

Projects 152:

Construction of Home Ownership Scheme projects at Hin Tin Street, Sha Tin Area 31 and Wang Yip Street West, Yuen Long, Hong Kong

Project 3

Construction of Public Rental Housing Development at Tung Tau Cottage Area East, Kowloon City, Hong Kong

Type:

Public Housing

Scheduled Time of Completion:

Project 1: Early 2018

Project 2: End of 2016

Project 3: Mid of 2014

BIM Benefits Soar from Underground to Tower Cranes

“Before BIM, we sorted out a lot of clashing of elements on site. BIM has helped us much by minimising abortive works.”

Frankie Fung Chi-fai,
Architect
Housing Department



Site Sub-soil BIM Model

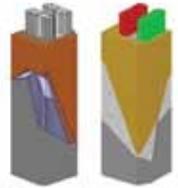


Image courtesy of Hong Kong Housing Authority

Hong Kong Housing Authority continues to expand its use of BIM, overseen by a BIM Project Steering Committee. BIM models are helping to fast track the Home Ownership Scheme projects such as Wang Yip Street West, Yuen Long and Hin Tin Street, Sha Tin. BIM has also enhanced the site works in the Public Rental Housing development in Tung Tau Cottage Area East. The applications of BIM technology are spanned subsurface geology, value management, and deploying tower cranes.

BIM Partners Involved:

- isBIM Limited
- Able Engineering Company Limited
- Majestic Engineering Co Ltd
- Pyrofoe Engineers Limited
- Hitachi Elevator Engineering Company (Hong Kong) Limited
- The Hong Kong Polytechnic University

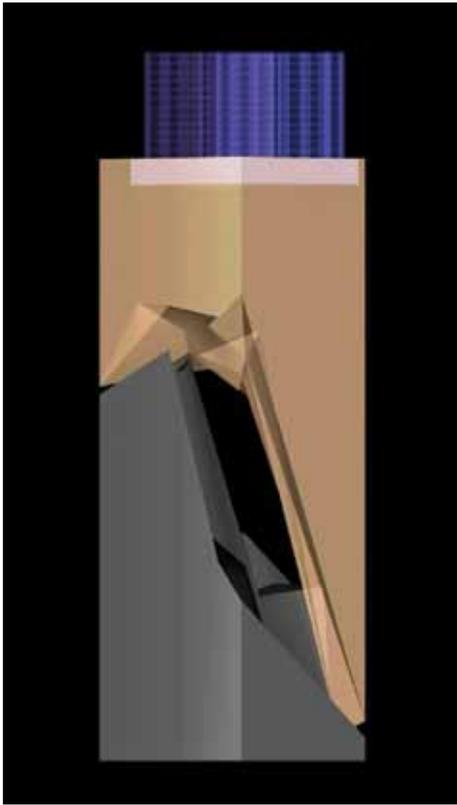


Image courtesy of Hong Kong Housing Authority

Visualisation of Complex Geological Condition

“Our site at Wang Yip Street West, in Yuen Long, was underlain by impure marble with cavity infill,” says Ir Clement KM Fung, Structural Engineer, Housing Department. “It’s in the Scheduled Area No. 2 as defined according to the Buildings Ordinance, for which we have to fulfil the requirement on the stress limit on the marble cavities.”

The project team conducted ground investigations, sinking totally 43 numbers of boreholes, of which some even extended down to 200m below existing ground. On basis of the information, 2D geological drawings (plans and sections), showing the alluvium and marble

bedrock, together with the overlying marble with cavity infill, were prepared.

Relatively shallower marble bedrock platform was revealed mainly in the west corner of the site. Based on the 2D drawings, the project team originally proposed to build a 35-storey building, with large diameter bored piles founding on the marble bedrock. Another lower block was also proposed in the same site, which was to be supported by shallower foundation that would have the overall stress within the stipulated limit of the marble with cavity infill stratum.

