BIM-based Automated Embodied Carbon Quantification and Analysis for Typical Buildings

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INSTITUTION

The Hong Kong University of Science and Technology

PROJECT NAME

BIM-based Automated Embodied Carbon Quantification and Analysis for Typical Buildings

PROJECT LOCATION

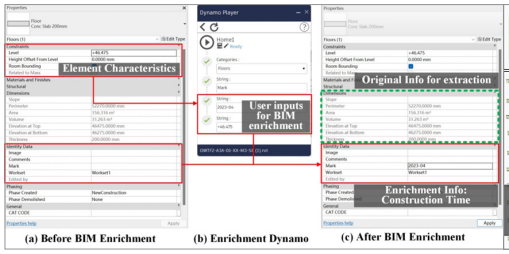
Sha Ling, North District, Hong Kong

TYPE

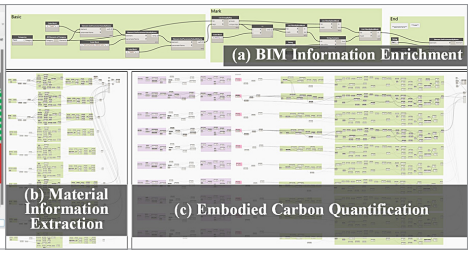
Embodied carbon quantification and analysis

AUTODESK PRODUCTS USED

Autodesk® BIM 360®
Autodesk® Dynamo
Autodesk® Navisworks®
Autodesk® Revit®
Autodesk Viewer



Dynamo plug-in for carbon information enrichment
Image Courtesy of The Hong Kong University of Science and Technology



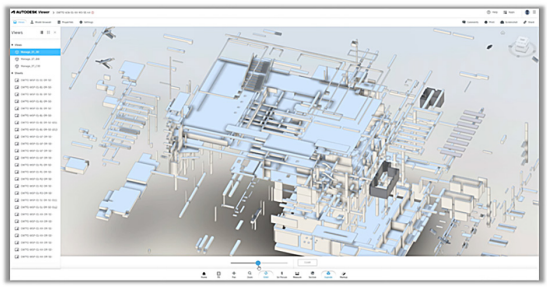
Dynamo-based automated BIM-based embodied carbon quantification solution
Image Courtesy of The Hong Kong University of Science and Technology

Project Background

The building and construction industry is among the leading industries contributing the largest carbon emissions. The importance of reducing carbon emissions associated with materials and construction processes throughout the whole lifecycle of a building (usually called embodied carbon) has been recognized rapidly. However, the process of quantifying embodied carbon is complex and time-consuming, requiring much manual effort and repetitive work. As a digital information management tool, building information modeling (BIM) has been studied in facilitating embodied carbon quantification. Based on the data stored in BIM, information required in embodied carbon quantification, such as material quantity take-offs, can be extracted automatically.

Project Challenges and Solutions

The first challenge is that there are too many data sources required for embodied carbon quantification. To solve this challenge, we designed a comprehensive ontology-based knowledge data model in the field of embodied carbon quantification. Secondly, due to the limited information for embodied carbon analysis that can be extracted from BIM models, we developed a plug-in based on Dynamo to enrich information in BIM models, especially for adding time information to conduct 4D embodied carbon analysis. Thirdly, since the existing embodied carbon quantification is not automated and customized enough, we proposed a user-friendly carbon emission statistics and analysis approach based on Dynamo for automated one-click quantification of embodied carbon. The last challenge is the difficulty of information collaboration to update the latest embodied carbon results during design stage. In this case, we designed a collaborative workflow for low-carbon design based on BIM360, which enables more efficient design and cross-departmental collaboration.



BIM Model Sharing Using Autodesk Viewer
Image Courtesy of The Hong Kong University of Science and Technology

How does BIM help for your project?

BIM provides project stakeholders with a common data environment for efficient embodied carbon quantification and analysis, which facilitates low-carbon material selection and green construction activities during green building design and construction stages. The BIM model developed in Autodesk Revit consists of different types of information required for embodied carbon quantification and analysis. In the project, we adopted Dynamo to develop an automated and customized workflow for comprehensive embodied carbon quantification, which significantly improves the accuracy of carbon quantification and avoids large amounts of manual work. Moreover, during the project collaboration process for embodied carbon analysis, BIM 360 provides a collaboration environment for all team members. At the same time, Autodesk Navisworks allows stakeholders to implement building analysis and upload to the BIM 360 cloud, while Autodesk Viewer supports easy BIM + CAD viewing and sharing for carbon analysis, which will be also uploaded to the cloud for collaboration.

AUTODESK