Integration of BIM Technology and Innovative Horizontal Rotation Method for Bridge Construction

COMPANY

Civil Engineering and Development Department, HKSAR Government
AECOM Asia Company Limited
CRCC - Paul Y. Joint Venture
Tyfron Consultancy Limited

PROJECT

Fanling North New Development Area, Phase 1: Fanling Bypass Eastern Section (Shung Him Tong to Kau Lung Hang)

LOCATION

Shung Him Tong and Kau Lung Hang, Fanling, New Territories

TYPE

Civil Project

SCHEDULED TIME OF COMPLETION

Early 2025

About Civil Engineering and Development Department, HKSAR Government

CEDD of HKSAR Government is a leading organisation for development of Hong Kong who is committed to provide high quality high civil engineering services to meet its development needs. It missions include striving for engineering excellence, creating a safe, green and sustainable environment, partnering with the community in infrastructure development and building a caring and motivating working environment for staff.

About AECOM Asia Company Limited

AECOM is the world's trusted infrastructure consulting firm, delivering professional services from planning, design and engineering to program and construction management on projects of transportation, buildings, water, new energy and environment with our technical expertise in innovation, culture of equity and diversity, and commitment to environmental, social and governance priorities. AECOM is a Fortune 500 firm and its Professional Services business had revenue of $13.1 billion in 2022.

About CRCC - Paul Y. Joint Venture

China Railway Construction Corporation Limited (CRCC) was established in 2007 in Beijing and is now a mega size construction enterprise under the administration of the State-owned Assets Supervision and Administration Commission of the State Council. It was listed in Shanghai and Hong Kong in 2008 with a registered capital of 13.58 billion yuan. Paul Y. Engineering Group was founded in 1946 in Shanghai who is now one of Hong Kong's largest contractors and plays a vital role in shaping Hong Kong, Macau and Mainland China, with a growing clientele in the region and other parts of the world.

About Tyfron Consultancy Limited

Tyfron offers BIM consultancy and implementation services aiming to provide quality BIM management and digitalized solutions to stakeholders on various construction projects.

AUTODESK PRODUCTS USED

Autodesk® Civil 3D®
Autodesk Construction Cloud®
Autodesk® Navisworks® Freedom
Autodesk® Navisworks® Manage
Autodesk® Revit®

Project Description

The project mainly comprises construction of an approximately 2 km long dual two-lane elevated structures with two long-span bridges over the existing Mass Transit Railway (MTR) tracks, Fanling Highway and Ma Wat River in the section between Shung Him Tong and Kau Lung Hang, approximately 2.4 km long noise barriers, relocation of approximately 400 metres long existing noise barriers along Fanling Highway, and alteration and addition works to the existing Ho Ka Yuen footbridge.

Project Challenges

- Alignment of the bypass meanders over the existing Ma Wat River and located in close proximity to adjacent village houses and industrial buildings which induce constraints for bridge construction works and additional needs from the sensitive stakeholders.
- The bypass spans over the existing MTR East Rail Line and heavily-trafficked Fanling Highway, which are the major transport infrastructure serving the North District of the New Territories.

Solutions for Challenges

- Digital surveying methods such as photogrammtery and point cloud scanning were adopted to capture existing conditions of works areas and surrounding areas.
- To avoid disruption to MTR operation, different construction methods such as horizontal bridge rotation, form traveller and launching girder were adopted for viaduct construction spanning over MTR tracks, Fanling Highway and Ma Wat River, respectively.
- Simulated method statement with the plant and equipment arragement and TTA simulation were utilized to analyze the feasibility of the proposed construction methods which also allowed visualization of the induced constraints regarding the traffic impacts, safety, environmental and quality aspects.

How does BIM benefit the project?

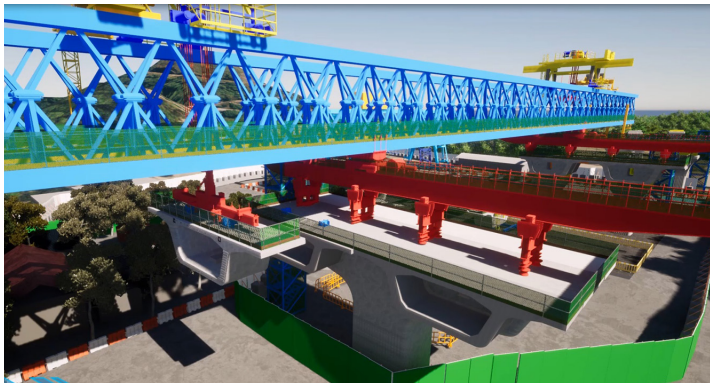
- Digital surveying results were utilized for production of existing conditions model to facilitate design and methodology studies.
- Prior to actual fabrication of large-scale formworks and temporary works, simulated construction methodologies and digital fabrication based on shop drawings were analyzed to determine the cost-effective production process.
- TTA simulation was also utilized for the development of TTA design aiming to minimize possible change to proposed TTA and reduce nightwork costs for implementation and nuisance to the public including safety hazards.
- Clash detection was carried out to produce a coordinated design which enabled minimization of abortive works on site.