As more borehole data was obtained, and with the BIM techniques, the team set up a 3D BIM model with a view to visualizing the complex subsurface geological settings. In addition, a 3D printed model was produced, with different colours representing marble bedrock, marble with cavity infill and alluvium – which could physically be disassembled like pieces of jigsaw to allow clearer apprehension of the rock strata. With the printed model, layers of steeply inclined bedrock overlaid by marble with cavity infill across the site were clearly visualized. “We found that such geology would render installation of end-bearing piles extremely costly and difficult, if not impossible,” says Ir Fung. “We realised it was prudent to explore other foundation options to avoid such construction risk, and, in collaboration with the project Architect, we tried to massage the building layout to keep the extra stress on the marble cavity within the allowable limit, while maximizing the development potential.”

The 3D models, in particular, the BIM video, had persuaded both the Architect and the Management of the need to substantially revise the design. Now, the Housing Authority is going to build two medium-rise domestic wings supported on shallow raft foundation on the eastern part of the site, away from the areas

affected by marble with cavity infill stratum.

Apart from the above, the BIM model has also been proved to be useful in other ways - a 4D BIM simulation – including time – has facilitated the project team in construction planning, in particular for works with deep excavation, in a more efficient manner than the traditional way.

“I think the time spending on preparation of the 3D model is comparable to that for the 2D drawings, but the result so derived is much more significant and advantageous,” says Ir Fung.

BIM as a Value Management Tool

A project for the construction of the Home Ownership Scheme Development at Hin Tin Street in Sha Tin faces great site challenges, including a very congested, long and narrow site adjoined with an extensive slope and sensitive residential developments, plus a hospital nearby.

“It’s a small but very delicate project, with very difficult geotechnical issues and site constraints,” said Alexander Yau Siu-fai, Senior Architect, Housing Department. “There will be around 240 flats, and we need the best value solution to optimise quality, construction time and lifetime costs, disregarding all the site constraints.”

“The project includes a large scale bore pile wall that will be more than 100 metres long surrounding the peripheral of the site. It was difficult to incorporate the wall into the narrow site as this would impose a major constraint to the disposition and configuration of the domestic block. To find the best solution, we used BIM models to verify the 2 options. First option is a wall of 2m bore piles, and the second option is a combination of 1m and 2m piles. BIM model is used to test the buildability, cost and construction time of these 2 options,”

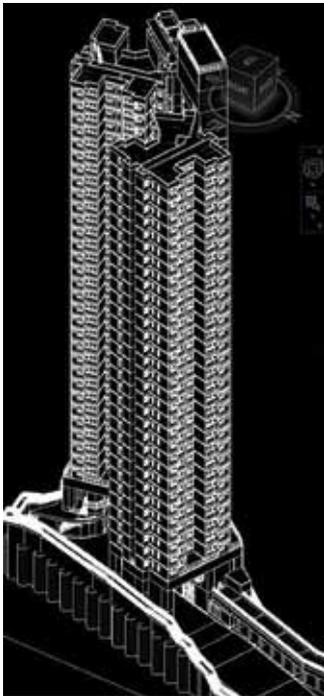


Image courtesy of Hong Kong Housing Authority



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be more costly. Again, BIM was employed for comparison - proving to be especially useful for assessing quantities of concrete and steel, which would take lots of efforts to estimate just by using 2D drawings. Quantitative analysis for the 2 options can be easily worked out through the BIM models. The team finally adopted the transfer plate system for more efficient construction and shorter construction time.

Another study on the use of BIM was the decision of flat numbers in each typical floor layouts – 6 or 8 flats per floor. “These options would have implications including cost, time

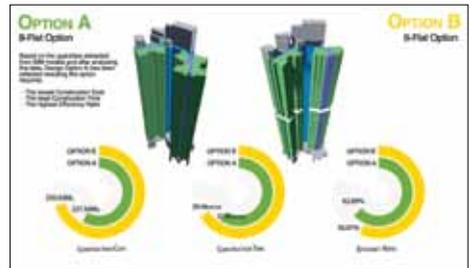


Image courtesy of Hong Kong Housing Authority

said Mr Yau. The comparison led to the team choosing the option with 2m bore piles, as this would take less time and cost to construct while the domestic block can still be accommodated within the remaining area of the site.

