Autodesk Hong Kong

BIM Awards 2021

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The Hong Kong Institute of Building Information Modelling
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Acknowledgement

Sincere thanks to all the winners – AECOM Asia Company Limited, Airport Authority Hong Kong, Andrew Lee King Fun & Associates Architects Limited, Architectural Services Department, HKSAR Government, Bureau of Public Works of Shenzhen Municipality, China Construction Engineering (Macau) Company Limited, China State Construction Engineering (Hong Kong) Limited, CLP Power Hong Kong Limited, Drainage Services Department, HKSAR Government, Gammon Construction Limited, Hip Hing Engineering Company Limited, Hong Kong Housing Authority, HKSAR Government, Hong Kong Science and Technology Parks Corporation, Leighton Contractors (Asia) Limited, MTECH Engineering Company Limited, The Jardine Engineering Corporation, Limited, Vircon Limited, Chui Ho Chun and Ong Qiao Min in providing such valuable information and pictures of their projects. Besides, we are extremely grateful for the contributions of the advisor - Dr. Calvin Kam and the AIAB committee and members, Kelvin Tam, Ir. Brian Leung, Kevin Luwemba Mugumya and Simon Ng who are profiled in this booklet.

Disclaimer

The photographs, images, drawings or sketches shown in this booklet represent the artist's imaginative impression of the projects only. They are not drawn to scale and/or may have been edited and processed with computerized imaging techniques.

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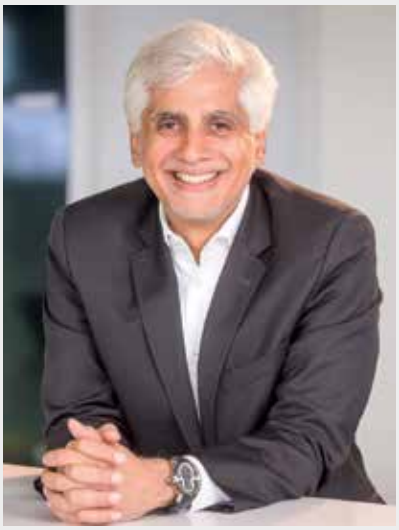

Empowering Innovation through Digital Transformation

A year ago, when I wrote the preface to the last BIM Awards, few of us believed the New Normal we were embracing then would look very similar a year on. But it speaks to our innate optimism and determination in building a better world for ourselves and the future generations. The winners in these pages illustrate that sense of hope and the vision to move forward.

The past year has been a time of learning, and humility. Many trends that predate the pandemic have shown themselves to be the right path, and accelerating them has helped us stay safe and productive. Digital transformation has provided the tools and the services that have helped us collaborate remotely. This process, of course, was already in motion, and in particular in the Architecture, Engineering, and Construction (AEC) world. But we're only just scratching the surface. As we move more and more of what we do to the cloud, the data we collaborate on will fuel the next wave of digital transformation. I'm excited to see companies already investing in not only Building Information Modeling (BIM), but also the Internet of Things (IoT), Extended Reality (XR), and predictive analytics.

As this booklet attests, these technologies are inspiring innovators in Hong Kong to ever greater heights. The annual BIM Awards are designed to celebrate those who think differently in their approach to projects, and this year is no exception. As their technology and business partner, we are incredibly proud to see how they embrace the possibilities and are working hard to ensure all our products share data with each other more seamlessly. Our commitment is to a platform that connects processes and data, automates workflows, and provides our customers with better insights for decision-making—and we can't wait to see how they use it.

At the same time, our experience in the past year has reminded us of the need to stay humble. Business continuity, reduced risk and closer collaboration have shifted in our minds from buzzwords to watchwords, fundamental to our personal well-being and that of the companies we work for. But the recent months have also shown us how intertwined we are with the fate of the planet. Last year, we became a net-zero greenhouse gas emissions company across our business and value chain. This is a significant step in our commitment to making sustainability an essential component of our business strategy and to translating that value to our customers, too. In practice, this means carefully analyzing the industries we support and helping them to reduce their impact by transforming processes through digital tools. The construction industry, for example, generates over a third of global waste, with volume expected to double by 2025. Tools like our Embodied Carbon Calculator (EC3) can help procure carbon-smart materials, reducing the embodied carbon in buildings.

Few of us would have predicted where we stand today, at the end of 2021. But it's how we've responded that has defined us, and I believe our industry has demonstrated its strength and vision to build a more sustainable, resilient and equitable world. At Autodesk, we've always been dedicated to helping our customers design that world. The BIM Awards showcased here are testament to that collaboration. On behalf of the Autodesk Asia Pacific team, I congratulate each and every one of you for your well-earned place at the head of our industry. Such imagination, commitment and drive inspire us all, and we are honored to be part of your journey!

.

Haresh Khoobchandani
Vice President, Sales, Asia Pacific Autodesk

Autodesk Hong Kong BIM Awards 2021

Congratulations to all the winners!

Award Winners

香港國際機場 HONG KONG INTERNATIONAL AIRPORT

中國建築工程(香港)有限公司 CHINA STATE CONSTRUCTION ENGINEERING (HONG KONG) LIMITED

建築署 Architectural Services Department

深圳市建筑工务署

建築署 Architectural Services Department

中國建築工程(香港)有限公司 CHINA STATE CONSTRUCTION ENGINEERING (HONG KONG) LIMITED

渠務署 Drainage Services Department

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CLP 中電

渠務署 Drainage Services Department

AECOM Imagine it. Delivered.

JEC 怡和機器 Jardine Engineering Corporation

Gammon

香港房屋委員會 Hong Kong Housing Authority

LEIGHTON

Young BIMer of the Year

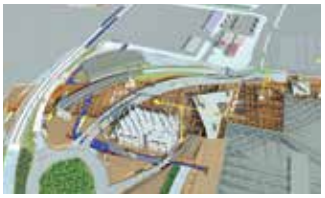
Chui Ho Chun, Eddie

Outstanding Student

Ong Qiao Min

City University of Hong Kong

Award Winners



ORGANIZATION
Airport Authority Hong Kong
China State Construction Engineering (Hong Kong) Limited

PROJECT
C3801 APM/BHS Tunnels on Existing Airport Island

ORGANIZATION
Architectural Services Department, HKSAR Government

PROJECT
Reprovisioning of Fu Shan Public Mortuary

ORGANIZATION
Bureau of Public Works of Shenzhen Municipality
Architectural Services Department, HKSAR Government
China State Construction Engineering (Hong Kong) Limited

PROJECT
North Lantau Hospital – Hong Kong Infection Control Center (HKICC)

ORGANIZATION
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

ORGANIZATION
Gammon Construction Limited
Hong Kong Science and Technology Parks Corporation

PROJECT
Advanced Manufacturing Centre

ORGANIZATION
Hip Hing Engineering Company Limited
Architectural Services Department, HKSAR Government
Vircon Limited

PROJECT
Design and Construction of Transport Department's Vehicle Examination Centre at Sai Tso Wan Road, Tsing Yi

COMPANY
Airport Authority Hong Kong
China State Construction Engineering (Hong Kong) Limited

PROJECT
C3801 APM/BHS Tunnels on Existing Airport Island

LOCATION
Hong Kong International Airport, Lantau, Hong Kong

TYPE
Infrastructure/Civil

SCHEDULED TIME OF COMPLETION
February 2022

BIM-through 3D, 4D and 5D BIM dimensions to achieve visualisation, collaboration, automation, estimation and simulation

"BIM is having a profound impact on the construction industry and the way the whole industry works together. We are fully utilizing the digital BIM framework throughout the process which leads to effective teamwork between different stakeholders and contributes to data integration and manageability. We believe the current BIM applications will take us to the next level in the delivery of BIM project."

