COMPANY
Hong Kong Housing Authority, HKSAR Government

PROJECT
1. BIM enabled Semi-automated Foundation Design (BIM-SAFD)
2. BIM enabled Residential Thermal Transfer Value Calculation (BIM-RTTV)

LOCATION
Hong Kong

TYPE
Public Housing Development

Housing Authority's Odyssey in Capitalizing BIM - Scaling a New Height in Integrating Designs with Revit Models

"BIM changes the whole industry practice by pooling professional knowledge throughout the project life cycle, from project planning to construction and utility management."

"Paint" External Façade and Roof
Image courtesy of Hong Kong Housing Authority, HKSAR Government

BIM Development of the Company

HA develops and implements a public housing programme which spans all development stages from planning to design, construction, facility operation and maintenance. Among the prevailing IT systems that are currently used in the construction industry, BIM is the most versatile tool that enhances the efficiency of information exchange, and in particular connects the intelligence of different disciplines to the project.

BIM was first introduced to the HA in 2006 and has since been used in some projects on a trial basis to enhance design quality, site safety and improve construction coordination. In 2007, HA established a BIM Project Steering Committee and a BIM Working Group to strategically plan the implementation of BIM, and formed the BIM Service Team as central support to the implementation of BIM in HA projects.

BIM changes the whole industry practice by pooling professional knowledge throughout the project life cycle, from project planning to construction and utility management. The two innovations this year underscore the significance of HA's odyssey in BIM. With advances in BIM technologies, there will be stronger participation by various building stakeholders in using BIM in Hong Kong, while the HA will continue to play an active role in advocating the use of BIM.

The Award-winning BIM Project

(1) BIM-enabled Semi-automated Foundation Design (BIM-SAFD)

In conventional foundation design, Structural Engineers use various discrete software tools to perform structural analysis and design. Even though there is a proliferation of design tools, there has never been a platform available for data interoperability through which different software tools effectively work together for instant information exchange.

HA therefore developed more responsive solutions, with one-stop integrated foundation design with **BIM**, to provide designers with a platform for data interoperability; and devised a set of Standard Approach to Modeling and measurement method to create a **BIM**-based method for estimation that is compatible with the standard and practices of measurement in the industry. **SAFD** was devised using Surfer, with integration of **BIM** to bring about a revolution in the way

foundations are designed, drawings are produced and quantities are measured – to achieve design and drawing production optimisation and, most importantly, enhance design accuracy and efficiency.

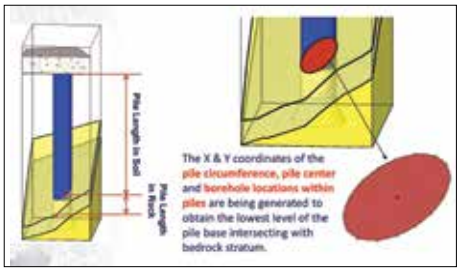

FIGURE 1 - Automatic Determination of Rockhead Level using "Grid Residual" Function of Surfer
Image courtesy of Hong Kong Housing Authority, HKSAR Government

SAFD comprises Surfer - a 3D visualisation, contour modeling software; and an Add-on Programme of MS Excel workbook for correlating the design output from Surfer. It enables the determination of rockhead level of each pile and automatically identifies the coordinates/levels of the intersection of the piles with the rockhead (Figure 1). **SAFD** provides a platform through which the results output from analytical software can be shared and interact with **BIM** to enable engineers to make prompt, systematic and precise decisions.

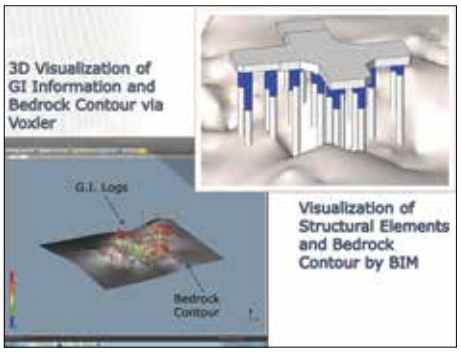

FIGURE 2 - BIM Revit Model Containing Foundation Elements, GI Logs and Bedrock Contour ready for 2D Drop-off
Image courtesy of Hong Kong Housing Authority, HKSAR Government

Upon completion of the foundation design, GI logs and contour information will be exported through Voxler to the Revit model for 2D Drop-off (Figure 2). As a result, the 2D drop-off with combination of structural elements, rockhead contours and GI data will be merged into a single 3D model, which will then be used for foundation plan submission (Figure 3).

