METHODOLOGY FOR AUTOMATED GENERATION OF 4D BIM

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Agenda

Introduction
Developed Methodology
Developed Software
Conclusion
Introduction

• There are commercial packages that can generate 4D BIM and numerous researchers have used 4D BIM in their research
• However, related literature does not disclose the methodology used or the know-how of creating 4D BIM
• This paper presents an automated methodology and describes how to construct a 4D BIM.
Visualization

4D Model

Schedule

BIM

Data Acquisition

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DEVELOPED METHODOLOGY

4D BIM = 3D model + construction schedule

• Baseline schedule (activities, job logic, ES and EF dates)
• Imports planned data from scheduling software, into database format
• Map 3D BIM model objects to project schedule baseline activities
• Different groups of 3D BIM objects are assigned to its respective activities
DEVELOPED METHODOLOGY

• Automated procedure compares current date to the ES and EF dates of each group, and controls each group’s visibility accordingly

• Future activities, those that have not yet started, are hidden from the developed 4D BIM

• Finished and checked activities visible in their final forms, and highlighted in red

• Currently in progress activities are displayed in yellow
DEVELOPED METHODOLOGY

1. Start
2. Group BIM Model Objects to be Compatible with Schedule Activities from 1 to n
3. 3D BIM Model
4. Assign each Group the corresponding Name of Project Schedule Activity
5. Link BIM Groups to Project Schedule Activities
6. 4D BIM
7. End
DEVELOPED METHODOLOGY

Start

4D BIM

Set Group i = 1

Enter Current Date

(ES) ≤ Current Date

Yes

Show Group i

No

Yes

(ES) ≤ Current Date

Show in Data Collection

No

Hide Group i from Model (Activities did not Start Yet)

Is the Group i Inspected?

Yes

Show Group i Highlighted in RED (May be delayed Activities)

No

Assign activities to Zones

Show Group i in its Final Form

Show Group i Highlighted in Yellow (Current Activities)
Visualization – 4D

- Integrated Schedule & BIM (4D)
- Virtual Construction @ different times
Developed Software

• Developed using the “Visual C# .NET” in Revit’s API.

• Revit was selected to be customized and the developed software was implemented to the Center for Structural and Functional Genomics (CSFG) at Concordia University in Montreal as a proof of concept and for testing the software.
Mapping 3D Revit objects to activities

1. User Selection
2. Choose Group Name
3. Group Elements
Added attribute “Group” to Revit object
Assigning MS Project activity to Group

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Show and hide activities by date (4D BIM)
Progress Visualization

Integrated
4D Model & Location

4D Model

Indoor Zone Identification

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Progress Visualization

Mapping Activity ID

Visualization

19RCCCOLG
Finished

20RCSLBG
In Progress

21RCCOL1
Future

Current Date

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Progress Visualization

- % Complete (Activity) = \( \sum_{i=1}^{n} Wi \times \sum_{i=1}^{n} (\% \text{ Earned})_i \)
- BCWP (Activity) = (% Complete \( \times \) BCWS) Activity

- BCWS (Project) = \( \sum \) BCWS (Activity)
- BCWP (Project) = \( \sum \) BCWP (Activity)
- ACWP (Project) = \( \sum \) ACWP (Activity)

- Updated Schedule        Updated 4D BIM
Conclusion

• This paper presents an automated methodology to create 4D BIM models
• The methodology is generic, straightforward and easy to use
• A prototype SW was developed based on the methodology
• The developed SW was later used in a case study of laboratory building on Concordia university Campus.
THANKS

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