—Kingsley Chiang

Project Director,
China State Construction Engineering (Hong Kong) Limited

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®
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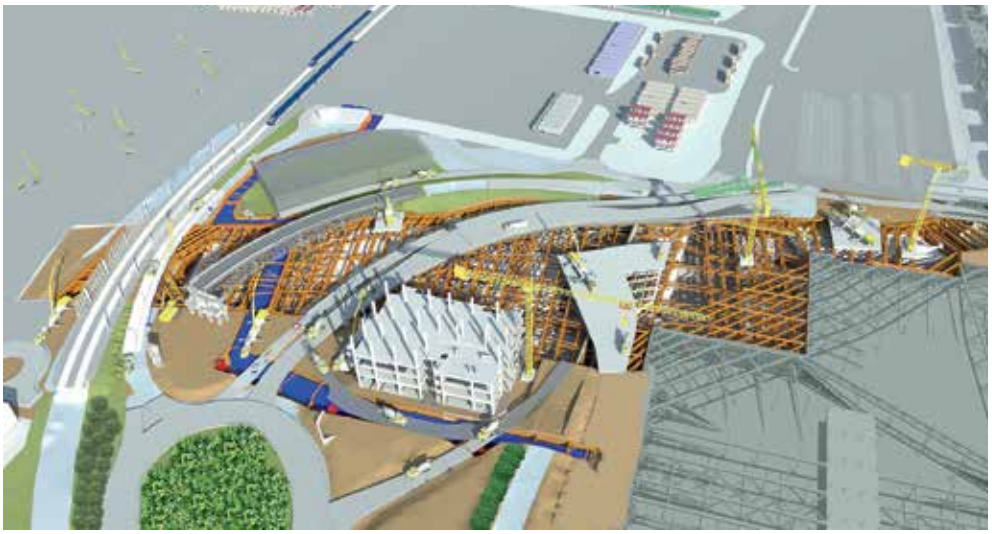
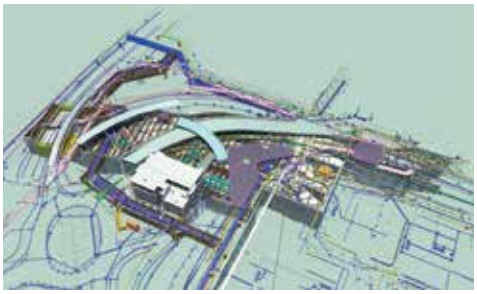


Site view of C3801
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

Contract 3801 (C3801) is one of the major Contract of Three-Runway System (3RS) Project of the Hong Kong Airport Authority. As the main contractor, China State Construction Engineering (Hong Kong) Ltd. is undertaking the construction works of C3801 using NEC3 ECC Option D contract. This project is a significant part of the 3RS Project for the connection between Terminal 2 and the newly reclaimed third runway. AAHK and China State are well-positioned to overcome different challenges with the innovative solution of Building Information Modeling throughout the project life-cycle.

APM/BHS Tunnels on Existing Airport Island

The project involves excavation and construction of a 4-cell reinforced concrete



Overview of permanent works and temporary works
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

C3801 BIM model explosion
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

Automated People Mover (APM) tunnel, 2-cell Baggage Handling System (BHS) tunnel, box culvert on existing airport island and a section of box jacking tunnel underneath the existing Airport Express Line. The contract also includes all associated road / utility diversions and reinstatement and a series of temporary works.

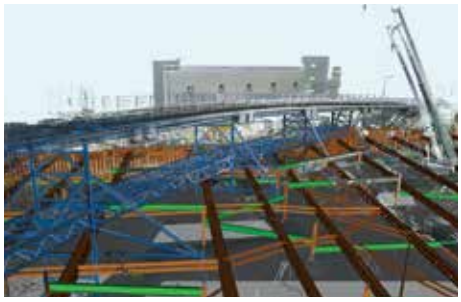
BIM and NEC Collaboration

AAHK and China State understand the paramount importance of collaboration for a high standard of project management. BIM has played a critical role in reforming the information flow and collaboration with the use of Autodesk BIM 360 Docs.

C3801 has set up a Compensation Event Quotation Team, comprising 7 full-time members of BIM engineers, quantity surveyors, engineers and programmer to facilitate the management change throughout the course of works. This team fully utilises BIM as a collaboration platform with AAHK to resolve project difficulties as soon as they were identified, particularly in permanent design optimisation and programme risk reduction associated with interface contracts. BIM also acts as a significant process in quantifying the changes from revised Employer's Drawings and handling the construction sequence issues with the help of 4D simulation.

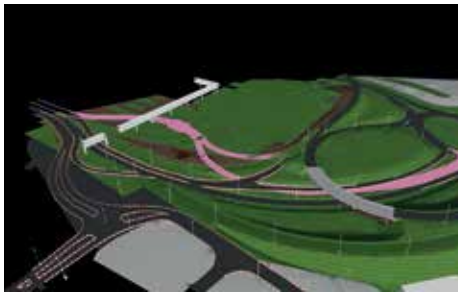
Jacked box tunnel underneath existing Airport Express Line
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

Simulation for construction sequence of box jacking
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited



BIM and point cloud data integration
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

3D laser scanning technology enhanced the speed and accuracy of data collection from construction sites
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited



Temporary traffic diversion simulation
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

Complex Temporary Work Design

The BIM provides an accurate digital representation amongst all temporary works in a congested site. It helps design engineers to identify any potential clashes and resolve them during the design stage. Direct data transfer between Revit Structure and load calculation software is adopted in order to accelerate the design coordination process between BIM team and design team.