FIGURE 3 - Workflow of BIM-SAFD for BIM Submission
Image courtesy of Hong Kong Housing Authority, HKSAR Government

Through **BIM-SAFD** upon completion of the foundation design, the Revit model will be passed to Quantity Surveyors for cost planning and estimation for tendering preparation. With **BIM-SAFD** based QTO, the information in the Revit model can also be shared and exchanged across disciplines. Any changes in geological information or block disposition can be automatically assessed and extracted for verification, whereby updated cost variation can be easily quantified (Figure 4).

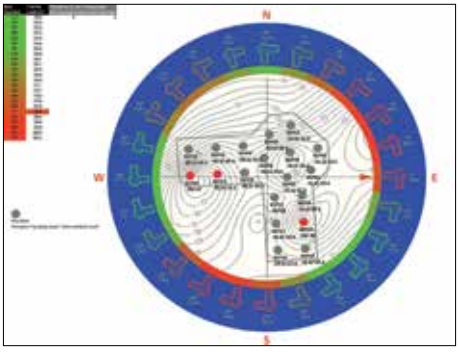

FIGURE 4 - Different Block Disposition for Achieving Optimum Pile Layout
Image courtesy of Hong Kong Housing Authority, HKSAR Government

Integrating **SAFD** and **BIM** brought about a breakthrough in design solution, in terms of data interoperability. It effectively streamlines the workflow from manual computations by individual disciplines, through design automation to multi-disciplinary collaboration via fully interchangeable information database. The introduction of **BIM**, a 3D interface, allows visualisation of the spatial arrangement of pilings, drillholes and rockhead surface, and enables the designers to proceed with the foundation design more efficiently. Also, the design workflow becomes more traceable and minimises the risk of human errors, while ensuring the finalised **BIM** model containing the required quality and quantity of information is sufficient for quantity measurement.

(2) BIM-enabled Residential Thermal Transfer Value Calculation (BIM-RTTV)

To maximise the potential of land to fulfill the strong demand for flats, calculation of **RTTV** is necessary for concession of GFA. To use the formulae in the guidelines on "Design and Construction Requirements for Energy Efficiency of Residential Buildings", the extraction of relevant building parameters is necessary. For conventional CAD designs which rely on 2D drawings, the process is laborious and manual, with a high margin for error.

HA sees opportunities in integrating **BIM** in the calculation of **RTTV**. It can save manpower and also achieve better accuracy. We had an innovative venture in retrieving building parameters and the required shading coefficient factors to facilitate the **RTTV** calculation from **BIM** models, saving manual effort which is prone to errors.

There was, however, no direct application in Revit to retrieve the orientation and area of façade at each orientation from **BIM** model. Therefore, we innovatively integrated the built-in function of Revit, a free plug-in to identify orientations and a QTO plug-in, a plug-in commonly used in taking quantity from Revit models, to retrieve the required data.

Multiple architectural and structural models are combined into a single model (Figure 5) to enable all external facades and internal walls to be identified without error.

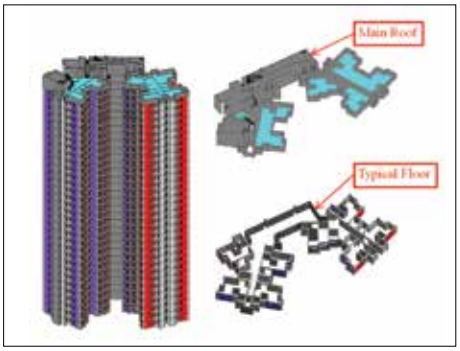

FIGURE 5 – Combined Model
Image courtesy of Hong Kong Housing Authority, HKSAR Government

