

COMPANY

Drainage Services Department,
HKSAR Government
AECOM Asia Company Limited
China State Construction Engineering
(Hong Kong) Limited
MTECH Engineering Company Limited

PROJECT

Relocation of Sha Tin Sewage Treatment Works to Caverns - Site Preparation and Access Tunnel Construction

LOCATION

Nui Po Shan/A Kuk Kok Street/Mui Tsz Lam Road,
Sha Tin, New Territories, Hong Kong

TYPE

Civil/Geotechnical/Structural/Infrastructure

SCHEDULED TIME OF COMPLETION

16 March 2022

Revolutionary Construction Breakthrough with BIM and Innovative Technology

“Drainage Services Department (DSD) has been encouraging the use of innovation and technology tools, including Building Information Modelling (BIM) technology to enhance works productivity, quality of construction and site safety. For the DSD’s project “Relocation of Sha Tin Sewage Treatment Works to Caverns”, we employed BIM technology extensively in the planning, design and implementation of works with promising results. Our BIM vision extends beyond the current applications and efforts are being made to integrate our Digital Works Supervision System (DWSS) with BIM with a view to enhancing our site supervision and contract management.”

– Mr. LEUNG Ka Chung, Tony

Chief Engineer/Cavern Projects,
Drainage Services Department,
HKSAR Government

BIM PARTNERS

Forida Limited
E Tag Solution & Services Limited
Innovative Associate Technology Limited

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®
Autodesk® Architecture, Engineering &
Construction Collection
Autodesk® BIM 360® Docs
Autodesk® Civil 3D®
Autodesk® Dynamo Studio
Autodesk® Forge®
Autodesk® InfraWorks®
Autodesk® Navisworks® Manage
Autodesk® Revit®
Autodesk® ReCap® Photo
Autodesk® ReCap® Pro
Autodesk® Rendering
Autodesk® Robot™ Structural Analysis
Professional



Relocation of Sha Tin Sewage Treatment Works to Caverns (Stage 1 Works) Overview
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited

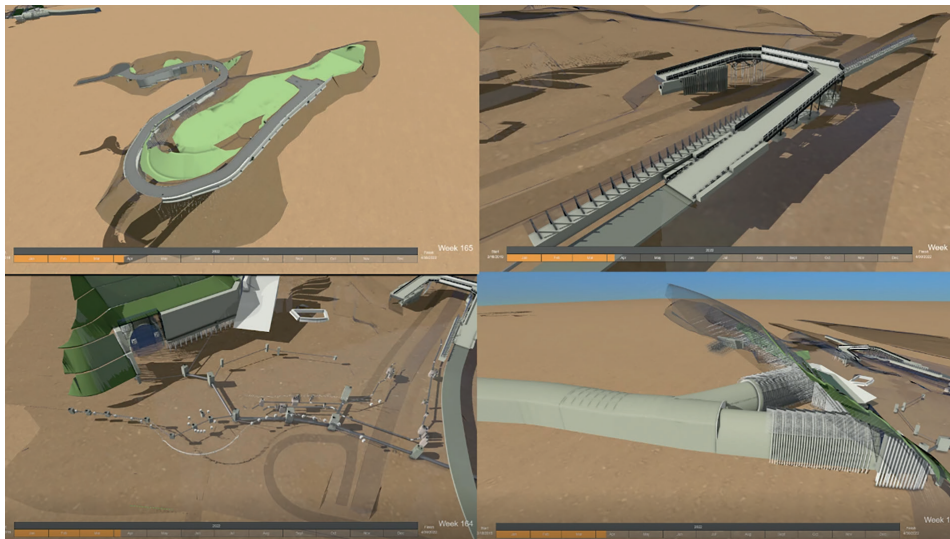
Project Information

Relocation of Sha Tin Sewage Treatment Works (STSTW) to Caverns is a pioneering project owned by the Drainage Services Department of the HKSAR Government to initiate the local cavern development for more sustainable land use. While aiming to mitigate the long-lasting shortage of residential land, the project will also

upgrade the ageing treatment facility to be more energy-efficient. Bearing the role of a pioneer, the project team wishes to influence the construction industry through piloting various cost-effective solutions to modernise the traditional workflow. To achieve this goal, the extensive adoption of Building Information Modelling (BIM) plays a vital role.



Computer Simulated Model of the Community Liaison Centre against the Reality
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited



4D BIM (Phase Planning)
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited

BIM Vision

The project team identifies the benefits of BIM adoption and aims to apply BIM throughout the entire project lifecycle. With reference to the ISO 19650 standard, the project team has developed a comprehensive BIM Execution Plan and implemented a structured BIM workflow since the beginning stage of the project. Thanks to the collaboration between multi-disciplinary project stakeholders, a lot of innovative and practical solutions have been created as a result to further enhance the project delivery.