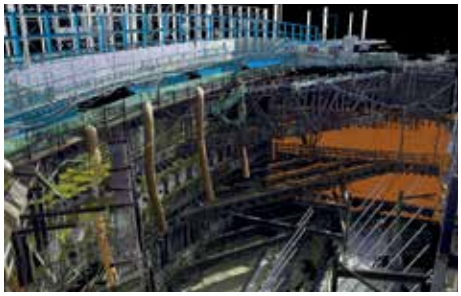
Second Jacked Box Tunnel in Hong Kong

C3801 is the second project to carry out box jacking technique in the Hong Kong construction market. To avoid disruption to the operation of AEL with strict settlement requirement is one of the critical challenges in C3801. With different BIM applications, the project team has taken immense steps forward both in mitigating the working restrictions and bringing forward new ways working.

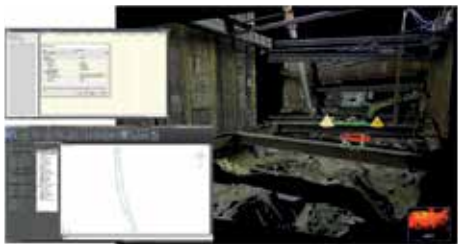
Unseen underground condition has high level of risk and uncertainty. To address this, geological condition is modeled using Autodesk Civil 3D to visualize the complex geology in box jacking zone. The BIM model offers an all in one visual database for justifying, positioning, foreseeing, analyzing geological condition with other construction tasks to monitor the workflow during deep excavation and box jacking.

Laser scanning technology is also deployed to take accurate point to point measurements of 15m depth cofferdam with 4 layers of ELS. When Autodesk Recap Pro combines with Civil 3D Volumes Dashboard function to perform earthwork balance calculation, it facilities site logistic and site safety analysis in depth. Total volume in cut/fill between soil and rock can be extracted to the engineers and quantity surveyors for further numerical analysis.

Logistics and hoisting method statements were also coordinated with the use of BIM. Together with the client's



A 3D visualization of BIM with dense point clouds for taking accurate, point to point measurements of existing conditions
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited



BIM and point cloud data integration for 5D earthwork calculation
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

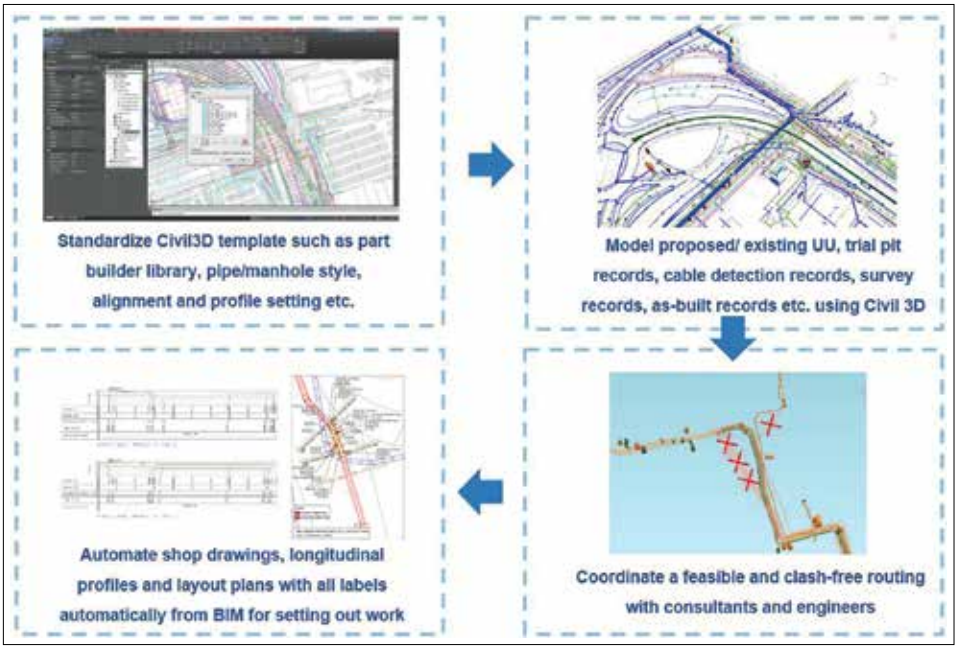
Augmented Reality (AR) with BIM
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

representative, manufacturer, logistic contractors, in-house safety and trade engineers, the methodology was clearly communicated and reviewed together using 3D simulation.

BIM-based Underground Utilities Management System

Managing 13 disciplines of underground utilities within the construction site is a critical challenge for C3801. In order to minimise disturbance, a BIM-based underground utilities management system is developed. Compared with traditional methods, this management system shall be performed during early stage of identifying design uncertainties. The procedures are starting from Civil 3D model establishment, design optimization, site construction and as-built recording. The engineers use this BIM-based system to brief the site worker before digging. AR technology is applied to superimpose BIM models into actual location of the verified or the proposed underground utilities with layering of the underground utilities. It is effective in reducing risk for abortive work and damage of existing underground utilities. BIM has a profound impact on the way the project team works together and handles with different information.

Virtual three-dimension models with physical reality for avoiding underground utilities damage
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited



BIM-based underground utilities management system
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

香港 國際機場 HONG KONG INTERNATIONAL AIRPORT

中國建築工程(香港)有限公司 CHINA STATE CONSTRUCTION ENGINEERING (HONG KONG) LIMITED

BIM model of C3801
Image Courtesy of Airport Authority Hong Kong and China State Construction Engineering (Hong Kong) Limited

About Airport Authority Hong Kong

The Airport Authority Hong Kong is a statutory body wholly owned by the Hong Kong SAR Government established in 1995. It is responsible for the operation and development of Hong Kong International Airport (HKIA), aiming to strengthen HKIA as the leading international aviation hub and a key engine for the economic growth of Hong Kong. Currently, the Company is committed to the Three Runway System (3RS) Project, which is the largest complex infrastructure development in Hong Kong. The 3RS project comprises 650 hectares of reclamation, a new runway and concourse, expansion of T2, new Automated People Mover system and Baggage Handling system, and other related facilities. Upon commissioning, it enables the capacity of HKIA to increase to over 100 million passengers and 9 million tonnes of cargo by 2030, catering for the long-term air traffic demand in Hong Kong.

About China State Construction Engineering (Hong Kong) Limited

China State Construction started its construction business in Hong Kong since 1979. It is a vertically integrated construction powerhouse, engaging in building construction and civil engineering operations as well as foundation work, site investigation, mechanical and electrical engineering, highway and bridge construction, ready-mixed concrete, pre cast production and infrastructure investment. In July 2005, China State Construction was listed on the Main Board of The Hong Kong Stock Exchange (stock code: 3311). China State Construction is amongst the largest construction contractors in Hong Kong to deliver Buildings, Port Works, Roads and Drainage, Site Formation and Waterworks. Currently the Company is one of the biggest NW2 contractors for Hong Kong Housing Authority projects.

COMPANY
Architectural Services Department, HKSAR Government

PROJECT
Reprovisioning of Fu Shan Public Mortuary

LOCATION
Shatin, N.T.

