

COMPANY

Arup
Greenwich Investors Limited

PROJECT

Renovation Works of Greenwich Centre

LOCATION

No.260, King's Road, North Point, Hong Kong

TYPE

Alterations and additions works

SCHEDULED TIME OF COMPLETION

May 2019

The BIM Model that Laser Scanning Built

“At Arup, we focus on providing better solutions for our clients through improved design, analysis and insight, enabled by new digital technologies. We applied the latest 3D mobile scanning technology in an existing building to help us develop a BIM model. This scan-to-BIM approach offers an efficient way of establishing an accurate digital representation for design and construction, as well as future management for existing buildings.”

—**Ir Clement Chung**

Director and East Asia Digital Leader, Arup

BIM PARTNERS

Andrew Lee King Fun & Associates Architects Limited

Chung & Ng Consulting Engineers Limited

King-Tech Engineering Company Limited

Regent Construction Company Limited

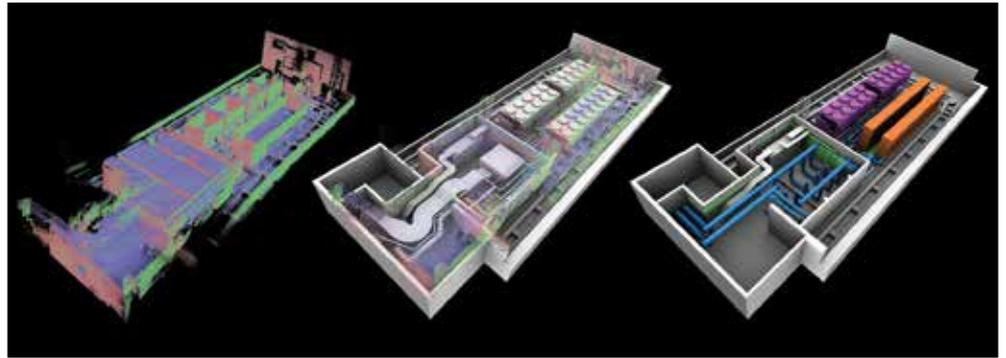
AUTODESK PRODUCTS USED

Autodesk BIM 360

Navisworks

Recap Pro

Revit



Scan-to-BIM approach for existing buildings
Image courtesy of Arup and Greenwich Investors Limited

The work on renovating the Greenwich Centre was a design-and-build project that involved the renovation of the central chilled water system and the façade of the commercial building. Constructed in the 1980s, the building has 23 floors with a GFA of 11,200m².

As the tenants were international banking services providers, financial institutions and leading retail companies, there was a strict proviso against interrupting the building operation or causing a nuisance to tenants during the project. The project construction and migration sequence needed to be well-planned and controlled, to maintain normal building operations.

To facilitate future planning and management, the project team established a common data environment (CDE) using BIM 360. This would enable effective management, dissemination and recording input / output of project data throughout the project lifecycle. This data included the design model, project specifications, construction information, contractor material submissions, and the as-built information upon completion of the project. An asset information model was also handed over to the client, to facilitate future asset management.

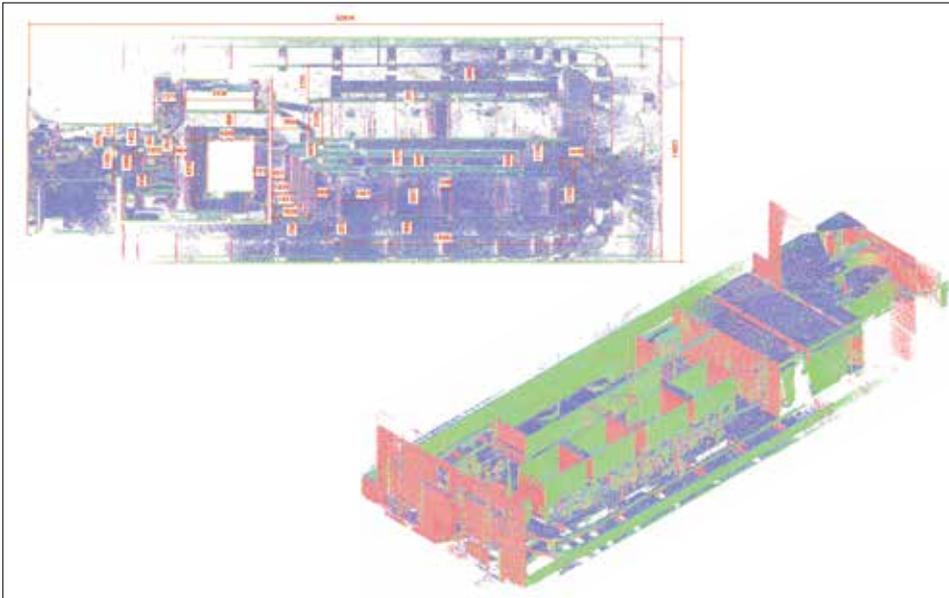
Facilitating future planning and management