Choices, Choices

The domestic block of Hin Tin Street project includes a transfer structure at the first floor level above the driveway. The space underneath the transfer structure provides the manoeuvring space required for the fire appliance under the domestic block. “We have considered two options for this transfer structure,” said Mr Yau. “One with a transfer plate, and the other with transfer deep beams.”

Though the transfer plate would be simpler to construct, it would require more materials and

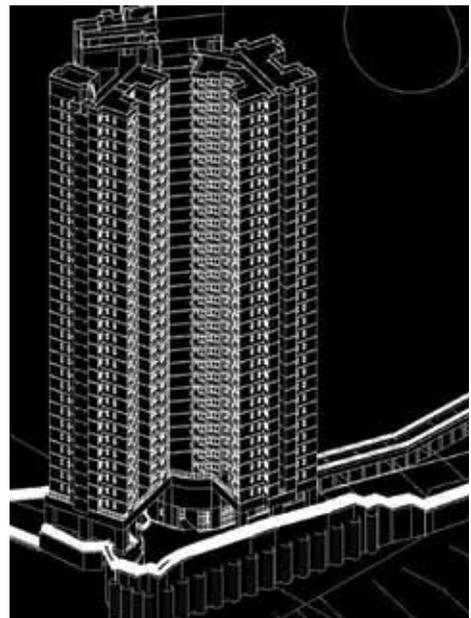


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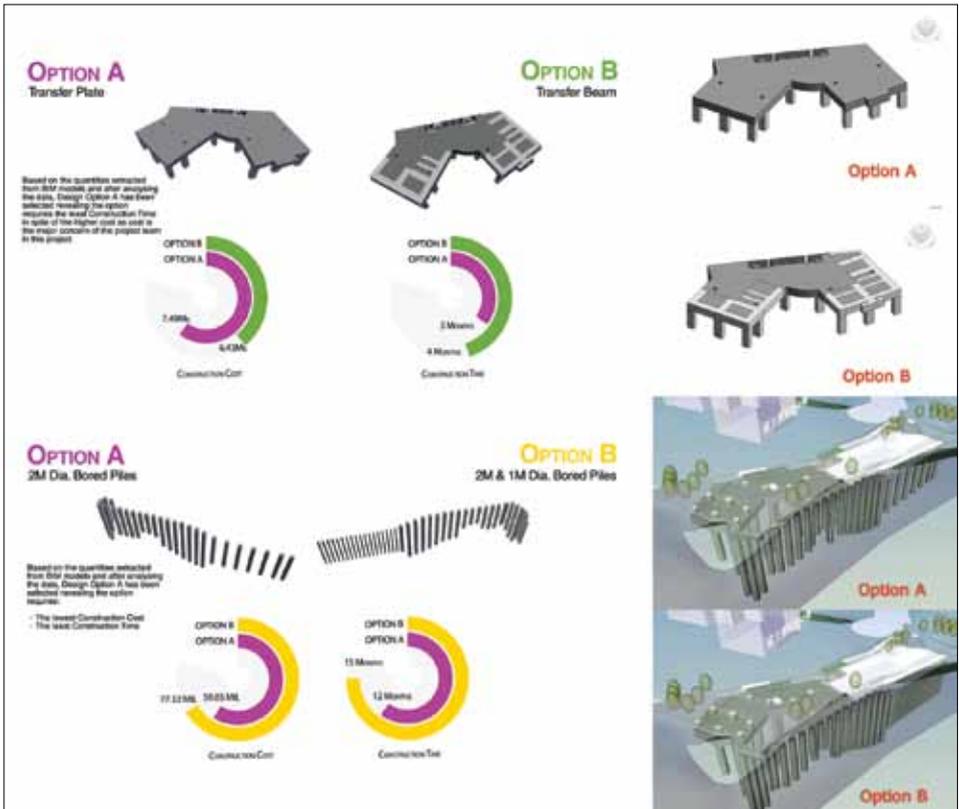


