

COMPANY

Link Real Estate Investment Trust
Nan Fung Development Limited

PROJECT

The Quayside

LOCATION

77 Hoi Bun Road, Kwun Tong

TYPE

Mixed-use Commercial Development

SCHEDULED TIME OF COMPLETION

Q1 2019

BIM – Key to Success for a Complex Green Commercial Development

“From design coordination, tendering, construction to facilities management, BIM has been instrumental for this green commercial project.”

— Nan Fung Development Limited

BIM PARTNERS

AECOM Asia Company Limited
Gammon Construction Limited
P&T Architects and Engineers Limited
WSP Hong Kong Limited

AUTODESK PRODUCTS USED

BIM 360 TEAM

Collaboration for Revit
Navisworks Manage
RECAP Pro
Revit



Visualisation of The Quayside from Hoi Bun Road
Image courtesy of Link Real Estate Investment Trust and Nan Fung Development Limited

The Quayside is a joint venture commercial development between Link REIT and Nan Fung Development Ltd. (NFD). The NFD Project Team was entrusted as the Project Manager to deliver the project with quality design and construction as well as high standards in sustainability and building health with the aim to attract multi-national corporations (MNCs) from the eco-smart communities at the onset of the project. The project has achieved provisional Platinum rating in both the HK BEAM Plus and the US LEED green building certification, and a Gold rating by the International WELL Building Institute.

The Quayside – a Sustainable and Healthy Building

The Quayside is a mixed-use development comprised of a 3-level retail and office lobby podium connected via a sky garden to 17 floors of Grade A offices at the twin office towers above, with a total GFA of approx. 884,000 sf. Lavish landscaping and vertical green walls/columns are interspersed both inside and outside of the building at the retail podium, sky garden, roof garden and open terraces to provide pleasant green working environments with excellent internal air quality (IAQ) for the building users.

To achieve such an ambitious project, Building Information Modelling (BIM) and Virtual Design and Construction (VDC) were adopted at inception of the project to manage the entire development value chain from design and construction to future operations and maintenance.

As one of the leading developers in HK, NFD has committed to utilize BIM in the design and construction process since 2014 to deliver high quality buildings for our customers. In-house BIM capacity is a prerequisite in the procurement of our major design consultants, including the

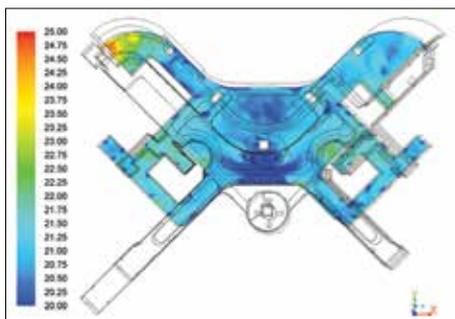


Bird's eye view of The Quayside from Wai Yip Street
Image courtesy of Link Real Estate Investment Trust and Nan Fung Development Limited

Architect, Structural Engineer, Building Services Engineers, Interior Designer and Landscape Architect.

BIM Model as Single Source of Truth for Design Coordination and Change Management