Creating a BIM model using 3D laser scanning

A site investigation and a survey with photos and manual measurements were



BIM 360 as a common data environment
Image courtesy of Arup and Greenwich Investors Limited



Using the 3D mobile laser scanning technology, a point cloud model was produced for highly accurate measurement on Recap Pro or Revit. Image courtesy of Arup and Greenwich Investors Limited

essential for verifying the existing condition before design works commenced. Adding to the project complexity and difficulty, there were many congested and unreachable areas that hindered the on-site manual measurements.

Arup devised a more efficient way for on-site data acquisition. Using 3D mobile laser scanning technology, we produced a point cloud model, for highly accurate measurements on Recap Pro or Revit. Based on this model, the project team then created a 3D BIM model of the existing condition. This BIM model was uploaded to the CDE as the basis for the project, and subsequently used to develop the design for the chiller plant upgrade.

Multidisciplinary collaboration from design, through construction to future asset management

With this newly developed BIM model, feasible options for the chiller plant upgrade were produced during the design stage. Different options with different spatial requirements were reviewed in terms of time and cost implications, as well as the architectural and structural modification work required. Detailed spatial analyses and coordination were conducted before construction. Using this method provided a thorough understanding of the construction sequence, facilitating coordination and communication with stakeholders.

The BIM model also enabled the team to appreciate the complexities of the project and envision the underlying risks

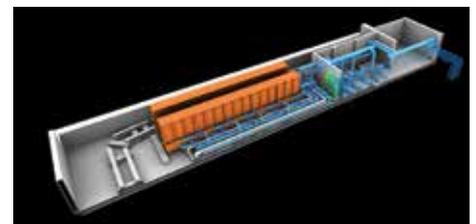
and issues in the design stage, so that mitigation measures could be proposed to ensure smooth construction. Moreover, it enabled early engagement with the building operators, so they could provide the specific requirements from the operation and maintenance perspective, and to align their expectations with the final product and ensure future maintainability.

This process helped minimise the design risks by resolving clashes in the early stage of the renovation, and facilitate the subsequent construction stage by reducing abortive works arising from design issues and inconsistencies across different disciplines. The fully-coordinated model also ensured a perfect fit of elements that could be built off site, allowing these components to be easily installed in place, rather than

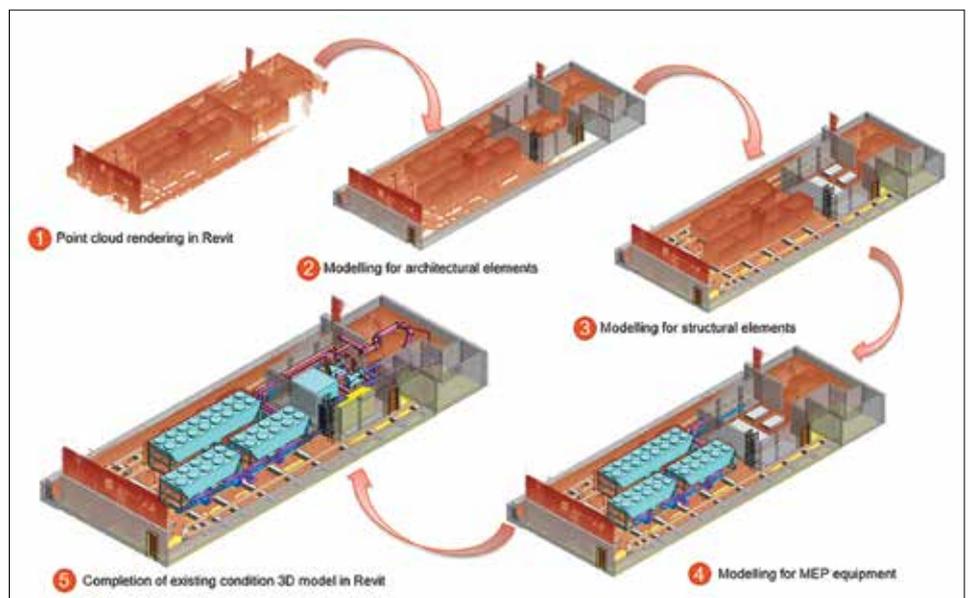
manufactured on site.