Image courtesy of Hong Kong Housing Authority

and the overall efficiency. We have also taken the building height and visual impact on the surrounding development into consideration,” said Mr Yau. Again, BIM was used as a decision analysis tool to facilitate comparison of all these factors. The design team has chosen 8 flats per floor to keep the low block less visual impact to the neighbourhood. Other benefits include shorter construction time, less cost and higher efficiency ratio.

As the project progresses, the project team aims to use 5D BIM – with spatial dimensions plus time and cost. The Housing Authority has previously used 5D BIM in the construction stage of another project. We now have advanced it to the feasibility/design stage.

Integrated Design

BIM is also being employed in another Public Rental Housing development at Tung Tau Cottage Area East in Kowloon City by the main contractor, Able Engineering Company Limited. Though there will be only one domestic block with 32 domestic storeys, the building takes a large footprint with a maximum of 33 flats per typical floor.

“It sits on a hillside, so detailed site planning is required,” explained Mr Frankie Fung Chi-fai, Architect, Housing Department. “There are 3 wings, each located on a different platform, and with three emergency vehicle access roads.” The scope of the main contract includes site formation work with retaining walls.



Image courtesy of Hong Kong Housing Authority

The drainage there with slopes is relatively complicated. Given the size, constraints and topography, it is very important to plan the sequence of work ahead carefully.

A BIM model has been employed in simulating different construction scenarios, to identify the best construction sequence. “Using only 2D drawings, it would be difficult for the contractor

to understand this sequence,” says Dr Neo KY Chan, the project’s BIM manager.

The BIM model also helps determining how best to deploy and use the 2-tower cranes in order to avoid clashing during operation.

As there are many “concealed” services in the building, Mr Fung wants to use the BIM model

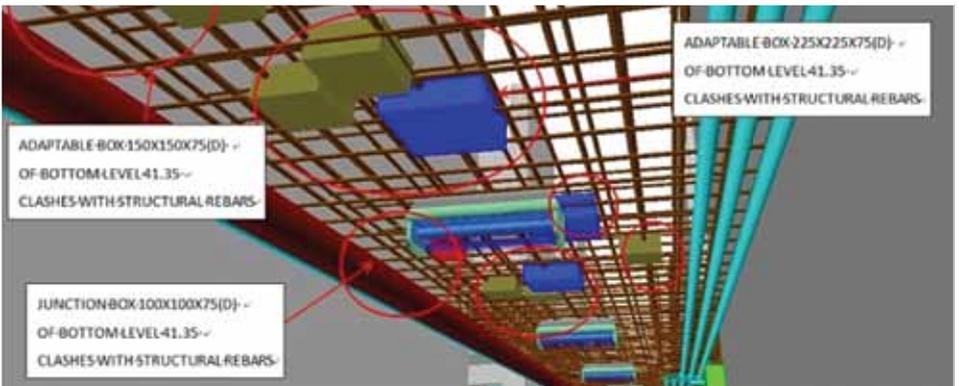


Image courtesy of Hong Kong Housing Authority



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to coordinate them. "With 33 flats per floor, comparing to other 18-20 flats per floor domestic blocks, we have many more services running along the corridor with which its width is about the same," he said. "Before BIM, we often sorted out the coordination between such as, junction boxes and steel reinforcement bars on site. BIM has helped us a lot by minimising abortive works and clashing of elements on site."

The model also includes the external areas around the building, helping to check for clashes with manholes, drainage and other services, as well as enabling Mr Fung to optimise aesthetics.

