COMPANY
Gammon Construction Limited

PROJECT
Tuen Mun – Chek Lap Kok Link Northern Connection Tunnel Buildings, Electrical and Mechanical Works

LOCATION
Tuen Mun – Chek Lap Kok Link

TYPE
Design and Construction

SCHEDULED TIME OF COMPLETION
2021

Link to the Future: Smart Build with BIM & DfMA

About Gammon Construction Limited

Gammon Construction, headquartered in Hong Kong, is a 50/50 joint venture between Balfour Beatty, a leading international infrastructure group, and Jardine Matheson, the Asian-based conglomerate. Gammon has a reputation for delivering high-quality projects throughout China and Southeast Asia. The company's integrated business focuses on civil, building, foundations, electrical and mechanical, facades and interiors works and design, and the construction services division provides considerable plant and steel fabrication and concrete production capabilities. Gammon has a strong building and information modelling department and a digital entity dedicated to furthering the commercial opportunities of the innovations.

BIM PARTNERS

Highways Department, HKSAR Government

AECOM Asia Company Limited

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®

Autodesk® AutoCAD®

Autodesk® Civil 3D®

Autodesk® Dynamo

Autodesk® InfraWorks®

Autodesk® Navisworks® Manage

Autodesk® ReCap® Pro

Autodesk® Revit®

Project Description

Tuen Mun – Chek Lap Kok link tunnel is Hong Kong's deepest and longest sub-sea road tunnel. This dual two-lane tunnel runs between the western New Territories and Lantau Island. It is the first sub-sea tunnel with underground Service Gallery for Electrical and Mechanical (E&M) installations in Hong Kong. Gammon was responsible for the provision of E&M facilities to serve the newly constructed tunnel, such as ventilation, lighting, central monitoring and control system, as well as the provision of civil and building works for the construction of a number of tunnel buildings.

Project Challenges

To make good use of the space under the tunnel carriageway, a service gallery was provided to house public and E&M facilities. However, there is limited space in service gallery along 4.7km in tunnel. Working space is only 3.1m in width and 2.6m in height, which raises safety and efficiency concerns when installing E&M services in such a narrow and enclosed space. Furthermore, the project also has an aggressive 28 month completion date with 17 key dates.

Solutions for challenges

To ensure a safe and efficient delivery of the contract, Design for Manufacture and Assembly (DfMA) and an Integrated Digital Project Delivery (IDPD) approach were adopted. In total, 6,450 E&M modules and 13,500 brackets were installed along the tunnel. 3D laser scanning was used to deliver the works to the highest accuracy and visual programming with Dynamo was used to automate checks of as-built deviation on items such as headroom, interfacing item detection and the location of openings. There was also the challenge of producing shop drawings suitable for fabrication and monitoring the modules on site. This was addressed by placing unique QR codes in the BIM object and fabrication drawings that corresponded to each module. Each module could then be tracked on site by scanning the barcode at different checkpoints.

How does BIM benefit the project?

DfMA increased productivity and made the workplace safer. It integrates construction plans through BIM, allowing production and prefabrication to be undertaken off-site and streamlining installation processes, thus reducing on-site risks and boosting efficiency. Compared with conventional methods, modularisation reduced skilled on-site labour by 40%. It also improved productivity, with a 15% reduction of person days and by shortening the construction period by 5 months. Module delivery also reduced travel by over 50%, resulting in environmental improvements.

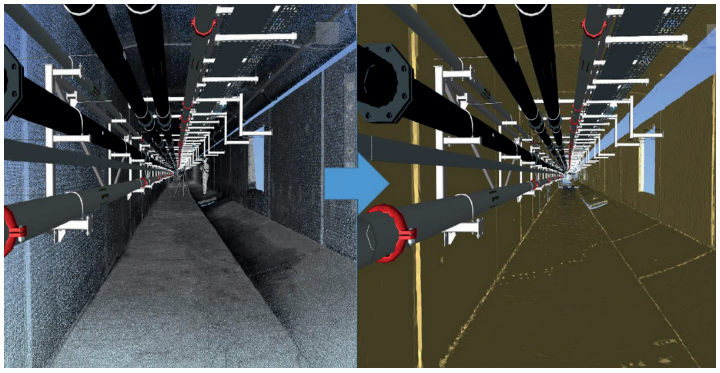
Better with BIM

3D scanning was essential for capturing accurate spatial dimensions. Instead of using traditional surveying methods, we made use of high-tech laser scanners to generate millions of data points per second that were then sent back electronically to the local survey grid. By automating the repetitive parts of this process, we were able to achieve more efficient and cost-effective outcomes.

BIM was applied to visualise how the pieces would fit together and planning the order of installation before works began on-site. BIM was also used in the logistic planning for storage, delivery, handling and installation of the E&M modules. This step-by-step guide for DfMA construction was all simulated with BIM.

Overview of Tuen Mun – Chek Lap Kok link (TM-CLKL) sub-sea Tunnel
Image Courtesy of Gammon Construction Limited

Design for Manufacture and Assembly (DfMA) of Tunnel Services Gallery
Image Courtesy of Gammon Construction Limited

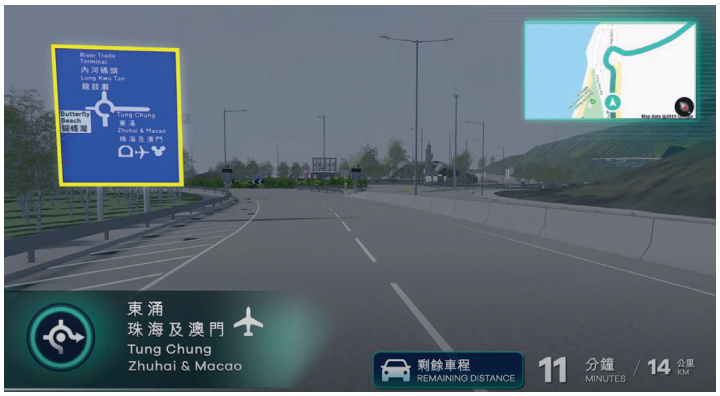


Point Cloud data into Mesh model to get all feature of site situation
Image Courtesy of Gammon Construction Limited

Modular Fabrication Factory
Image Courtesy of Gammon Construction Limited

As Built Tunnel BIM Model
Image Courtesy of Gammon Construction Limited

Design review in BIM model for lane control system (LCS) and road marking arrangement
Image Courtesy of Gammon Construction Limited



BIM Driving Guide Video for Public Relations
Image Courtesy of Highways Department, HKSAR

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