

COMPANY

Drainage Services Department,
HKSAR Government
Summit Technology (Hong Kong) Limited

PROJECT

Advance Works for Shek Wu Hui Sewage
Treatment Works – Further Expansion Phase 1A
and Sewerage Works at Ping Che Road

LOCATION

Shek Wu Hui, Hong Kong

TYPE

Sewage Treatment Works

SCHEDULED TIME OF COMPLETION

March 2018

BIM Success in Construction of Sewage Treatment Works Project, with lasting benefits

“From the civil, and the electrical and mechanical teams, we had two sets of drawings and found many clashes – so we wondered: could BIM help?”

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— **Ir Michael Leung**
Engineer, Hong Kong Drainage
Services Department

BIM PARTNERS

The Jardine Engineering Corporation,
Limited

Tsun Yip Waterworks Construction
Company Limited



General view of the sewage treatment works with new and existing facilities
Image courtesy of Drainage Services Department, HKSAR Government and Summit Technology (Hong Kong) Limited

The Shek Wu Hui Sewage Treatment Works, in northern Hong Kong, commenced operation in 1984, and is now nearing its design capacity, leading to plans for an on-site reprovisioning of the aging sewage treatment works. This would involve demolishing two of the ten final sedimentation tanks – which will be replaced by a new Membrane Facilities Building and Membrane Filtration Tanks – together with further upgrading works, including a new Chemical Storage Room and a modified Bioreactor to achieve higher effluent quality.

The upgrading project began in July 2015, the site is now ready for the new Membrane Facilities Building and Membrane Tanks, and the Drainage Services Department aims to have the upgraded system functioning during 2019. “It’s challenging to keep the treatment works functioning while we implement the construction works, which requires flow diversions,” says Michael Leung Ho-kwun, Engineer in the Sewerage Projects Division of Hong Kong’s Drainage Services Department.

Refining Design in 3D and Developing DSD’s BIM Practices

At the beginning of the contract, the team did not plan to utilize BIM, but as work began, and the challenges of fitting equipment within the buildings became apparent; they began exploring how to deploy BIM as a solution. “From the civil, and the electrical and mechanical teams, we had two sets of drawings and found many clashes – so we wondered: could BIM help?” says Ir Leung. Use of BIM was also encouraged by the Hong Kong Government, for helping with project design, construction planning and operation, and this was a perfect opportunity to continue developing BIM implementation in the Drainage Services Department.

This would be one of DSD’s first BIM implementations on sewage treatment works projects. Soon, the benefits were apparent, including working time reduction as the team switched from working with purely 2D drawings to being assisted by 3D BIM models.

“With 3D, the design is more obvious, while with 2D, you require some imagination,” says Tom Lee, Senior BIM Engineer, Summit Technology (HK) Ltd. “BIM can

solve problems, such as with stairs, beams, building shapes - which may not be apparent in drawings, but become glaring with BIM. Also, you can walk through the model and come to a better understanding on how the project is supposed to function when completed.”

While the initial meetings followed the traditional approach of using 2D drawings, latter coordination meetings expanded on the use of 3D walkthrough and proved far more fruitful by revealing issues such as the equipment access path not being wide enough. “We had our civil engineers, along with electrical and mechanical engineers, and both contractors, looking at models in which they could easily identify and resolve these issues, with the models redrawn in a short time to reflect the resolutions.” says Ir Leung.

Design coordination is the basic of BIM application; this project was about doing more, about paving the road for future BIM implementation, and fittingly, the DSD staff asked and cooperated with the BIM team to explore further BIM applications, including 4D construction sequence, equipment maintenance procedures and commissioning procedures. Ir Leung has these words to say, “We held coordination meetings with future operators, so they could visualise the facilities – they were so pleased to do this.”



4D method statement to demonstrate construction activities of the Membrane Facilities Building and Membrane Tanks
Image courtesy of Drainage Services Department, HKSAR Government and Summit Technology (Hong Kong) Limited



Screen capture of Dynamo for extracting relevant data from the BIM models
Image courtesy of Drainage Services Department, HKSAR Government and Summit Technology (Hong Kong) Limited



Internal view of the Membrane Facilities Building where the treated water exits from the membrane filters
Image courtesy of Drainage Services Department, HKSAR Government and Summit Technology (Hong Kong) Limited

Helping Staff Prepare for Operation & Maintenance and Commissioning

“We also used 4D BIM [with time as the fourth dimension], to look at installation and maintenance of equipment - ensuring there won't be any obstacles, so maintenance staff can work effectively in the future,” says Mr Lee.

The team produced 4D simulations showing ways to lift and remove equipment from buildings for maintenance, along with details such as nails and screws; for critical parts, they even showed how to unscrew an item, where to lift it and lower it, along with other aspects of operations such as how a railing or beam is supposed to be removed. Simulations focusing on maintenance revealed “soft clashes”, where elements do not clash when stationary, but would clash when moved during regular operation and maintenance.