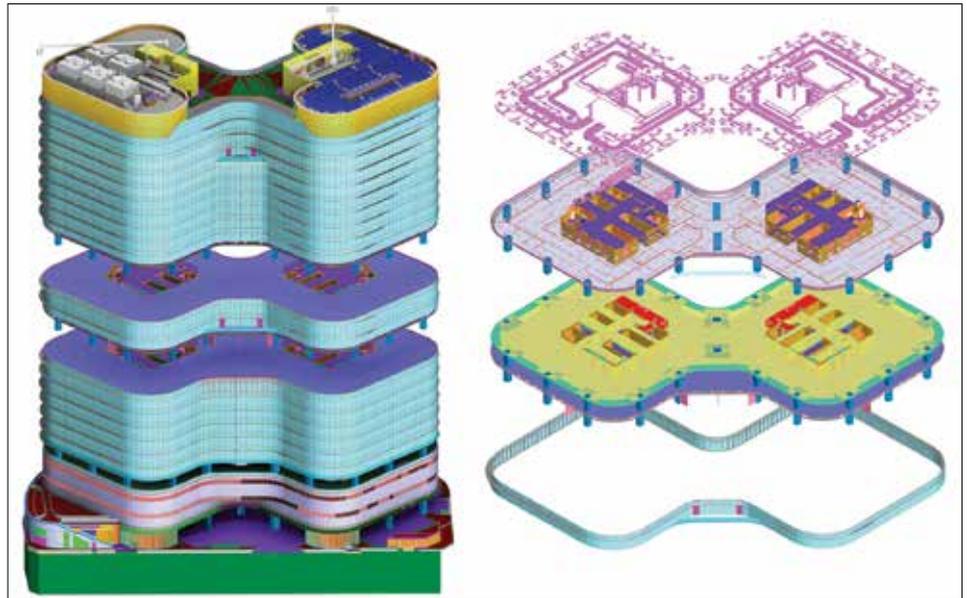
In The Quayside project, the BIM design process was fully implemented starting from detailed design stage to contract documentation. A single BIM model in the Common Data Environment (CDE) was utilized to achieve a "single source of truth" throughout the design stages; it ensured all updates / changes to the project would be reflected in the latest BIM model in real time, which was accessible by all project stakeholders. The BIM model was continuously updated and refined to determine the optimal design solution and to verify design assumptions. Regular design-conflict analysis meetings were held among the consultants to identify clashes and to agree on the corresponding resolutions to ensure all building designs were well coordinated and considered.



Indoor Computational Fluid Dynamics (CFD) simulations were carried out to confirm the design assumptions based on spatial organization of interior spaces exported from BIM
Image courtesy of Link Real Estate Investment Trust and Nan Fung Development Limited



Solar heat gain analysis with building envelope from BIM model was carried out to optimize shading fins design
Image courtesy of Link Real Estate Investment Trust and Nan Fung Development Limited



For The Quayside project, 10+ different trades were involved in BIM process for cross-discipline coordination
Image courtesy of Link Real Estate Investment Trust and Nan Fung Development Limited

BIM Model for Advanced Technical Studies

The BIM model was not only used to explore different architectural designs and visualization of the proposed spatial quality, the same model was used for other advanced technical studies, such as:

- Indoor Computational Fluid Dynamics (CFD) simulations to verify the effectiveness of air distribution within the interior spaces;
- Air flow patterns at the podium sky garden under yearly wind conditions to identify high wind areas as well as stagnant zones where Air Induction Units (AIU) will be installed to induce air flow for maximum user comfort;
- Solar path analysis to ascertain the most effective sun shading configurations on the building facades to satisfy energy performance requirements while balancing aesthetics considerations;
- Overall Thermal Transfer Value (OTTV) calculations based on the building envelope exported from the BIM model.

BIM Model to Facilitate Contract Tender and Construction Planning

The BIM model was given out to the building contractors at tendering stage as a reference to facilitate their understanding of the scale and complexity of the project. The model helped expedite the tender query