TYPE
New Build

SCHEDULED TIME OF COMPLETION
Q1 2022

From BIM to DfMA: the reinvention of construction process of 21st century mortuary building

"Being the BIM pilot project in our Department, reprovisioning of Fu Shan Public Mortuary gives us the opportunity to practise full lifecycle of BIM. Thanks to the partnering with different stakeholders, the use of BIM in various stages has brought productivity, cost control, quality and safety of this highly complex project to the next level. We hope to realize the full potential of BIM and believe the current applications shall inspire us for more future projects."

—Thomas Wan

Chief Architect,
Architectural Services Department,
HKSAR Government

BIM PARTNERS

Nishimatsu Construction Co., Limited

ATAL Building Services Engineering Limited

RH STUDIO

AUTODESK PRODUCTS USED

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From BIM to DfMA: the reinvention of construction process of 21st century mortuary building
Image Courtesy of Architectural Services Department, HKSAR Government (ArchSD)

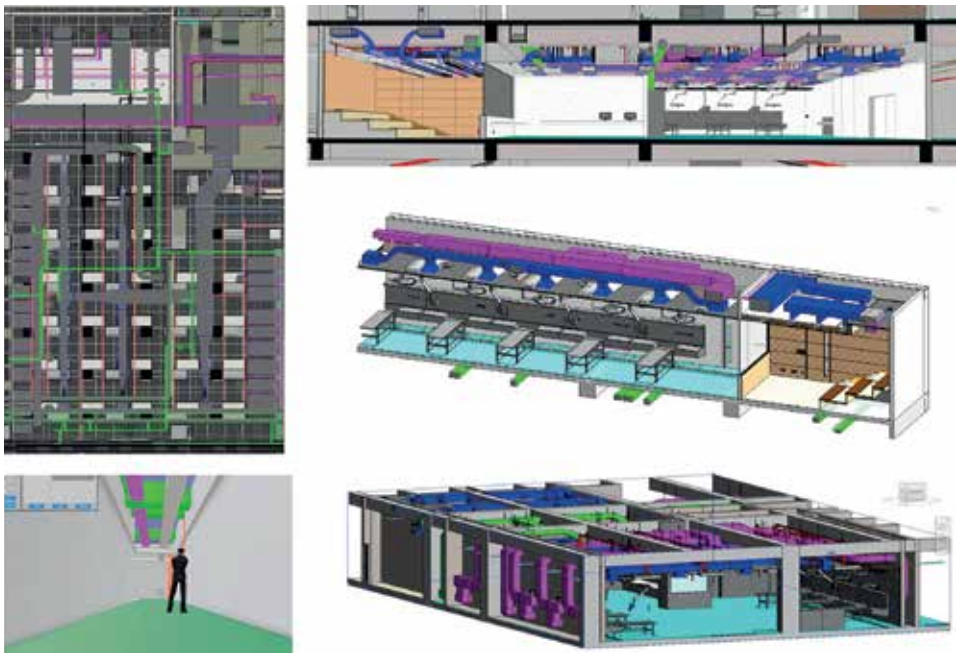
Project background

There are total four existing public mortuaries in Hong Kong. The key aims of Fu Shan Public Mortuary (FSPM) re-provisioning project were to increase the body storage capacity, to meet the current standards in infection control and the quality of mortuary service, and to rebrand mortuary through digitalization of services and new building image. Upon establishment, FSPM will become the largest public mortuary building in Hong Kong. The new FSPM comprises of both functional facilities including eight autopsy suites of different cases, X-ray and CT scan rooms, laboratories; and public facilities including public waiting hall, ceremony hall, resting lounges, interview rooms and facilities for bereavement services.

Design Visualization

BIM facilitates visualization throughout various stages of design development, from façade to interior design. It also makes communication to both client and contractor easy and effective. Virtual reality (VR) is created by using headset and motion tracking to help simulating user experience. By connecting to the BIM model, VR allows the stakeholders to experience the important functional spaces of the mortuary building e.g. ceremony hall, public waiting hall, the autopsy suites and viewing rooms etc. The whole process is beneficial to the project team since instant feedback could be obtained from the user to ensure that the end-product is fit for purpose and met all the operational requirements.

BIM facilitates visualization throughout all stages of design development, from exterior to interior design
Image Courtesy of ArchSD



BIM allows collaboration among multi-disciplines at early stage which effectively resolves clashes and minimizes abortive works
Image Courtesy of ArchSD

BIM workflow and lifecycle

BIM Execution Plan (BEP) was prepared by the Contractor at the beginning of construction stage, which defined project needs, implementation and methodology producing deliverables from BIM. In this project, all BIM dimensions are involved to assist project management throughout construction life cycles. As BIM model had already introduced in design stage, methodology and obligation of these enriched data was defined in BEP as well.

Multi-disciplinary collaboration

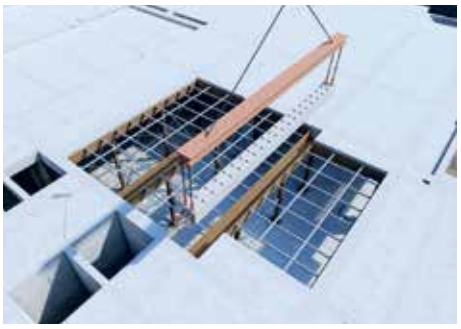
The mortuary building is a rare and complex typology. It comprises of autopsy suites and other restricted zones which involve high complexity in architectural, structural and building services elements to suit operational need. Inputs from multi-disciplinary stakeholders require a dynamic integration throughout different stages of the project. BIM enhances communication collaborations at various areas such as autopsy suites, cold rooms and E&M installations above ceiling etc. In traditional project, E&M coordination are highly depended on contractor's work schedule during construction stage. In this project BIM allows collaboration between disciplines to start early. 3D views are available for easy communication for E&M planning. Clashes between builder's work and E&M installations were resolved before construction which facilitates future site progress and minimizes abortive works.

Prefabrication and DfMA of MEP modules

Building services provision and arrangement is an important part of a mortuary building. With the help of BIM, standardization and DfMA of MEP modules is made possible for major plant rooms including AHU room, switch room, FS and water pump room across multi-disciplines. Dimensions are precisely coordinated in 3D model with consideration of delivery and logistics. Fabrication can be carried out simultaneously with site construction work which greatly reduces time, cost and labour. The reduction of labour also minimized the risk of site incident and virus spread among workers in this pandemic time.

Construction planning and logistics

BIM simulation programme, such as Autodesk Navisworks, Autodesk Vehicle Tracking and Lumion, was used to illustrate the actual site conditions and constraints, i.e. actual dimension of materials to be delivered, vehicle size, congested logistic area, etc. Animations of the logistic progress are produced for different parties to review before deliveries. Construction programme is reviewed at the same time to eliminate obstacle for the delivery of precast units and ensure smooth installation of the DfMA equipment.