Ir Leung said that the adoption of BIM technology greatly reduced the working time and enhanced the effectiveness for identification of clashes, the BIM models were efficient and accurate in identifying clashes. From hands-on experience, it was observed that for clash analysis carried out manually, usually only 30% of the clashes were spotted, he commented, and with more clashes identified and resolved at an early stage, it means that there would be less defects and less remedial work, hence resulting in substantial time and cost savings.

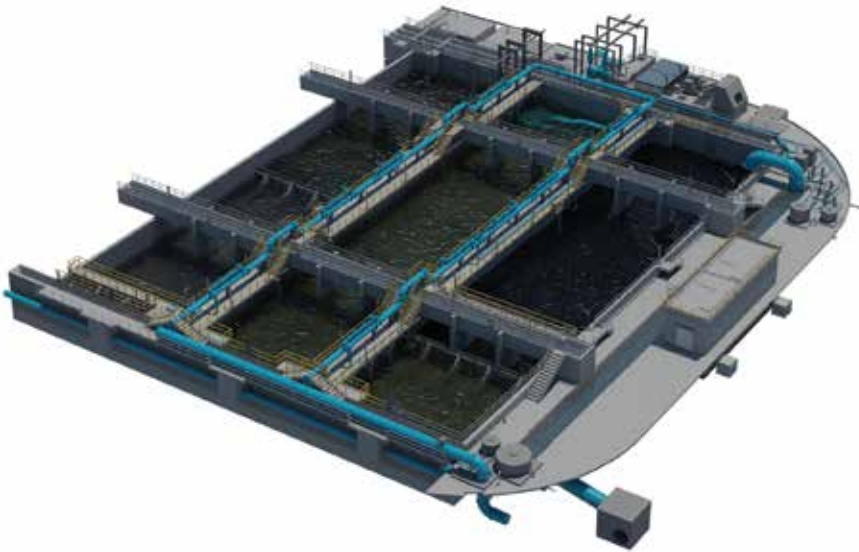
With the BIM models performing well, the team opted to simulate the

commissioning procedures well ahead of schedule. The commissioning procedures are challenging in that any slight error can hamper the plant's capacity and impair sewerage treatment services for the Sheung Shui and Fanling residents. Additionally, the reprovisioning works include one of the first implementation of membrane technology in sewerage treatment in Hong Kong, which further adds to the complexity of the commissioning procedures. This is the part when BIM comes for the rescue. Although the project is still in progress, the BIM models already contained majority of the completed and future works, so engineer from DSD suggested simulating the commissioning procedures. The produced animation can help shorten a process that would otherwise require weeks to prepare for, as well as serving as basis for future public relations and educational purposes.

Training, and much to explore in BIM

Based on its successful application in the project so far, the team believes BIM has been proven as viable for large scale design-build infrastructure project in Hong Kong. The project has given rise to new ideas on BIM application, including knowledge transfer.

From the outset, the project involved on-job training for Drainage Services Department staff, initially using a simple BIM model with no mechanical systems, which evolved to a complete BIM model with asset data by joint effort from the DSD staff and the BIM consultant. The team progressed to different kinds of



Existing Bioreactor No.1 renovated to accommodate the new membrane treatment process
Image courtesy of Drainage Services Department, HKSAR Government and Summit Technology (Hong Kong) Limited

be coming to a close in the near future, DSD is stimulated by the success of BIM in this project and will persist with its expansion in BIM applications, including refining its BIM standards and encouraging wider BIM literacy in the department. Above all else, BIM aligns with the department's commitment of achieving greater success in drainage and sewerage works, and DSD will continue to work internally and externally with the industry to develop BIM applications for drainage and sewerage works.

training for staff at different levels. "For top level management, we especially focused on how to access and criticize BIM models," says Mr Lee. "While we are training technical staff on how to operate and maintain BIM models - the ultimate goal is for them to be able to handle the project model afterwards." Essentially, the trainings were designed to transfer skills and techniques applied during this project to the DSD staff.

The plant will be upgraded day by day, so it will be important for the technical staff to know how to revise the model, and to use it with a new asset management system. The team has applied Dynamo, a visual programming tool for Revit; the visual programming script could be easily written to integrate the information of