Better with BIM

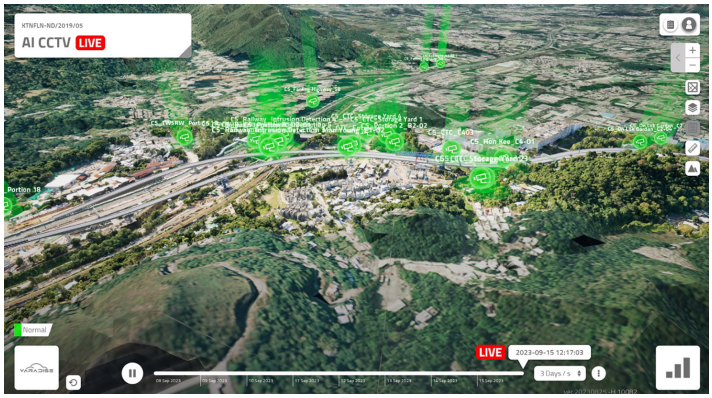
Collabration among project users were carried out through coordination workshops and project's Common Data Environment (CDE). BIM outputs as a result of collaboration would then be converted into Augmented Reality (AR) file format allowing frontline staff to visualize proposed works to be constructed on site. This project also implemented Centralised Management Platform (CMP) which enhanced management of massive project data. The use of smart technology was promoted where BIM models on CDE could be accessed through smart devices on site. Training workshops were conducted on smart device usage and CMP to ensure staff is able to work digitally without hassles.

Overview of Fanling Bypass Eastern Section (Shung Him Tong to Kau Lung Hang)
Image Courtesy of Civil Engineering and Development Department, HKSAR Government and AECOM Asia Company Limited and CRCC - Paul Y. Joint Venture and Tyfron Consultancy Limited

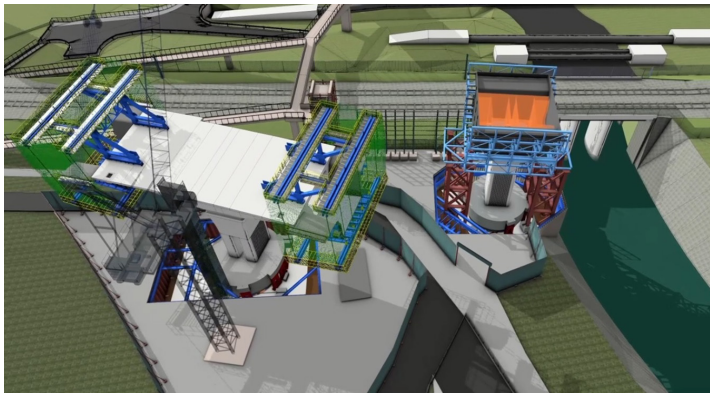
Integration of 3D survey and photogrammetry data for design and methodology studies
Image Courtesy of Civil Engineering and Development Department, HKSAR Government and AECOM Asia Company Limited and CRCC - Paul Y. Joint Venture and Tyfron Consultancy Limited



Simulation of bridge construction by launching girder
Image Courtesy of Civil Engineering and Development Department, HKSAR Government and AECOM Asia Company Limited and CRCC - Paul Y. Joint Venture and Tyfron Consultancy Limited



Centralised Management Platform (CMP) for Site Management and Monitoring
Image Courtesy of Civil Engineering and Development Department, HKSAR Government and AECOM Asia Company Limited and CRCC - Paul Y. Joint Venture and Tyfron Consultancy Limited



Simulation of method statement with plant and equipment for bridge rotation
Image Courtesy of Civil Engineering and Development Department, HKSAR Government and AECOM Asia Company Limited and CRCC - Paul Y. Joint Venture and Tyfron Consultancy Limited

TTA simulation
Image Courtesy of Civil Engineering and Development Department, HKSAR Government and AECOM Asia Company Limited and CRCC - Paul Y. Joint Venture and Tyfron Consultancy Limited

Simulation of form traveller operation for bridge construction at Fanling Highway
Image Courtesy of Civil Engineering and Development Department, HKSAR Government and AECOM Asia Company Limited and CRCC - Paul Y. Joint Venture and Tyfron Consultancy Limited

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