BIM Application – Design Phase

Construction of retaining walls using the Design for Manufacture and Assembly (DfMA) methodology was traditionally considered impractical due to on-site connection issues between pre-fabricated panels. The team leveraged BIM and solved the critical issue. During the design stage, the team used Autodesk Revit and Robot Structural Analysis Professional to accurately align and design every connection between panels. After the off-site fabrication, the team would conduct thorough 3D scanning to obtain point cloud data of every joint to ensure a smooth connection subsequently. Besides, the design team could also utilize the rendered model for architectural design purposes. The team also made use of the developed BIM objects to achieve 4D BIM (Phase Planning) and 5D BIM (Cost). 4D BIM permitted the team to visualize the construction sequence and further enhanced communication between multi-disciplinary parties in the planning stage while 5D BIM enabled the team to have more accurate budget management and cash flow forecast.

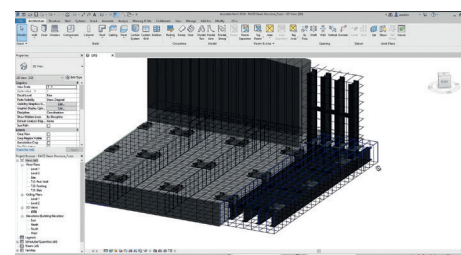
BIM Application – Construction Phase

In addition to the design phase, BIM also played an important role in the construction phase. Rock bolts were required for tunnel stabilization work due to the large tunnel span. As a result, the Drill-to-BIM approach which was an automatic rock bolt modelling approach during rock bolt construction was developed by the project team. It allowed construction activities and asset information modelling (AIM) to occur simultaneously. The fully automated AIM also allowed the clashes between the rock bolts to be detected automatically and instantaneously. It was particularly useful in the congested zone and helped the team to avoid reworks. Moreover, BIM validated construction methods through simulations. The construction team was, therefore, able to identify relevant site constraints and reduce risks for individual construction activity accordingly. For example, the simulation was particularly useful for the construction team to determine and lifting method and the position of the mobile crane. Besides a pre-assembly in the virtual environment, trial assembly in the reality was also performed with

the 3D printed prototypes of modules. Virtual construction method statements developed using BIM elements also demonstrated the installation process to site personnel to further deepen and strengthen their understanding of the construction methods, resulting in further improvement in safety performance.

BIM Application – Operational Phase

The application of BIM stimulated information exchange among different stakeholders during the operational phase. Autodesk BIM 360 served as the project's Common Data Environment (CDE) to ensure effective information management. The operation and maintenance team could retrieve the required asset information models from the CDE on their pursuits. With suitable Internet of Things (IoT) installed, real-time monitoring was also possible. A temporary vehicular steel bridge was built across A Kung Kok Street for site traffic to mitigate traffic impact on Ma



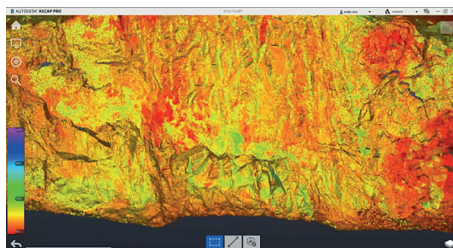
BIM Model of DfMA Retaining Wall Members
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited



Photogrammetric Model of Portion 11 Generated from Point Cloud Data
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited



Drill Holes Verification from Trimble XR10 with HoloLens 2
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited

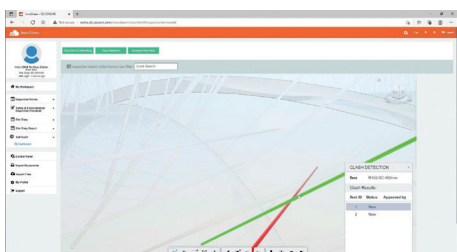


Geological Mapping using 3D Scanning Image
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited

collaboration between parties. An IoT platform assisted the project team to enhance facility management by installing sensors on different completed structures, for example, the temporary vehicular steel bridge and the site office. All these applications helped the project team to deliver the project in an efficient and much safer way.

Project Achievements

BIM is of paramount importance to our project delivery. Proven by widely recognized awards, BIM with other innovative technologies has proven to have brought tremendous benefits to the Phase 1 Works of the entire relocation project, from excellent safety and environmental performance to overall project administration and project delivery. The project team will continuously thrive in the construction industry to apply BIM throughout the whole project lifecycle.

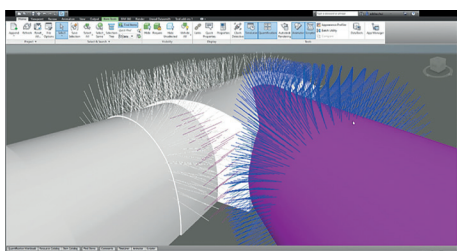


Automatic Clash Detection between Rock Bolts
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited

process. The function also avoided unwanted information loss. Construction team members could access the Common Data Environment to obtain the latest information. This well-established DWSS undoubtedly enhanced the communication and quality management process.

