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INSTITUTION

The Hong Kong University of Science and Technology

PROJECT NAME

OpenBIM-based Design Optimisation and Prefabrication Automation of Steel Reinforcement

PROJECT LOCATION

Ma Chai Hang, Kowloon, Hong Kong

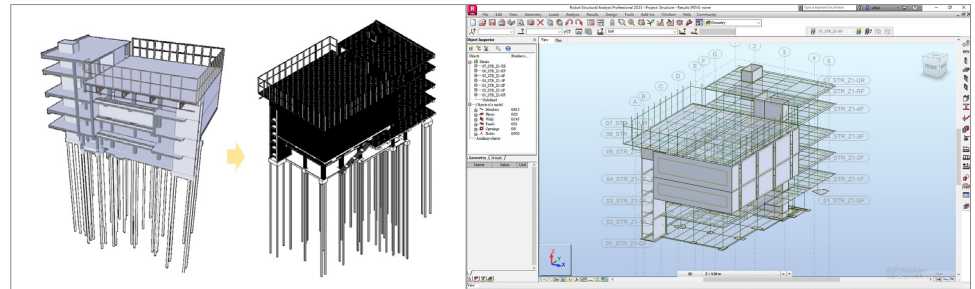
TYPE

Design optimisation and prefabrication automation of steel reinforcement

AUTODESK PRODUCTS USED

- Autodesk® AutoCAD®
- Autodesk® BIM 360®
- Autodesk® Dynamo
- Autodesk® Revit®
- Autodesk® Robot™ Structural Analysis

OpenBIM-based Design Optimisation and Prefabrication Automation of Steel Reinforcement



Automatic generation of clash-free rebar BIM model
Image Courtesy of The Hong Kong University of Science and Technology

Structural analysis using Robot
Image Courtesy of The Hong Kong University of Science and Technology

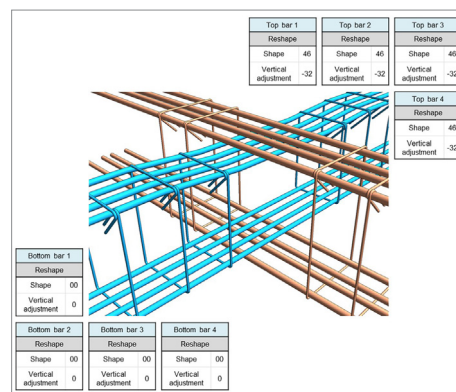
Project Background

In recent years, the industry and academia have growing interests in offsite construction. The Hong Kong Government also introduced policies to support offsite prefabrication and prefabricated steel reinforcement (also called rebar) components. The design of rebar is important and necessary for the construction of RC structures. Currently, rebar design is performed manually or semi-automatically by structural engineers with computer-aided design software, which is tedious and labour-demanding, and possibly over- or under-designed. Building information modeling (BIM) technology with open processes and standards allows us to coordinate effectively and access information needed for clash-free rebar design optimisation and prefabrication automation.

Project Challenges and Solutions

Firstly, since the conventional rebar design is conducted manually or semi-automatically, we integrated metaheuristic algorithms and deep learning to generate optimal designs efficiently. Secondly, we employed Robot to enable smooth transformation from the BIM model to structural analysis model to avoid the tedious and error-prone model

establishment process, and developed a plug-in based on IFC to extract the results from Robot for design optimisation. Thirdly, to get rid of time-consuming human operations to solve rebar clashes and establish rebar model, we developed a plug-in based on Dynamo to generate the rebar BIM model integrating a rebar clash solver that can automatically identify and parametrically resolve the rebar clashes. With the clash-free BIM model, the rebar bending schedule, drawing and BVBS code can be generated automatically using developed plug-in based on IFC to support prefabrication. Last but not least, BIM360 was adopted to allow the remote collaboration of our team members.



Automatic and parametric rebar clash avoidance
Image Courtesy of The Hong Kong University of Science and Technology

How does BIM help for your project?

BIM provides a common data environment for us to work smoothly and efficiently, connecting the architectural model, structural analysis engine, cloud application and customized plug-ins. In addition, the BIM model consists of different types of information required for clash-free rebar design optimisation. In the project, the integrated workflow based on Revit and Robot and the IFC-based information extraction significantly improve productivity and enhance accuracy of design. More importantly, the information in the design stage contained in BIM can further support downstream activities. The generation of rebar BIM model facilitates rebar fabrication and onsite installation. A customized plug-in was developed based on IFC to automatically generate rebar bending schedule, drawing and BVBS code to support prefabrication automation. In addition, BIM improves communications between our team members and its cloud application allows us to collaborate remotely.

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