The construction sequence of this chiller plant renovation was divided into multiple phases in Revit. The models were further exported to Navisworks, to create an animation for illustrating the construction sequence. The animation was then uploaded to BIM 360 cloud space, to help the project owner “visualise” the construction phases, thoroughly understand the project execution plan and logistics handling, and easily evaluate potential impacts on the building operations during the construction stage.

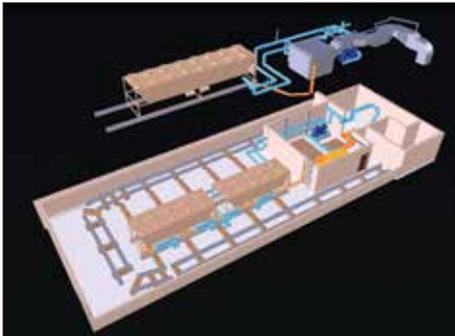
The BIM model will be enriched to include equipment ratings, performance data, model information, supplier information and etc. and become an asset information model (AIM), for handover to the building operator, and use in future asset management.



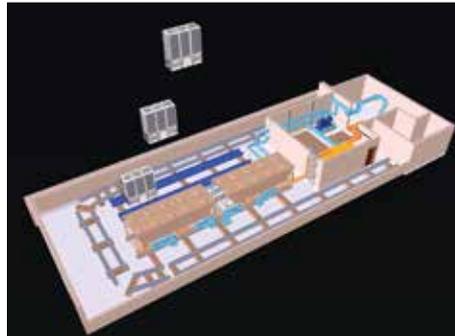
Multidisciplinary collaboration and spatial analysis for new equipment. Image courtesy of Arup and Greenwich Investors Limited



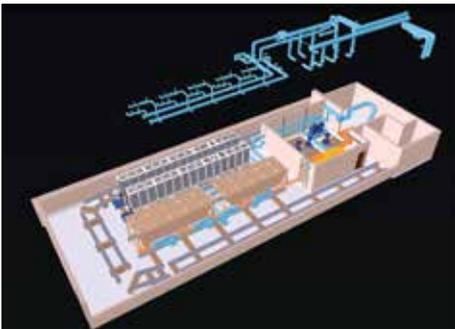
Modelling process from point cloud to BIM model. Image courtesy of Arup and Greenwich Investors Limited



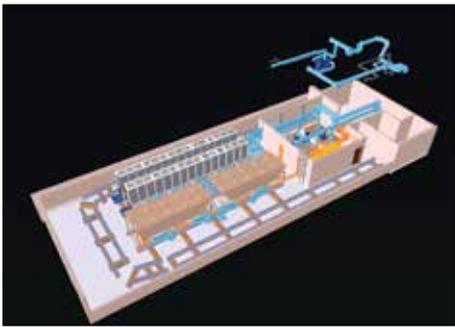
Visualisation of the construction sequence: Phase 1 – Demolition of existing chiller, pipeworks and ductworks
Image courtesy of Arup and Greenwich Investors Limited



Visualisation of the construction sequence: Phase 2 – Installation of new modular chillers
Image courtesy of Arup and Greenwich Investors Limited



Visualisation of the construction sequence: Phase 2 – Installation of new water pumps and associated pipeworks
Image courtesy of Arup and Greenwich Investors Limited



Visualisation of the construction sequence: Phase 3 - Demolition of remaining equipment
Image courtesy of Arup and Greenwich Investors Limited

the project team saved 50% of the time required for site surveys and measurements, compared to traditional manual measurements, while the initially planned design period was shortened by one third. Also, the construction period was shortened from 14 months to 11 months, as the fully-coordinated BIM model resulted in reduced RFI and abortive works during construction.