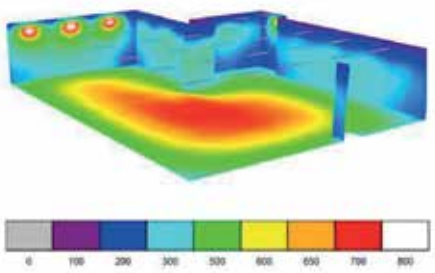
BIM facilitates site planning for precast installation. Simulation of delivery and installation process are made possible by using Autodesk softwares
Image Courtesy of ArchSD

Standardization and DfMA of MEP modules enhances buildability, reduces time, cost and labour.
Image Courtesy of ArchSD

Instant comments on shop drawings and CSD submissions are done on BIM 360
Image Courtesy of ArchSD

CDE platform makes document management easy and accurate which is the foundation for project success
Image Courtesy of ArchSD

BIM provides basis for Air Flow Study by IES-Virtual Environment at autopsy suites
Image Courtesy of ArchSD



DIALux helps the calculation & visualization of lighting provision for outdoor and indoor areas especially for autopsy rooms
Image Courtesy of ArchSD

Cloud-based Common Data Environment (CDE)

Autodesk BIM 360 was adopted in this project for regular site safety & environmental supervision which allows instant record of irregularities by inspectors and endorsement of rectification reports. Also, Contractor makes use of the platform for instant record of inclement weather which allows project team to review the impact on the overall programme and assessment of EoT claim. Materials and shop drawings comment and approval from different parties (e.g. architect, structural engineer, building services engineer) were also carried out on the CDE which results in transparent and efficient communication throughout construction.

BIM during time of pandemic

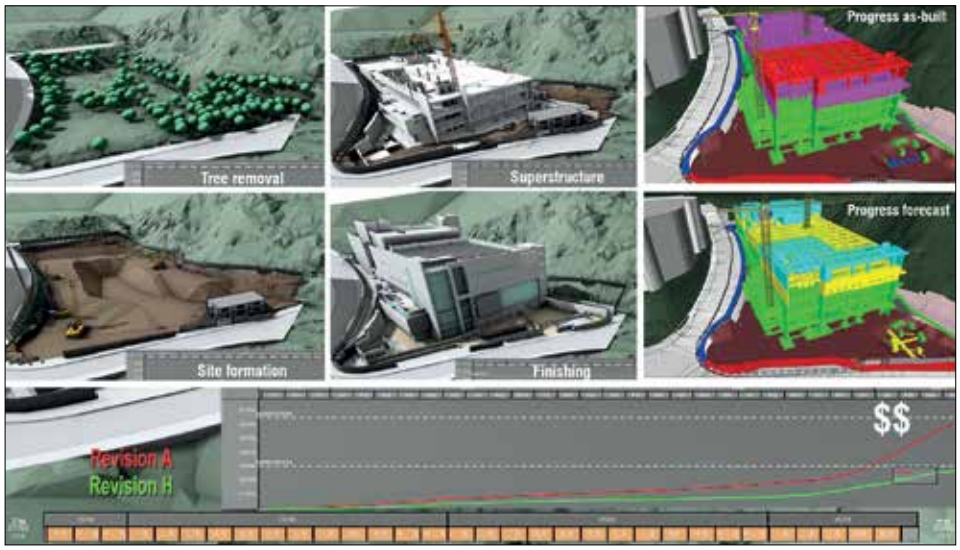
As Pandemic covers most of the time of this project, an alternative communication method should be considered in order to maintain effective coordination and also social distancing. The CDE platform (BIM 360) allows issues to be marked, commented and allocated to responsible person with simple clicks. Efficient information exchange and coordination are undisrupted even under the work from home arrangement.

Lighting and Airflow study

For the autopsy suite, BIM provides basis for lighting design by DIALux and air flow study by IES Virtual Environment. Value is added to lighting and air flow design which is critical to autopsy operation and to avoid cross-contamination in autopsy suite. Location of air grille and exhaust are placed in the optimized position so that pollutants and germs in air are removed before reaching human breathing level.

4D/5D simulation

4D/5D simulation of construction allows project team to have a better control on overall programme and cost forecast which improves cost predictability and resource management. As-built monthly progress and work forecast of different trades of work is also available with the help of BIM which facilitates progress comparison and monitoring. Some further studies included in this project, such as plant room spatial studies for maintenance purpose, and the handling, reuse and optimization of construction waste.



4D/5D simulation for construction and project management
Image Courtesy of ArchSD

建築署
Architectural Services Department

From virtual to reality, from design planning to construction
Image Courtesy of ArchSD

About Architectural Services Department, HKSAR Government

Architectural Services Department (ArchSD) was found in 1986 serving as one of the works departments under the Development Bureau of the HKSAR Government for the development and upkeep of public facilities. Our aim is to provide efficient and cost-effective professional and project management services for the design, construction, maintenance and refurbishment of government buildings and facilities. We also provide professional and technical advice to the Government and quasi-government organisations. Our mission is to serve and care for our community by enriching the living environment through high quality professional services; and to promote best practices in the building industry.

COMPANY
Bureau of Public Works of Shenzhen Municipality
Architectural Services Department, HKSAR Government
China State Construction Engineering (Hong Kong) Limited

PROJECT
North Lantau Hospital – Hong Kong Infection Control Center (HKICC)

LOCATION
Reserved Land next to AsiaWorld-Expo (AWE)

TYPE
Government Project

SCHEDULED TIME OF COMPLETION
Jan 2021

Together, We Build to Fight the Virus!

"In the post-pandemic era, faced with various changes and uncertainties, we should always maintain an adaptive and creative mindset. We should quickly introduce innovative methods to build the necessary infrastructures. By this we can fulfill the mission bestowed by this era, and also breathe new vitality into the traditional construction industry."

—Zhang Yi

CSHK Assistant President /
CSIM General Manager /
HKICC Project On-site Commander,

China State Construction Engineering (Hong Kong) Limited

BIM PARTNERS

China State Construction International Medical Industry Development Company Limited

China State Construction Science and Technology Limited

China State Construction Hailong Technology Company Limited

Transcendence Company Limited

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®
Autodesk® AutoCAD®
Autodesk® BIM 360® Design
Autodesk Construction Cloud®
Autodesk® Fabrication
Autodesk® FormIt®
Autodesk® Navisworks®
Autodesk® ReCap® Pro
Autodesk® Revit®
Autodesk® Revit® Live

MiC production factory in China Zhuhai
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department, HKSAR Government and China State Construction Engineering (Hong Kong) Limited

Background

In 2020, COVID-19 pandemic rampaged the world, requiring many additional temporary healthcare facilities to be built in a short time to cope with the overwhelming needs. The HK Special Administrative Region Government then requested support from the Central Government of the People's Republic of China, to build a new negative pressure isolation hospital to enhance our public hospital capacity to fight the pandemic upsurge. The target was to build more than 800 beds' hospital that must comply with HK's building regulations, and to be completed in 4 months. We took this momentous task with honor and achieved this challenging mission by using the modular hospital concept with the help of Building Information Modeling (BIM) and related creative construction technologies.

