COMPANY Drainage Services Department, HKSAR Government AECOM Asia Company Limited ATAL-Degremont-China Harbour Joint Venture PROJECT Design, Build and Operate San Wai Sewage Treatment Works – Phase 1 LOCATION Yuen Long, New Territories TYPF

Sewerage and Sewage Treatment SCHEDULED TIME OF COMPLETION 2020 (Construction); 2035 (Operation)

> "Design-Build-and-Operate contract arrangement gives us the opportunity to readily practice Lifecycle BIM for San Wai Sewage Treatment Works, partnering with the Contractor to manage and use the BIM beyond planning and design to operation. We hope to realize the full potential of BIM, not only to provide accurate, timely, and relevant information for design and construction, but also keep the BIM "alive" by continue creating, maintaining and utilizing building information to improve the effectiveness of the facility operations."

—Ir. Lawrence Lee

Chief Engineer/Harbour Area Treatment Scheme, Drainage Services Department, HKSAR Government

BIM PARTNER

Ove Arup & Partners Hong Kong Limited

AUTODESK PRODUCTS USED

AutoCAD MEP Autodesk Civil 3D Autodesk Navisworks Manage Autodesk ReCap[™] Pro Autodesk Revit Applying BIM in different stages of sewage treatment project delivered by Design, Build and Operate Contract



Site View of San Wai Sewage Treatment Works Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and ATAL-Degremont-China Harbour Joint Venture

San Wai Sewage Treatment Works – Phase 1

The key aims of the San Wai Sewage Treatment Works (SWSTW) upgrading project were to replace the existing SWSTW (since 1993), reduce pollution loads to the northwestern waters of Hong Kong while increasing the capacity to manage the population growth in the Northwest New Territories and reduce odour emissions.

The new SWSTW is located adjacent to the existing SWSTW, and adopting the Chemically Enhanced Primary Treatment (CEPT) process with ultraviolet disinfection (UV) facilities in order to meet the tighter effluent discharge standard. A Design-Build-and-Operate (DBO) contract arrangement is used for the project to allow Contractors the flexibility in planning the works schedule in the design and construction stages, and to achieve reasonable construction and operation costs for the SWSTW.

The improvements to the sewage treatment level, from the existing preliminary treatment to CEPT plus UV, have a direct positive impact to the environment. Given the project site is sitting in rural context, abutting cargo depot, away from high density developments and public facilities, the overall design concept of the appearance of the new SWSTW are in line with green concern from the public and matching the rural setting of the context. Meanwhile, SWSTW is one of the DSD selected pilot projects in 2013 for using BIM. With the support from management to promote wider use of BIM, the project team attempted to fulfill the potential and bring the BIM technology to public. SWSTW has been using BIM with VR, AR and animated demonstration for the project communication, which changed the way people experience meetings and consultation sessions.



Simulating Construction Sequence in BIM Model Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and ATAL-Degremont-China Harbour Joint Venture



Using Clash Analysis for planning and laying of the underground utilities and pipeworks Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and ATAL-Degremont-China Harbour Joint Venture

The use of BIM in various stages

At the early design and construction stages, Navisworks Timeliner added a time dimension of BIM to the established model to simulate the whole construction stage. This is very useful as it could foresee construction problems and eliminate them in the planning and design stages. The Project Planning Programme "Primavera P6" file was converted and imported into Navisworks Timeliner for interaction with the model and could simulate construction stage on any specific date. This enabled the project team to have a clearer visualization of the construction processes, identifying conflicts and resolve in advance. It also improved the effectiveness of communication between the concerned parties in particular with the construction sequence and site logistics arrangement.

Different LOD of BIM was developed at different stages of the project for early commencement of construction before fully completion of design. LOD 200 was adopted in the early stage with the key elements of the plant graphically



Point Cloud 3D Scanning Imposing BIM for Site Verification and Measurements Image Courtesy of Drainage Services Department, HKSAR Government and AEEOM Asia Company Limited and ATAL-Degremont-China Harbour Joint Venture



The New Inclined UV Disinfection System Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and ATAL-Degremont-China Harbour Joint Venture

represented as a generic system in a 3D model of conservative approximate in quantity, size, shape, location, loading and orientation. Based on the LOD 200 model, the detailed foundation design was completed, making it possible for the piling works to commence in the early stage. The BIM model was then progressively developed to LOD 300 with part of the model to LOD 400, which incorporated true/exact design data with systems/equipment models provided from the suppliers, and reflected specific interfaces between systems. By then, the civil requirement design could be carried out based on the exact systems/ equipment. With the model being developed at different LOD in different stages of the project, the time and space constraints were progressively overcome.