This scan-to-BIM approach will become more extensively adopted in future renovation projects, especially those with a tight programme and challenging spatial requirements.

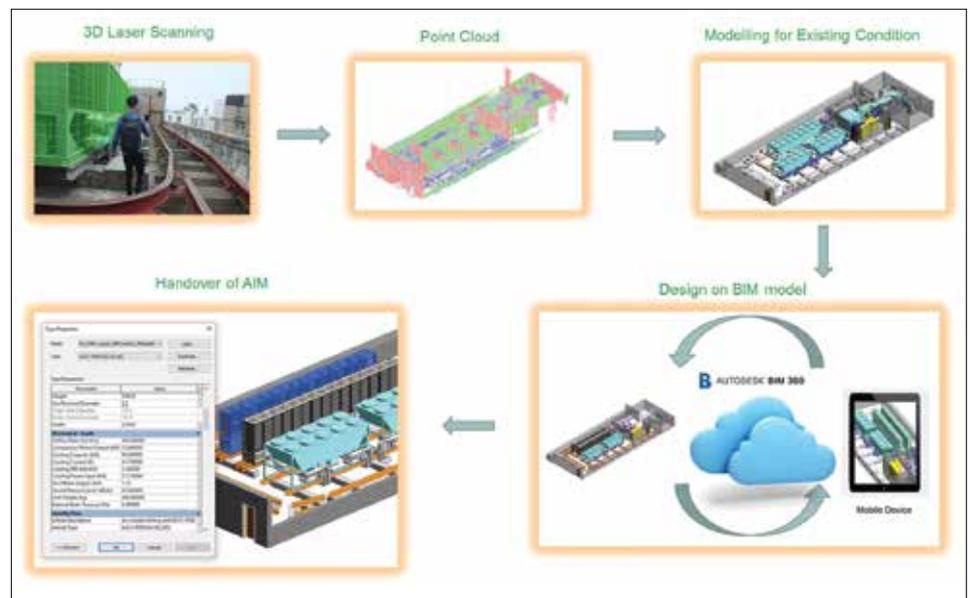
and would rather opt for traditional 2D drawings, which are considered to “cost less”.

3D mobile laser scanning was adopted in this project to capture and measure the existing condition of the chiller plant, saving the time required for the labour-intensive on-site manual measurements, which are also often subject to errors. This technology has been widely used in large-scale applications such as landscapes, tunnels and facade engineering. In this project, 3D mobile laser scanning was deployed in an MEP plant for a renovation work, and connected to the BIM process as part of the project delivery.

With this scan-to-BIM approach,

BIM: a sustainable way to manage old and existing buildings

BIM has been extensively adopted in the construction industry, offering an integrated solution from the design stage to the building operating phase. However, such an approach is not common in renovation of existing and old buildings, due to the complexity of creating a 3D BIM model for the existing condition. Building owners tend to think that the BIM approach implies a higher cost



The new workflow can be applied in renovation works of existing buildings
Image courtesy of Arup and Greenwich Investors Limited

ARUP

GREENWICH INVESTORS LTD.



About Arup

Arup is the creative force at the heart of many of the world's most prominent projects in the built environment and across industry. We offer a broad range of professional services that combine to make a real difference to our clients and the communities in which we work.

We are truly global. From 87 offices in 34 countries our 14,000 planners, designers, engineers and consultants deliver innovative projects across the world with creativity and passion.

Founded in 1946 with an enduring set of values, our unique trust ownership fosters a distinctive culture and an intellectual independence that encourages collaborative working. This is reflected in everything we do, allowing us to develop meaningful ideas, help shape agendas and deliver results that frequently surpass the expectations of our clients.

The people at Arup are driven to find a better way and to deliver better solutions for our clients. We shape a better world.

Renovation Works of Greenwich Centre

Image courtesy of Andrew Lee King Fun & Associates Architects Limited and Greenwich Investors Limited