analysis and legal review (Kwon, 2011). By

using system-based data, the modeling enables more accurate and faster data processing, and enhances information linking. BIM-based project management can be further improved by consolidating information on project schedule (4D) and even cost (5D).



Fig. 1. Establishment of BIM-based information

3. WBS-CBS INTEGRATION INFORMATION

WBS (Work Breakdown Structure) is a logical tool that categorizes project items, in greater details for sub-categories. CBS (Cost Breakdown Structure) is based on unit price of construction materials, and is also known as work-type item structure since it differs by types of construction projects.

From another perspective, WBS is considered a physical categorization system as it consists of facility, space, elements. By comparison, CBS can be regarded a conceptual system. For this discrepancy, the lowest part of WBS—activity—and the lowest category of CBS, cannot be effectively matched. However, the third-order category of WBS—information on construction

elements—can be used with work-type items of CBS in the estimate stage of a project. WBS-CBS integrated information can be built by linking element-specific information of WBS with CBS data by work-types, and generating activities accordingly.

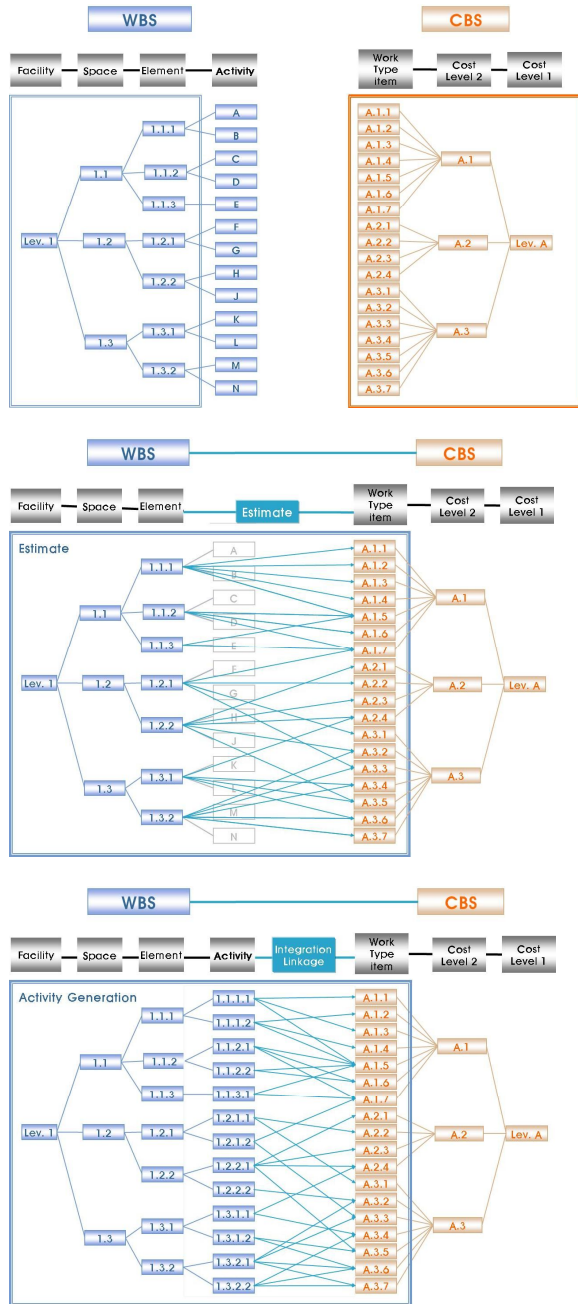


Fig. 2. Linking WBS with CBS data

4. BIM(3D) MODELING

To build BIM data for 4D and 5D information, type definition and property information should be provided for each object. To do so, the study defined level and space on the BIM model, and identified parameters that can categorize each objects.

Table 1. Identified parameters example

Module		Parameter code	Element
Structure	RC	111	column
	SRC	126	truss
	PC	133	slab
Windows	Interior	211	door
		212	Window
	Exterior	221	door
		222	window
Interior	Finish work	231	floor
		232	wall
Exterior	Finish work	281	floor
		282	wall
Stairs	Stairs	261	floor
		262	wall
Civil	Civil	311	civil
		313	pile



Fig. 3. Type definition and property information example

5. LINKING 3D MODEL WITH INTEGRATED INFORMATION ON PROJECT COST AND SCHEDULE

Each object of a 3D model has unique property values. And they can be linked with WBS-CBS integrated information by entering values of variables that can connect objects, FID (Finish Identity), and definition of level and space. Combined together, objects data and WBS-CBS integrated information make up XDB (Extreme Database) to be used for 4D and 5D simulation.

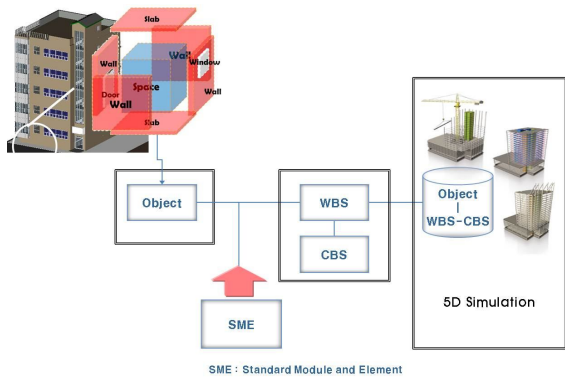


Fig. 4. Process of linking 3D model with integrated information on project cost and schedule

6. BIM-BASED 5D SIMULATION IN WEB ENVIRONMENT

Then data is transferred from XDB to web server DB that can provide data and information in web environment. By using the database, 3D simulation of project cost and schedule, as well as their contract details can be drawn up. Project managers use 3D data on cost and schedule, and 5D simulation to examine the budget expenditure and work progress. Also, staff can utilize the contract information to monitor project cost and schedule.