Helping to solve complex arrangement problems and to implement innovative ideas

Constrained by the limited land available, the new SWSTW has only one internal circular road, unlike other plants which have multiple internal circular roads. As the project is highly complex with numerous equipments and facilities, the sole circular road in the plant become the route for the vast majority of the underground utilities and pipeworks between buildings and facilities including process pipes, odour pipes, foul and storm drain pipes, electrical services, fire services, water services, signals, telecommunication connections, etc. The team had to coordinate with many stakeholders, including government departments, public services providers and internal teams covering different trades. It was by means of the NavisWork's clash analysis that clashes between utilities and pipeworks were

identified and resolved in the early design stage. Also with the aid of BIM, coordination meetings were held effectively as the problems could be clearly visualized and fixed or revised one by one systematically. The avoidance of clashes on site had been very successful and this was instrumental in the timely completion of the construction.

SWSTW Project uses the DBO contract to elicit new and innovative ideas, the Contractors introduced various advance sewage treatment technology to the Project, viz. a new inclined UV disinfection system and a step type fine screen system. BIM helped us to guickly deal with the new proposal with identifying effect of the possible design changes, the future operation and maintenance needs in term of spatial requirement. Moreover, the final completion process was rehearsed before the actual construction and operation, which helped to improve the safety, planning and overall cost effectiveness of the project.

The project team had also explored other ways to use BIM to reduce timeconsuming works. It is believed that the less time spent on construction site is the most effective way to avoid accident. Traditional site checking and surveying works require interfacing with ongoing works for inspection which is difficult and time-consuming, workers also need to be climbing up and down to conduct measurements. It was sometimes not frequent enough that some works needed to be rectified after a period of time when deviations were found during hold point checking. The team initiated an efficient way of monitoring and recording the site work by combining the Point Cloud 3D Laser Scanning and BIM



IoT Smart Safety Helmet Integrated with BIM Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and ATAL-Degremont-China Harbour Joint Venture



BIM Viewer on Computerised Maintenance Management System Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and ATAL-Degremont-China Harbour Joint Venture

model. Point Cloud 3D laser scanning was conducted for buildings, equipment and utility facilities, with highly accurate measurements, and by superimposing on the BIM model could accurately reveal any deviation, conduct measurements, make plan for installation works and adjust the site work/design immediately. This new method had improved the performance of works in many ways over the traditional methods.

To further enhance safety, the project team had integrated smart safety helmets with IoT technology with BIM to improve the safety management on site. Not only the helmets could detect sudden fall or unusual body temperature and heart rate of workers, the feedback from helmets would also present the location of the workers on the BIM model, which could be used with alarming system to avoid unauthorized entry to those dangerous and restricted areas.

Keep the BIM "alive"

Approaching the completion of the project and getting ready for the LOD 500 model, the team had also planned for the use of BIM for asset management. Integrating BIM with Asset Management platform had been proposed since the early stage of the project, the new Computerised Maintenance Management System (CMMS) - BIM for the project features a fully integrated BIM viewer to assist the plant operation. It would allow the operation team to view the model objects and technical details in the BIM, the ongoing and planned works orders, spare parts and maintenance history. The CMMS-BIM would also integrate with the Supervisory Control And Data Acquisition (SCADA) and the Smart Optimisation Systems to form a comprehensive operation control and management system to facilitate a safe and smooth operation of SWSTW. All these combination use of BIM would see

the model applicable during the whole life cycle of the project.

While the SWSTW project works has been benefiting from BIM on its design and construction stages, the team is looking forward to gain further benefit and success from the BIM applications during the operation stage. DSD is stimulated by the success of BIM in this project and will continue to work internally and externally with the industry to develop BIM applications for drainage and sewerage works.









Step Type of Fine Screen and Grit Removal System Layout Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and ATAL-Degremont-China Harbour Joint Venture

About Drainage Services Department, HKSAR Government

Established in 1989 to provide world-class wastewater and stormwater drainage services enabling the sustainable development of Hong Kong, Drainage Services Department (DSD) has strived to upgrade sewage treatment and flood protection levels in Hong Kong, and committed to introduce new technologies for projects implementation and operation of facilities. DSD will continue to promote BIM technology, with resources being deployed on development, so as to upgrade the accuracy of project design and shorten works period.

About AECOM Asia Company Limited

AECOM is the world's premier infrastructure consulting firm, delivering professional services throughout the project lifecycle – from planning, design and engineering to program and construction management. AECOM, partnering with clients to solve their most complex challenges and build legacies for generations to come.

About Atal-Degremont-China Harbour Joint Venture

Formed by ATAL Engineering Limited, Suez International (formerly known as Degremont) and China Harbour Engineering Company Limited. The team aims to provide a higher quality results by adopting BIM technology throughout the project cycle from design to construction and up to end of operation.