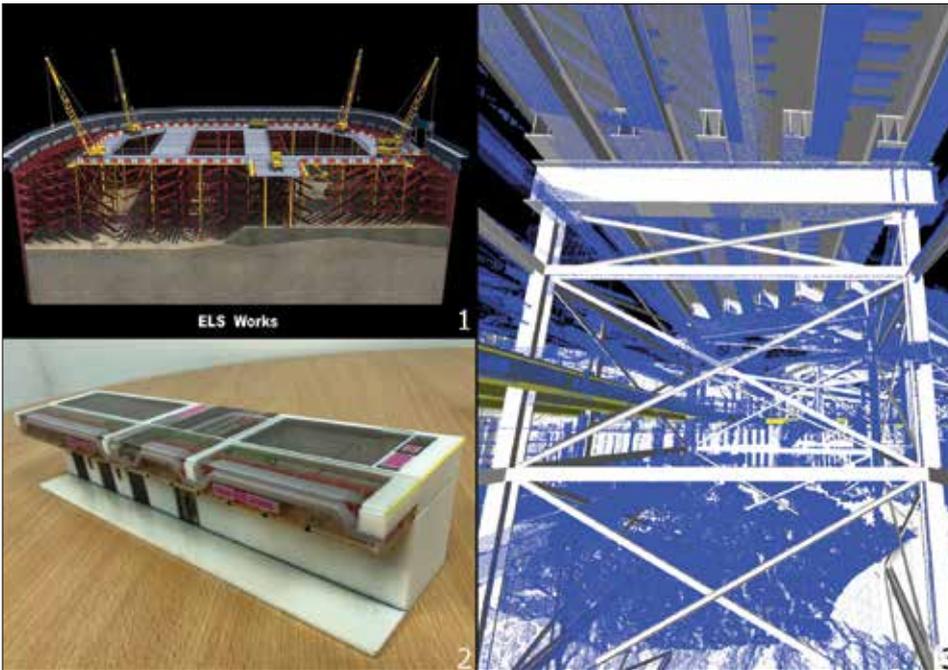
process and allowed the contractors to formulate in-depth questions about the project in a relatively short time. Many of the contractors had in fact utilized the BIM model to simulate their proposed construction planning and works sequence to demonstrate their understanding of the project's key issues and constraints during tender interviews.

The BIM model was passed to the awarded Main Contractor during construction to be further developed into a higher Level of Development (LOD) to generate 3D Combined Services Drawings (CSDs) and Combined Builder's Works Drawings (CBWDs) to verify once again the design assumptions against actual site conditions, for example, whether ceiling headroom clearance could be achieved prior to final installations, especially in critical areas like basement parking and the office floors.

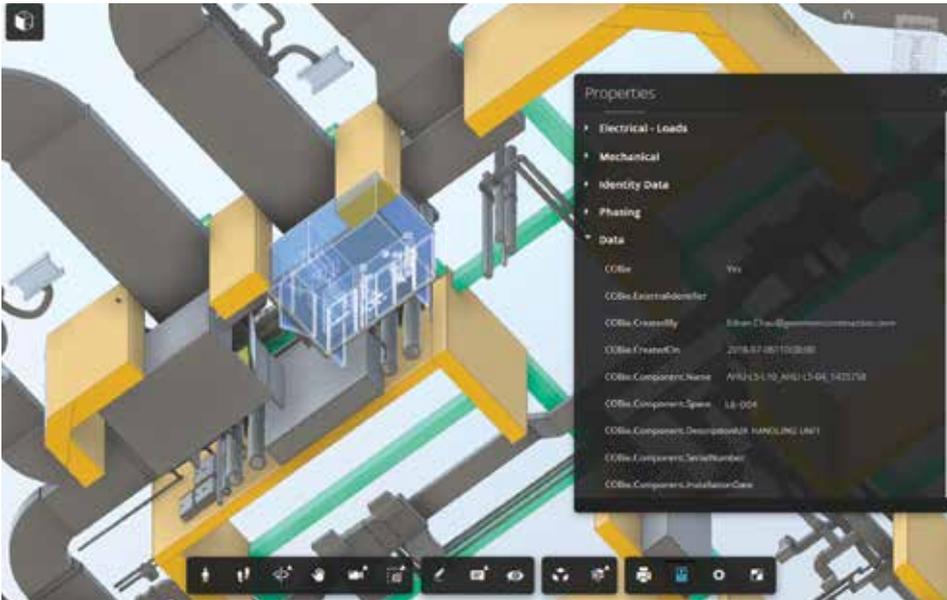
In areas with congested building services, 3D printing was actually utilized to print out such services for better visualization of the potential challenges to install the building services works. For quality assurance, the Main Contractor employed laser scanning regularly to survey the as-built conditions of the completed foundation / ELS works to ensure construction accuracy against the BIM model.