HA successfully tested a free plug-in, “Case”, which can be used to automatically identify the external wall orientation. The eight directions (N, E, W, S, NE, NW, SE & SW) are indicated as the properties of the wall. The orientation of a window can therefore be identified with reference to the orientation of the wall to which it is attached. The orientation is assigned as a “material” property. Nine different “materials” are assigned to represent the eight directions of the external wall and roof. (Figure 6)

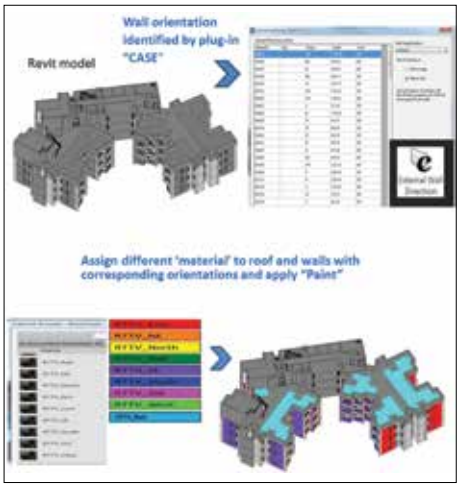

FIGURE 6 –“Paint” External Façade and Roof
Image courtesy of Hong Kong Housing Authority, HKSAR Government

Through applying REVIT “Paint” function to external wall and roof, according to the “material” assigned for each direction and roof, which is originally used for assigning materials to different building components, areas of external façade can be obtained. The Overhang Projection Factor (OPF) and Side Projection Factor (SPF) can also be calculated by using the information contained in the window property (Figure 7).

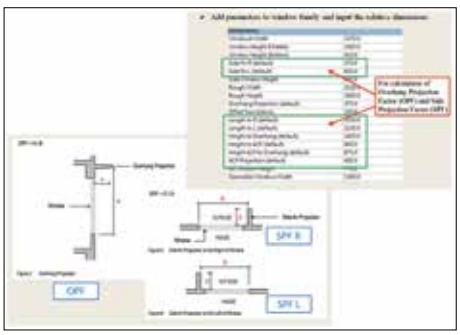

FIGURE 7 – Data in Window Properties
Image courtesy of Hong Kong Housing Authority, HKSAR Government

By using the “Auto-coding” function of the QTO plug-in “EqBQ” (Figure 8) to assign a code for each painted element, the sum of areas of facades of different orientations can be automatically retrieved and exported for further operations. The data retrieved, including the required external shading coefficients, can be used to perform detailed calculations.

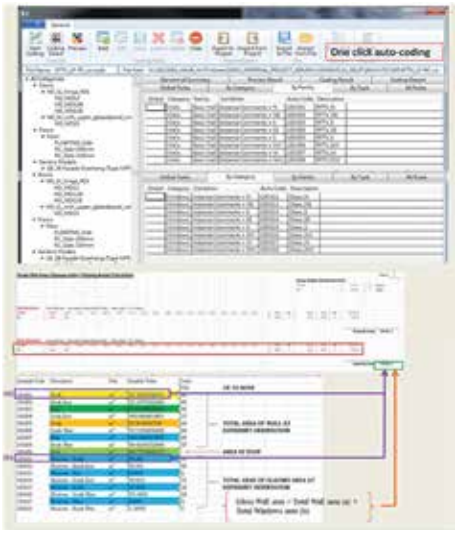

FIGURE 8 – Extracted Data can be used in RTTV Calculation Sheets
Image courtesy of Hong Kong Housing Authority, HKSAR Government

A successful trial of retrieving building parameters from **BIM** model to facilitate **RTTV** calculation resulted in the following benefits -

(i) Speed, traceability and accuracy of **RTTV** calculation can be enhanced;
(ii) Manpower needed to perform the calculation can be reduced;
(iii) Building envelope can achieve better energy efficiency and human comfort through design optimisation.

香港房屋委員會
Hong Kong Housing Authority

Image courtesy of Hong Kong Housing Authority, HKSAR Government

About Hong Kong Housing Authority, HKSAR Government

Hong Kong Housing Authority (HA) is a statutory body established to provide subsidized public rental housing to low-income families, and to help low to middle-income families gain access to subsidised home ownership. Approximately 30% of the Hong Kong population is now living in public rental housing units. The Housing Department is the executive arm of the HA to help the Government achieve its policy objective on public housing.