

COMPANY
 Drainage Services Department, the Government of the Hong Kong Special Administrative Region
 AECOM Asia Company Limited
 China State Construction Engineering (Hong Kong) Limited – Alchmex International Construction Limited Joint Venture

PROJECT
 Relocation of Sha Tin Sewage Treatment Works to Caverns

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
 2031

Revolutionary Construction Breakthrough with AI-Integrated Generative BIM and Contractual BIM



“Drainage Services Department (DSD) has been actively pursuing construction digitalization through adoption of innovative tools, including BIM technology, to enhance productivity and quality. In the project “Relocation of Sha Tin Sewage Treatment Works to Caverns”, we employed BIM technology throughout the project lifecycle with promising results.

Our BIM vision is to advance construction digitalization and promote enhanced design, construction and asset management. The integration of the two cutting-edge technologies, AI-Integrated Generative BIM, streamlines project collaboration for greater precision and productivity.”

–LEUNG Ka Chung, Tony
 Chief Engineer/Cavern Projects,
 Drainage Services Department,
 the Government of the Hong Kong Special Administrative Region

AUTODESK PRODUCTS USED
Autodesk® BIM 360® Docs
Autodesk® Civil 3D®
Autodesk Construction Cloud®
Autodesk® Docs
Autodesk® Dynamo for Revit
Autodesk® Dynamo Studio
Autodesk® Forma
Autodesk® Navisworks® Manage
Autodesk® Revit®



Caverns Location
 Image Courtesy of Drainage Services Department, the Government of the Hong Kong Special Administrative Region and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited – Alchmex International Construction Limited Joint Venture

BIM development of the company

Relocation of Sha Tin Sewage Treatment Works (STSTW) to Caverns is a pioneering project owned by the Drainage Services Department of the Government of the Hong Kong Special Administrative Region 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. The project team aims to influence the construction industry by piloting cost-effective solutions to modernize traditional workflows. To achieve this goal, extensive adoption of Building Information Modeling (BIM) is vital.

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 enhance the project delivery.

BIM Application – Design Phase Generative BIM for Site Office Planning

The generative design process presented challenges: Traditional site planning in projects manual iterations for environmental constraints like sunlight and noise, often

leading to suboptimal layouts and extended feasibility studies. Autodesk Forma effectively addressed these challenges. Autodesk Forma enhanced this process by enabling the rapid analysis of site conditions, environmental impacts, and land constraints in order to generate optimal design configurations. The team generated a layout with real-time analysis in Autodesk Forma. The team also defined multiple-level goals and constraints to explore and optimize alternatives. The team used Autodesk Forma to integrate with existing conditions and generate rendered models for multidisciplinary reviews.

A generative BIM workflow using Revit Generative Design was created for the rapid exploration and optimization of site office floor plan designs. The AI-powered automation function was tailor-made to link high-level constraints and goals to corresponding layout alternatives and real-time analyses, streamlining the conceptual and feasibility study process. This function also prevented suboptimal configurations. Team members could access the cloud-based platform to obtain the latest iterations. This well-established generative BIM workflow enhanced collaboration and the decision-making process.

BIM Application – Construction Phase

Automated Parameter Input for Asset Compliance Using Dynamo

Manually inputting parameters for thousands of repetitive elements, such as manholes and pipes, is time-consuming and risks inconsistencies and errors, violating standards like ISO 19650. To address this, a visual programming solution in Dynamo was developed. The script automated the insertion of shared parameters into Revit families, validated data against project requirements, and ensured standardized consistency.

This process significantly enhanced efficiency, reduced manual effort, and ensured accuracy for downstream simulations, clash detection, and site constraint analysis. For example, the automated script inserts required parameters into families, a task that was previously only possible through manual creation. This provided a superior user interface without requiring extra settings and achieved a 90% time saving for repetitive tasks.

Rebar Modeling for Structural Elements Using Dynamo Automation

Conventional rebar modeling for concrete columns and beams is a time-consuming and complicated process. To overcome these challenges, the project team developed a Dynamo-based automation solution. This innovative approach utilized visual programming to generate rebar models for structural elements. The workflow allowed the team to modify the elements accurately and comprehensively.

Revit to Total Station Coordinate Workflow

Manually extracting coordinates for numerous survey elements increases the risk of error in large-scale cavern projects, complicating import into total stations and potentially causing construction delays. Revit to Total Station Coordinate Workflow effectively addressed this challenge. Survey coordinates were extracted directly from Revit models, exported to CSV format, and imported into total stations for precise on-site verification. This automation minimized human error in repetitive tasks and enabled instantaneous clash detection in congested zones.

Dynamo Automation for Rock Bolt and Canopy Tube Modeling

In addition to the design phase, BIM also played an important role in the construction phase. Rock bolts and canopy tubes were required for cavern stabilization work due to the large cavern span. Consequently, the project team developed the Q-system integration, an approach that automatically arranges rock bolts during the design process. This allowed for design modeling simultaneously. The fully automated modeling allowed clashes between the rock bolts to be detected automatically and instantly. This was particularly useful in congested zones and helped the team avoid rework. Therefore, the construction team could identify relevant site constraints and conduct mapping accordingly. Using Dynamo, the team developed a visual scripting solution that rapidly models rock bolts based on the mapped Q-value of the rock, the number of joints, and the nature and presence of joint water.

Point Cloud Processing with Sastrugi for As-Built Modelling

Traditional survey methods lack the precision required for accurate as-built modeling in complex cavern environments. The team

utilized the Sastrugi Dynamo package to process point clouds by filtering selections and converting them into Dynamo points. The script determined the pipe centerline at the “crown level,” projected points onto a perpendicular plane, calculated the radius using best-fit geometry, and generated new pipe elements based on that radius.