Way Forward

As BIM technology is more mature and practical to use in housing projects, Hong Kong Housing Authority has confidence to move ahead for adopting BIM to all our new development projects by 2014/15. It views that the architectural, construction and engineering (AEC) industry need to carry out a more thorough exploration of the potential applications of BIM with the aim to build a better living environment to our citizens.

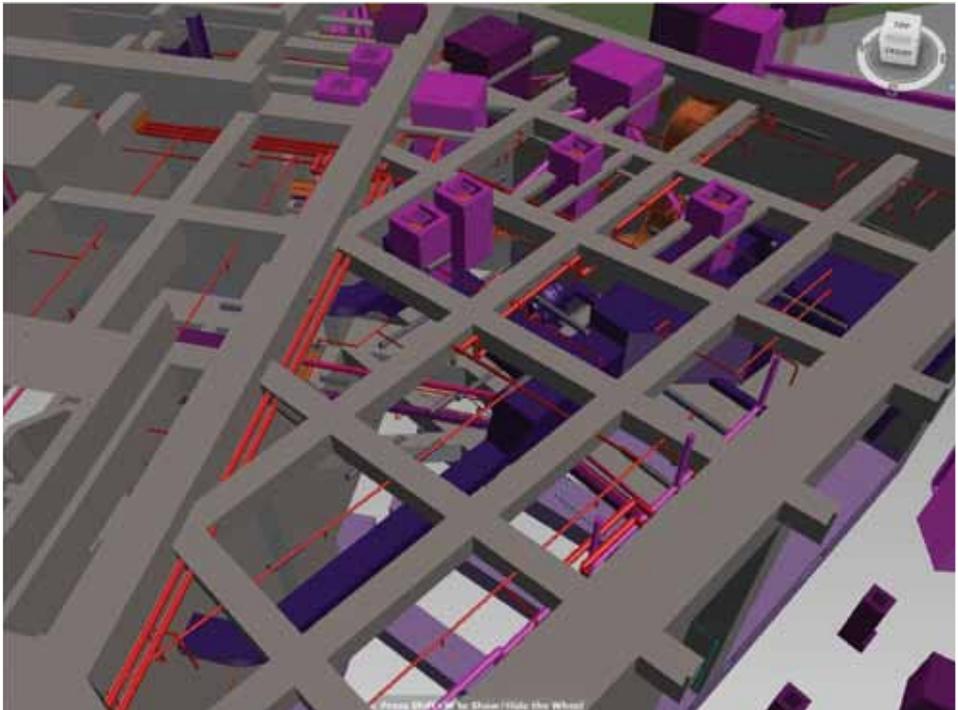
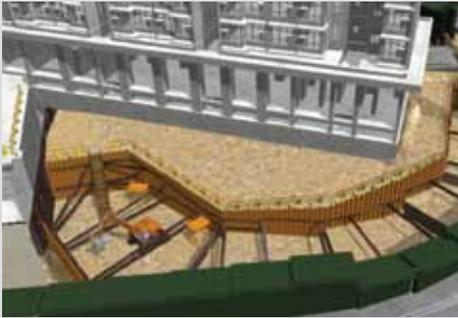


Image courtesy of Hong Kong Housing Authority



About Hong Kong Housing Authority

The Hong Kong Housing Authority (HA) is a statutory body established to develop and implement Hong Kong's public housing programme. Its mandate is to help low-income families in need gain access to affordable housing. Approximately 30% of the Hong Kong population is now living in public rental housing units.

The HA plans, builds, manages and maintains different types of public housing, including rental housing estates, interim housing estates, and transit centres. In addition, the HA owns and operates some flattened factories and ancillary commercial and other non-domestic facilities. Also, with the resumption of Home Ownership Scheme, HA builds 17,000 new HOS flats for four years from 2016/17 to 2019/20 and thereafter 5,000 new HOS flats a year.

The Housing Department acts as the executive arm of the HA to help the Government achieve its policy objective on public housing.