Project Scale and Complexity

The whole project took 120 days, from September 2020 to January 2021. It was officially named North Lantau Hospital –

MiC delivery through the Hong Kong-Zhuhai-Macau Bridge
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department, HKSAR Government and China State Construction Engineering (Hong Kong) Limited

Point-cloud model generated by laser scan process
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department
HKSAR Government and China State Construction Engineering (Hong Kong) Limited

HK Infection Control Center (HKICC) and had started operation since mid-February 2021.The HKICC was built on the reserved land next to the AsiaWorld-Expo (AWE), with pre-existing underground services such as high-tension power cables, which increased the complexity of the site formation works. It covered a site area of 22,000 m^2, with construction floor area of 44,000 m^2. Planning had considered existing noise and vibration factors from the northwest side from the railway track and the airport northern runway.

Designed with modular hospital concept, the HKICC was comprised of six 2-storey Ward Blocks, one 2-storey Medical Block, 1 Energy Centre, VIE Tank, DG Stores, and Plant room for Medical Gas. The six ward blocks were equipped with 136 six-beds negative pressure isolation rooms, providing a total of 816 beds. The negative pressure isolation room was designed in accordance with the international healthcare standards. Each room consisted of 3 MiC modules with their M&E parts and interiors pre-manufactured at the MiC factory in Zhuhai, China, enhancing the construction efficiency. The Medical Block accommodated laboratories, pharmacy, storage and medical staff facilities. The laboratory was designed for performing routine and Nucleic Acid Extraction (PCR) tests.

BIM Works and Related Collaboration Mode

To complete the HKICC within such a short time, the design teams worked closely with BIM teams in HK and Shenzhen (SZ) via the Autodesk BIM 360 platform. The whole team utilized the "Live Model Coordination" function of the BIM 360 to develop the BIM model synchronously. It was not only facilitated the different party's design review need but also ensured the BIM model reflecting the latest design information for coordination.

VR and Laser Scan Technology

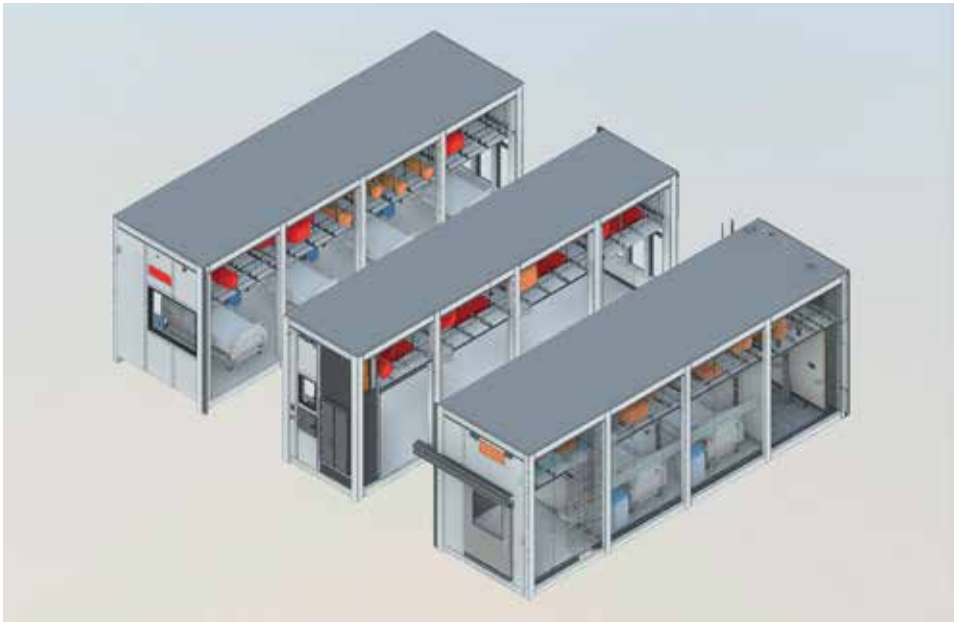
The combination of VR (Virtual Reality) technology and MiC method was another innovative and successful trial for the project. With VR set, designers could readily visualize the outcome and review the interior design of the MiC unit. This greatly facilitated the design coordination of the MiC ward and helped to confirm the details of the MiC ward for early and accurate mass production.

With the help of the laser scan technology, the team could scan the MiC units in both factory pre-fabrication stage and the on-site installation stage. The point-cloud model generated by the laser scan process could be used to compared with the BIM model by using the Autodesk Navisworks Manage for quality checking.

AR Technology for Construction Coordination and Facility Management

AR (Augmented Reality) technology can layer certain groups of details and BIM elements of building onto the real site. Models were grouped by different trades such as architectural fittings, structural elements, MVAC, fire services, electrical fittings, pumping & drainage systems and MiMEP units for easy checking. Project management teams could make use of the AR technology to train the site staffs and workers regarding the overall design concept, system locations, and installation progress with displaying detail BIM models in real condition.

Laser scan process in the construction stage
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department, HKSAR Government and China State Construction Engineering (Hong Kong) Limited



BIM Model of the MiC
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department
HKSAR Government and China State Construction Engineering (Hong Kong) Limited

4D Simulation
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department, HKSAR Government and China State Construction Engineering (Hong Kong) Limited

VR application and design review process
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department, HKSAR Government and China State Construction Engineering (Hong Kong) Limited

BIM and Smart Site Control Center of the project
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department, HKSAR Government and China State Construction Engineering (Hong Kong) Limited

Engineers could also check and compare the on-site installation with the design models.

Using the AR technology, the installation and system discrepancy could be easily identified as the visualized screen could be switched from real world to BIM model or even mixed. By clicking the display model, detail information would be shown on the AR device. This greatly benefited the facility management (FM) works especially the building services system. FM staff could easily locate the water pipe or air duct by using the

AR technology and application in construction stage
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department, HKSAR Government and China State Construction Engineering (Hong Kong) Limited

AR device without opening the false ceiling. This project successfully adopted AR technology together with BIM models, which provided convenience for construction coordination, building operation and maintenance.

Smart Construction and DWSS (Digital Works Supervision System)

Our project team set up a smart-site control system which integrated by Autodesk Forge. This system included installation progress system, workers' distribution statistics with the help of smart-helmet system, real-time CCTV monitoring, quality security system, MiC production logistic system as well as related design BIM models and other information modules, that provided the convenience for the project management staff to supervise the project quality and progress.