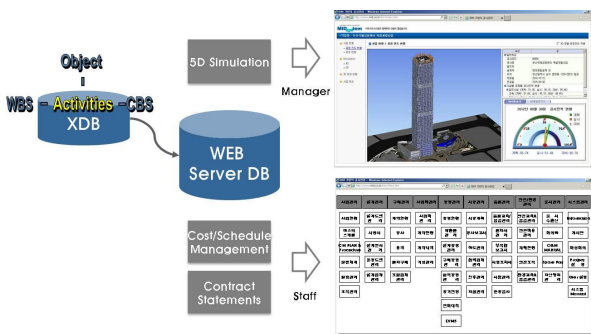


Fig. 5. Concept of BIM-based 5D simulation in web environment

3D model shows project progress, and displays project overview and progress on a dashboard.

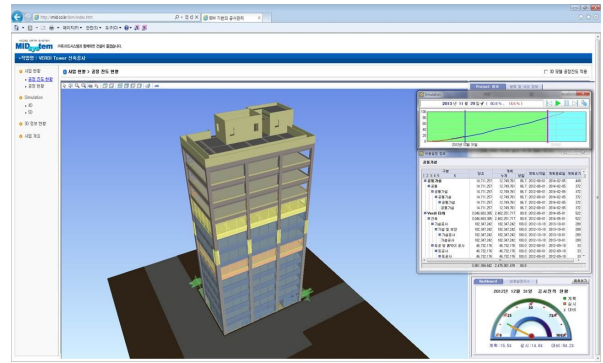
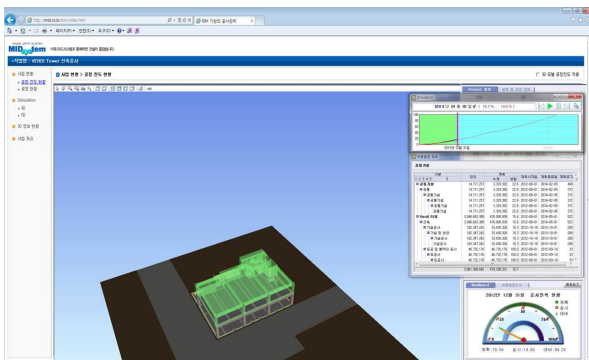


Fig. 6. Displays project overview and progress

Cost and schedule details can be checked, and the model facilitates decision-making such as revising details of the project.

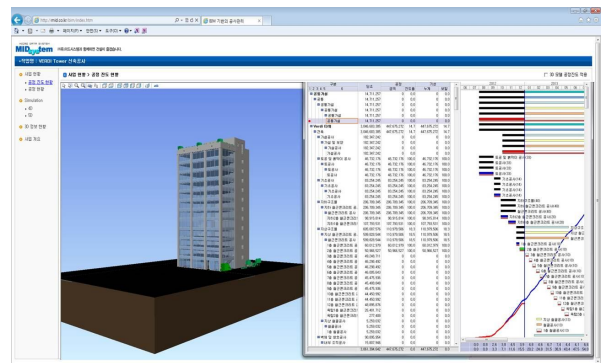


Fig. 7. Cost & schedule simulation

By linking object data with WBS-CBS integrated information, property data can be drawn including schedule, cost and location of selected objects.

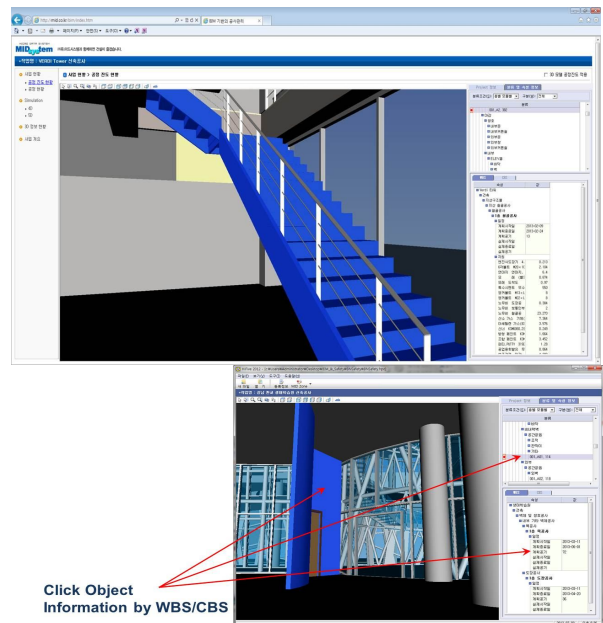


Fig. 8. Property data of selected object

By linking the BIM object data with CBS-WBS integrated information, the data can be utilized for project management, and information can be efficiently used through web-based 5D simulation.

7. CONCLUSIONS

This study examined how to utilize BIM data in a construction project, by linking cost and schedule data in web environment, to better utilize the information and maintain consistency of the BIM information.

To do so, the model integrated WBS data and CBS data, linked them with BIM model to realize 5D simulation in web environment. As a result, cost and schedule data could be simultaneously acquired, and object properties—cost, schedule, location—as well. These are expected to contribute to developing a BIM-based automatic data-processing system in web environment. The BIM model shows that it is essential to clearly define necessary information and form accurate database in the initial design stage of a project. Further research is needed to utilize the BIM model and its data for the post-construction maintenance stage of a project.

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