BIM with Innovative Technology

Besides the enhancement of the DWSS, the project team also created many cost-effective solutions by incorporating BIM with other innovative technologies. The self-developed robotic system enabled accurate point cloud data of each rock face after blasting to be obtained from 3D scanning. The point cloud data was then inputted to Autodesk Recap Pro for generating a 3D model for geological mapping and record. Trimble XR 10 with HoloLens 2 provided support in blast design inspection, safety training, and

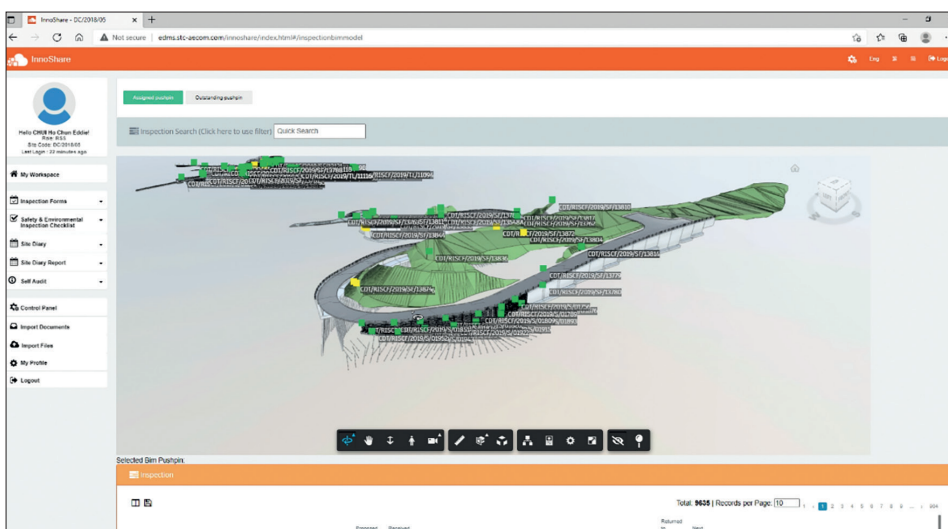


Automatically Generated BIM Model of Rock Bolts
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited

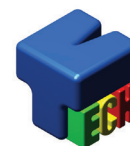
On Shan residence. Strain gauges were installed onto the main girders to monitor and record deflections in real-time to ensure the design assumptions of the bridge were fulfilled anytime.

Digital Works Supervision System (DWSS) with BIM Compatibility

A project-based DWSS used for the submission and acceptance of the Request for Inspection/Survey Check (RISC) Form as well as Safety and Environmental Inspection Checklist was developed in-house using Autodesk BIM 360 and Forge. The BIM push-pin function was tailor-made, aiming to link BIM elements to the corresponding RISC forms and quality documentation, to streamline the inspection and auditing



Digital Works Supervision System with BIM Compatibility
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited



Site Photo of Relocation of Sha Tin Sewage Treatment Works to Caverns (Stage 1 Works)

Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited

About Drainage Services Department, HKSAR Government

Drainage Services Department's (DSD's) vision is to provide world-class wastewater and stormwater drainage services enabling the sustainable development of Hong Kong. Since the establishment in September 1989, DSD has strived to upgrade sewage treatment and flood protection levels in Hong Kong, and has acquired noticeable achievement. The completion of three drainage tunnels in Tsuen Wan, Lai Chi Kok and Hong Kong West, Happy Valley Underground Stormwater Storage Scheme, Regulation of Shenzhen River Stage IV and the Kai Tak River Improvement Works are examples of our encouraging achievements in recent years. With the Harbour Area Treatment Scheme Stage 2A fully commissioned in 2015, the water quality of Victoria Harbour was significantly improved. In future, DSD will continue to implement various large-scale projects to uplift the levels of flood protection and sewage treatment services.

About AECOM Asia Company Limited

AECOM is the world's trusted infrastructure consulting firm, delivering professional services throughout the project lifecycle – from planning, design and engineering to program and construction management. On projects spanning transportation, buildings, water, new energy and the environment, our public- and private-sector clients trust us to solve their most complex challenges. Our teams are driven by a common purpose to deliver a better world through our unrivaled technical expertise and innovation, a culture of equity, diversity and inclusion, and a commitment to environmental, social and governance priorities. AECOM is a Fortune 500 firm and its Professional Services business had revenue of \$13.2 billion in fiscal year 2020. See how we are delivering sustainable legacies for generations to come at aecom.com and [@AECOM](https://www.instagram.com/aecom).

About China State Construction Engineering (Hong Kong) Limited

China State Construction Engineering (Hong Kong) Limited (CSHK) started its construction business in Hong Kong in 1979. The Company engages in building construction and civil engineering works. CSHK is among the largest construction contractors in Hong Kong, and is approved by the Works Bureau, to be on the List of Approved Contractors (Group C) for Public Works in the five major categories of building and civil engineering works, namely, "Buildings", "Port Works", "Roads and Drainage", "Site Formation" and "Waterworks".

About MTECH Engineering Company Limited

Established in 1995, MTECH Engineering Co., Ltd. is an information technology orientated company to provide and apply BIM Consulting Services to Hong Kong and China building construction industry for productivity and quality improvement. BIM and Integrated Project Delivery solutions support the lifecycle of construction projects, from design and engineering to fabrication and facilities management. With our unique experience in manufacturing, our solutions bring the best available digital technologies to distributed project teams collaborating on complex building and infrastructure projects.