Conclusion

With undivided attention to details and determination to achieve one common goal of site safety and works completion on time, the HKICC was completed in 120 days in January 2021 to users' satisfaction. It has been a miraculous project only made possible through innovative concept and construction technology, early users' engagement and seamless inter-department cooperation. As the HK's and the world's first all-MiC negative pressure isolation hospital, HKICC not only set a benchmark for subsequent projects in terms of design and construction speed, but also greatly promoted the development of construction industry. We have witnessed how the HKICC has transformed the way we built to fight the virus!

Hong Kong Infection Control Center (HKICC)
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department HKSAR Government and China State Construction Engineering (Hong Kong) Limited

深圳市建筑工务署
BUREAU OF PUBLIC WORKS OF SHENZHEN MUNICIPALITY

建築署
Architectural Services Department

中國建築工程(香港)有限公司
CHINA STATE CONSTRUCTION ENGINEERING (HONG KONG) LIMITED

Project Team photo upon HKICC completion date
Image Courtesy of Bureau of Public Works of Shenzhen Municipality and Architectural Services Department, HKSAR Government and China State Construction Engineering (Hong Kong) Limited

About Bureau of Public Works of Shenzhen Municipality

Public Works of Shenzhen Municipality is the administrative department of Shenzhen government, which is responsible for the construction and management of the government investment projects except water and transportation projects. Engineering Design Management Center (EDMC) is responsible for the whole process management of the design for government investment projects.

About Architectural Services Department, HKSAR Government

The Architectural Services Department (ArchSD) serves and cares for our community by enriching the living environment through quality professional services. ArchSD ensures the quality, cost effectiveness and sustainable development and upkeeping of community facilities; provides quality professional advisory services on community facilities and related matters; and promotes best practices in the building industry. ArchSD is also committed to collaborating with the industry partners, user departments and stakeholders in developing and maintaining the public facilities for providing a better service to the general public.

About China State Construction Engineering (Hong Kong) Limited

China State Construction Engineering (Hong Kong) Limited started its construction business in Hong Kong in 1979. The Company engages in building construction and civil engineering works. China State Hong Kong plays an active role in the construction industry by means of its sound quality management and has professional expertise capable of undertaking high quality and technically advanced projects. It has undertaken over 800 construction projects in Hong Kong and Macau over the past 40 years and has acquired substantial experience and capabilities in doing so.

Revolutionary Construction Breakthrough with BIM and Innovative Technology

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

"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

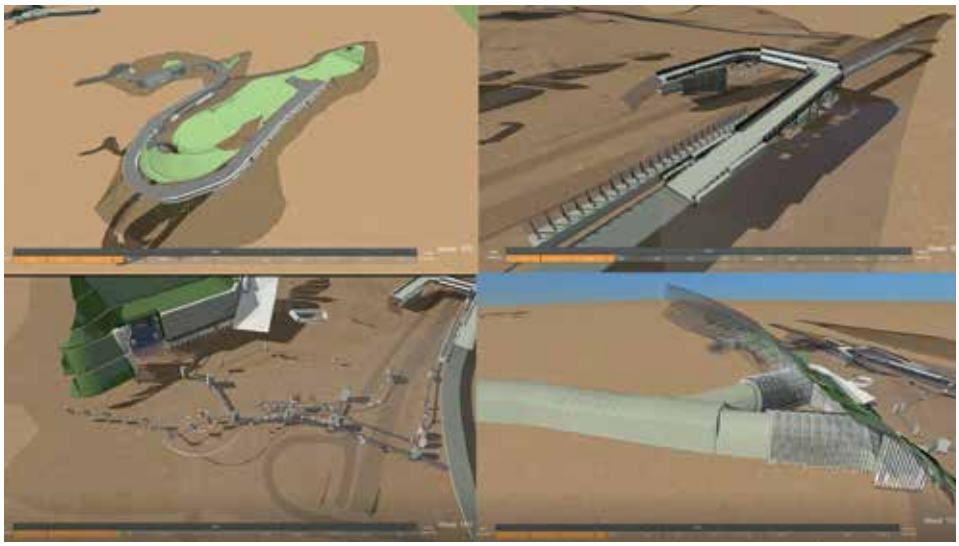
Autodesk® 3ds Max®
Autodesk® Architecture, Engineering & Construction Collection
Autodesk® BIM 360® Docs
Autodesk® Civil 3D®
Autodesk® Dynamo Studio
Autodesk Forge®
Autodesk® InfraWorks®
Autodesk® Navisworks® Manage
Autodesk® Revit®
Autodesk® ReCap® Photo
Autodesk® ReCap® Pro
Autodesk® Rendering
Autodesk®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

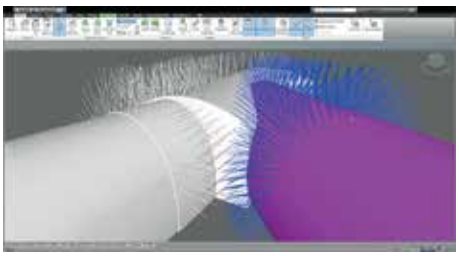
The application of BIM stimulated information exchange among different stakeholders during the operational phase. Autodesk BIM 360 served as the project's Common Data Environment (CDE) to ensure effective information management. The operation and maintenance team could retrieve the required asset information 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

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

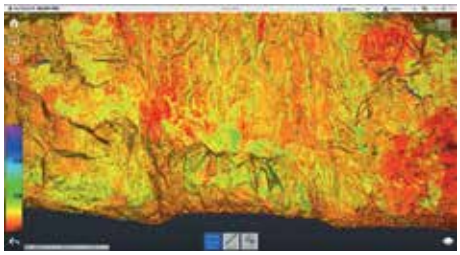


Automatically Generated BIM Model of Rock Bolts
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and China State Construction Engineering (Hong Kong) Limited and MTECH Engineering Company Limited

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 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



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

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 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.

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

渠務署
Drainage Services Department

AECOM

中國建築
CHINA STATE CONSTRUCTION

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.

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.

COMPANY
Gammon Construction Limited
Hong Kong Science and Technology Parks Corporation

PROJECT
Advanced Manufacturing Centre

LOCATION
Tseung Kwan O Industrial Estate, T.K.O.T.L. No. 39 & Ext. Thereto S.R. RP, S.B RP.

TYPE
New Building Construction, Manufacture Building

SCHEDULED TIME OF COMPLETION
Early 2022

A Full-cycle BIM implementation into construction digitization singularity

"Innovation is the key of staying competitive in the market. While full machine automation for replacing hard labour is still a long way, innovation and digitization can increase the productivity and help address the labour issue. In the years ahead, our vision is to transform Gammon by pushing back the boundaries of technology for the benefit of our clients and the construction industry at large. We thrive to become the Smart and Digital Contractor of Choice."