Face Area Extraction for Formwork QTO

Revit cannot calculate face areas through family selection alone, which makes efficient quantity take-off for formwork challenging. However, the BIM-based tool with generative AI integration effectively addressed this challenge. The tool used visual programming enhanced by generative AI to extract surface areas from rectangular and square columns. Face Area Extraction for Formwork, enhanced with generative AI integration, streamlined repetitive tasks and improved precision.

BIM Application – Operation Phase Streamlining Asset Management

BIM application encouraged strong information exchange among stakeholders during the operational phase. Automation ensured compliance with Asset Information Requirements (AIR) and facilitated the standardisation of data across thousands of assets. This reduced the need for manual input, validated information, and enhanced the efficiency and accuracy of asset management. Autodesk BIM 360 and Autodesk Construction Cloud served as the project’s Common Data Environment (CDE), ensuring effective information management. This integrated data foundation enabled real-time monitoring, mixed reality for as-built validation, and predictive maintenance scheduling. Beyond automation, the project team developed cost-effective solutions by integrating BIM with other innovative technologies. These included using visualisation to coordinate systems during planning to proactively eliminate clashes.

Project Achievements

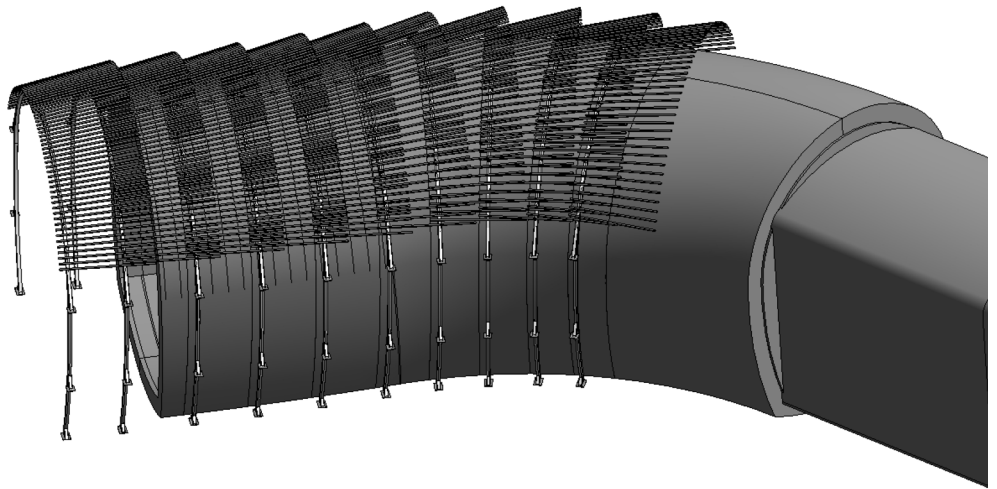
BIM is of paramount importance to our project delivery. BIM with generative AI, automation, and contractual innovations has proven to bring benefits to the entire project life cycle, from excellent safety and environmental performance to overall project administration and delivery. Our project team will continue to pioneer sustainable development by applying BIM throughout the entire project lifecycle.



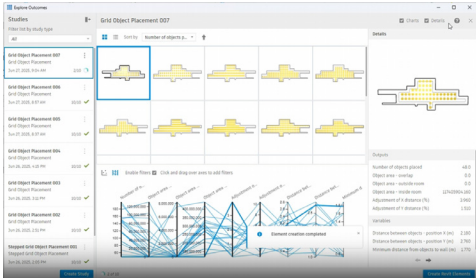
Existing Sewage Treatment Works
Image Courtesy of Drainage Services Department, the Government of the Hong Kong Special Administrative Region and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited – Alchmex International Construction Limited Joint Venture



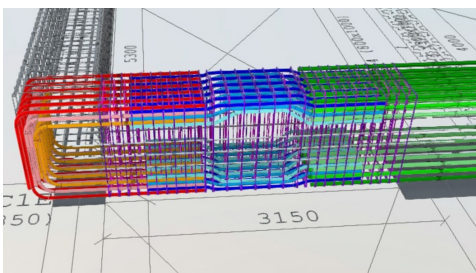
Site Office Planning
Image Courtesy of Drainage Services Department, the Government of the Hong Kong Special Administrative Region and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited – Alchmex International Construction Limited Joint Venture



Dynamo Automation for Canopy Tubes
Image Courtesy of Drainage Services Department, the Government of the Hong Kong Special Administrative Region and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited – Alchmex International Construction Limited Joint Venture



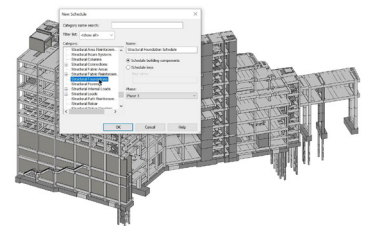
Generative Design
Image Courtesy of Drainage Services Department, the Government of the Hong Kong Special Administrative Region and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited – Alchmex International Construction Limited Joint Venture



Rebar Modelling
Image Courtesy of Drainage Services Department, the Government of the Hong Kong Special Administrative Region and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited – Alchmex International Construction Limited Joint Venture



Point Cloud to BIM model
Image Courtesy of Drainage Services Department, the Government of the Hong Kong Special Administrative Region and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited – Alchmex International Construction Limited Joint Venture



Quantity Take-off
Image Courtesy of Drainage Services Department, the Government of the Hong Kong Special Administrative Region and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited – Alchmex International Construction Limited Joint Venture