BIM Workflow in Tandem with Laser Scanning to Reduce Abortive Works

The BIM workflow has pushed forward the design coordination process much



1. 4D Construction Sequence Simulation was carried out to review works planning, site logistics, constructability reviews, etc.
2. 3D Printing of project BIM models were utilized for areas with congested building services for construction sequence review and potential use for maintenance team's training purpose.
3. Laser scanning was employed regularly on site to survey the as-built conditions to ensure construction accuracy against the BIM model. Image courtesy of Link Real Estate Investment Trust and Nan Fung Development Limited



As-built BIM models with asset information embedded will be exported for Facility Management software and web-based CDE to facilitate future O&M team. Image courtesy of Link Real Estate Investment Trust and Nan Fung Development Limited

earlier than the conventional 2D CAD design approach, in which 3-dimensional relationships among different building elements and services are normally difficult to visualize, and clashes would only come to light on site when the structure is already in place – a major cause of abortive works. The construction of the BIM model required the consultants to agree among themselves on planning strategies, such as zoning and levels of building services in the ceiling voids, and establish design decisions when the BIM model is first constructed in the CAD system.

The use of laser scanning to verify as-built conditions in tandem with the BIM model during construction has enabled the contractors to verify the site works are well within the design tolerances prior to the start of the works downstream.

Though there have been no formal studies on the effectiveness of using BIM to reduce Change Orders, RFIs and Abortive Works (all indicators of how well coordinated the set of design documents are), our experience of

low numbers in the above metrics, and much below our projects' average benchmarks, are positive signs of the value of BIM to the project of this scale and complexity.

Looking Ahead for BIM Application in Future Projects and Facilities Management

In looking ahead for the future of BIM application in our projects, NFD is pushing to implement BIM use from 3D to 5D & 6D, i.e. for cost management and facilities management respectively. To achieve that end, we have recently established our own in-house BIM Team to manage the effective use of BIM in our current projects by setting up our own BIM standards and manual.

BIM 5D cost management is being implemented in our new projects. Quantity take-offs from the BIM model will be used to verify the Bill of Materials (BOM) generated from the conventional method for future claims and VO assessments. To dovetail the use of BIM in cost control, the design consultants were requested to adopt an internationally recognized specification format such that the same material classification could be used to code the corresponding building elements in the BIM model to ensure a systematic measurement of the building materials and hence accuracy of the cost estimates. NFD is contemplating to harvest the cost data from the various BIM models of our development projects for analysis and forecasting costs for our future developments more efficiently and accurately.

Regarding BIM 6D for facilities management, as part of the main contract requirements for Quayside, information of machinery and equipment from sub-contractors will be embedded in the final as-built BIM models and exported to a facilities management software from the web-based CDE environment to help the future O&M team for works planning.



Visualization of The Quayside from Hoi Bun Road
Image courtesy of Link Real Estate Investment Trust and Nan Fung Development Limited

About Link Real Estate Investment Trust

Link Real Estate Investment Trust is the first REIT listed on Hong Kong Stock Exchange and is a constituent of the Hang Seng Index. We are Asia's largest REIT and also one of the world's largest retail focused REITs in terms of market capitalisation. With a diversified portfolio that consists of retail facilities, car parks and offices across Hong Kong, Beijing, Shanghai and Guangzhou, we aim to deliver sustainable growth and create long-term value for our Unitholders.

About Nan Fung Development Limited

Founded in 1954, Nan Fung Development Limited is a subsidiary of Nan Fung Group, one of the largest privately-held conglomerates in Hong Kong with global interests in real estate development and investment and holds a well-diversified, substantial financial investment portfolio. The Group has a track record spanning over 50 years with over 165 projects including residential, commercial and industrial buildings. The Group's vertically integrated team enables significant synergies across development to property management.

In recent years, the Group expanded its investment focus on ICE (Innovation, Creativity and Entrepreneurship), exemplified by its signature project, the Mills, a revitalization of its legacy yarn factories into a hub promoting tech-style and destination for culture and learning. The Group also made significant progress in investments related to life sciences in the US via Pivotal; and in Mainland China via an affiliate, New Frontier, which focuses on healthcare, elderly care, education and new technology.