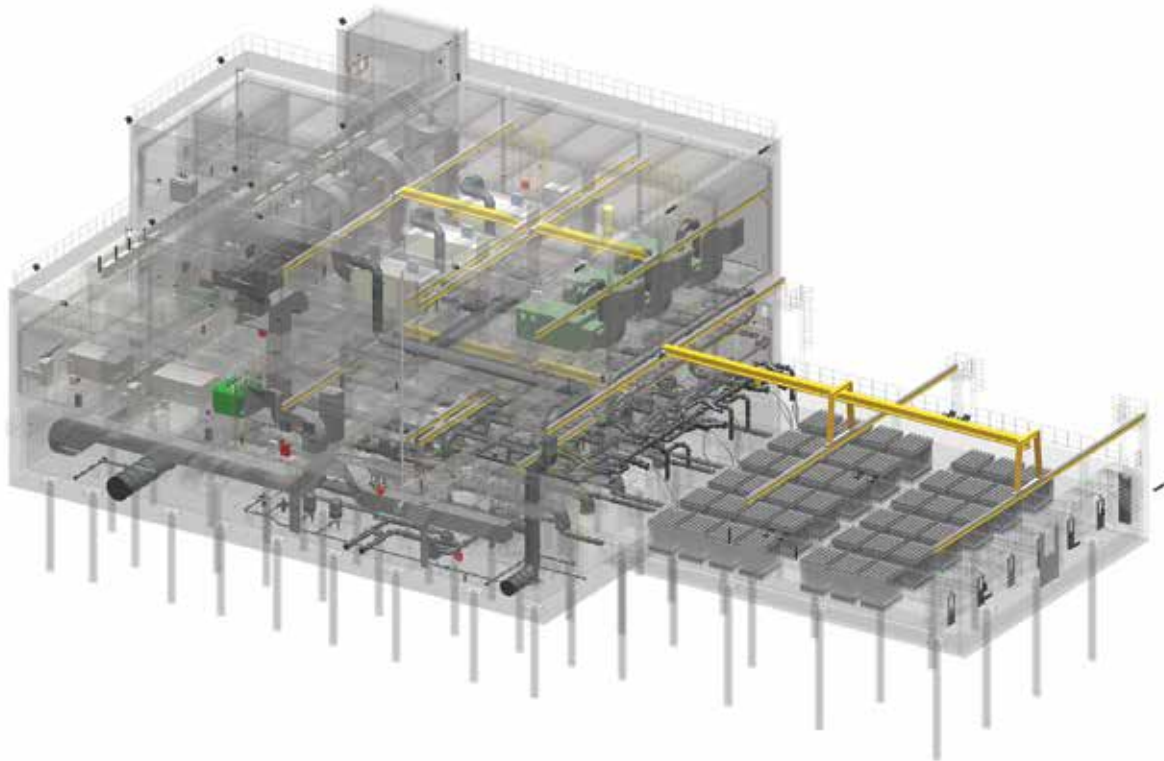
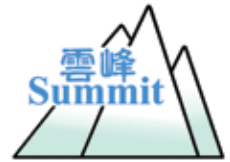
BIM and equipment for future usage in asset and facility management.

The department has found there are many other areas to explore regarding BIM in the future. "One is to establish a delivery standard, and common practice, for building and upgrading more sewerage and drainage facilities," says Ir Leung. "Also, we want to incentivise and promote wider use of BIM in construction and preliminary planning. With asset management, we have many things in the library, and want to integrate that with BIM, so in the future, staff can click in the model and locate relevant information - such as by using virtual reality on a tablet."

While this advance works project may



Internal view of the Membrane Facilities Building with Air Scouring Blower and Aeration Blower for backwash
Image courtesy of Drainage Services Department, HKSAR Government and Summit Technology (Hong Kong) Limited



Transparent view of the Membrane Facilities Building and Membrane Tanks showcasing the latest sewage treatment process in Hong Kong
Image courtesy of Drainage Services Department, HKSAR Government and Summit Technology (Hong Kong) Limited

About Drainage Services Department, HKSAR Government

The Drainage Services Department (DSD) is a department of the Government of the Hong Kong Special Administrative Region and is responsible for drainage and sewerage. DSD was established in September 1989 with a clear vision: to provide world-class wastewater and stormwater drainage services, enabling the sustainable development of Hong Kong. DSD has made good progress in both sewage treatment and flood prevention in five major areas: first, to design and construct green architectural features of the sewage treatment plant, sewage pumping stations, drainage & flood control facilities; second, to operate and maintain sewage-related equipment, use renewable energy, and energy-efficient equipment; third, to clean channels, remove plants impeding the flow of the river and clean up the sludge; fourth, to implement strategic replacement and rehabilitation plans of underground drains, sewers, rising mains, manholes and the like widely spread over the whole territory; and fifth, to implement strategic plans to relocate sewage treatment plants into caverns.

About Summit Technology (Hong Kong) Limited

Summit Technology (Hong Kong) Limited is a Hong Kong-based private limited company dedicated to actively working with the local architectural, engineering and construction industry in providing BIM product and project solution, while also having an internal R&D team to continue supporting the enhancement of the building lifecycle process using BIM as the centric platform. Summit has been aware of BIM's untapped potential as early as 2003. The set philosophy of Summit has always been our commitment on offering BIM Total Solution to our clients from Planning, Design, Construction to Facility Management. Summit strongly believes that BIM will be the next generation of design and management tool in building and construction projects and will enhance the traditional 2D way of information communication. Through BIM, Summit aims to help the local industry achieve better design coordination, more accessible documentations, more comprehensive understanding of projects, smoother transition between project stages, and many more.

Above all else, Summit advocates for a shift to the traditional working culture and embraces BIM culture, which requires changes to the stakeholders, the technology and work process. Summit will continue to work with the public and private sector and promotes this new cultural development.