—Sammy Lai

Director,
Gammon Construction Limited

BIM PARTNERS

Wong Tung & Partners Limited

Meinhardt (C&S) Limited

Wong & Ouyang (Building Services) Limited

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®

Autodesk® AutoCAD®

Autodesk® BIM 360®

Autodesk® Dynamo Studio

Autodesk® InfraWorks®

Autodesk® Navisworks® Manage

Autodesk® ReCap® Pro

Autodesk® Revit®

Autodesk® Vehicle Tracking

AMC is one of the first manufacture buildings to meet the industrial 4.0 standards.
Image Courtesy of Gammon Construction Limited and Hong Kong Science and Technology Parks Corporation

Project overview

The Advanced Manufacturing Centre (AMC) in Tseung Kwan O Industrial Estate is one of the HKSTP's key initiatives for the re-industrialisation of Hong Kong. The 1.2 million-sq.ft. facility features superior design parameters in headroom, column-span, and structural loading capacity to provide an environment for big data processing, automated equipment, and advanced robotics, all of which support the drive towards Industry 4.0. AMC is a modern industrial premise suitable for smart production, with innovative design, provisions for flexible and highly automated production and distribution of products, and embedded services. By making high-value-added production facilities accessible to industries of various sizes, AMC facilitates the re-industrialisation of Hong Kong. AMC is under construction and is set to open in 2022.

Gammon Construction Limited is proud to be the contractor of this project. In parallel to supporting re-industrialisation in Hong Kong, we have also demonstrated industry changes promoted by the Government via

Coordination with a comprehensive BIM model including regional geography data.
Image Courtesy of Gammon Construction Limited and Hong Kong Science and Technology Parks Corporation

Common Data Environment (CDE) ensuring information exchange wouldn't be misplaced.
Image Courtesy of Gammon Construction Limited and Hong Kong Science and Technology Parks Corporation

Construction 2.0. These changes center on Innovation, Professionalisation, and Revitalisation: Building Information Modelling (BIM) is used in all levels, from design coordination to the supervision of different work trades. The 3D models and associated documents are hosted on a Common Data Environment (CDE) so that all stakeholders can access the most up to date information. BIM is also supporting Design for Manufacture and Assembly (DfMA) and Module integrated Construction (MiC), such as precast reinforced concrete construction and prefabrication of MEP systems.These modern methods of construction have significantly reduced onsite labour resources, safety risk for working at height, and construction time.

Commitment to construction digitalization

The 1.2 million square-feet multi-story industrial building is built to Industry 4.0 standards, and conceived to support high value-added production facilities accessible to industries of all sizes. The delivery of such a complicated project required construction digitalisation. The AMC construction team is committed to implementing BIM and various digital tools throughout the project.

A dedicated BIM team modernised the process and created thousands of prefabricated DfMA components for efficient construction. The development of mobile digital tools also greatly accelerated the adoption of the 3D BIM environment and digital delivery in the construction site.

CDE ensuring a single source of information

On this project, a Common Data Environment (CDE) was used with the sub-contractors. Design-related and specialty equipment contractors used the CDE to collaborate and produce a federated 3D model. Each of the 3D models and the associated design updates interchange on Autodesk BIM 360. The adoption of the CDE has ensured information assets wouldn't be misplaced.

Full-cycle BIM

To further improve economy and safety, almost 75% of construction components were constructed with DfMA, MiMEP, and prefabrication. BIM took a big role in the anticipation and analysis of these construction elements. This included a 4D master programme, temporary works & safety design, design validation, logistic analysis, all the way to handover of as-built models and data for facility management.

Many different pieces of hardware were applied, such as laser scanners, drones and 360 cameras, as well as integrations with mobile phones. We reviewed and handpicked the most applicable BIM software to improve our delivery and meet the BIM requirements.

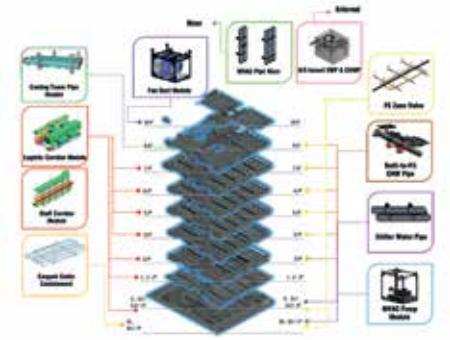
As the majority of MEP services were constructed by DfMA, once CSD / CBWD submissions were extracted from the 3D models, the BIM team would create DfMA shop-drawing on behalf of DfMA manufacturers. This significantly reduced the DfMA production timeframe.

Program language in BIM

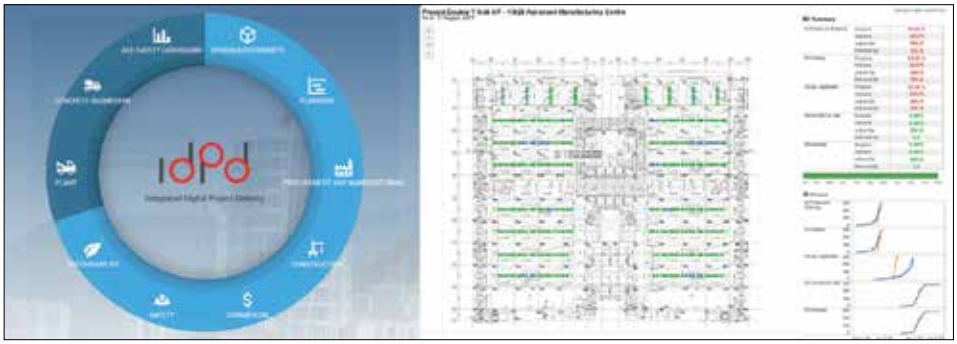
Gammon has self developed a web interface called Integrated Digital Project Delivery (IDPD), which is a central hub for all digital information on their projects. The backbone of IDPD is an API "data-hooking", which can be connected to any database, regardless of data from the construction site, or database from the client's system. All information forms a singular dashboard to report the most current status on-demand.

Gammon also has skills in using "Dynamo" and API to create Revit & Navisworks plug-ins. Unlike proprietary software, our tools are customised to suit the needs in the Hong Kong construction industry and our internal processes.

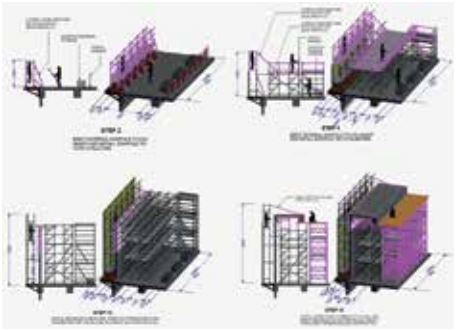
For AMC, there are many machines capable to do complex movements and joint articulation. These issues can be challenging to analyze in typical BIM software, so we developed solutions with game engines. This took traditional BIM data to the next level and the results



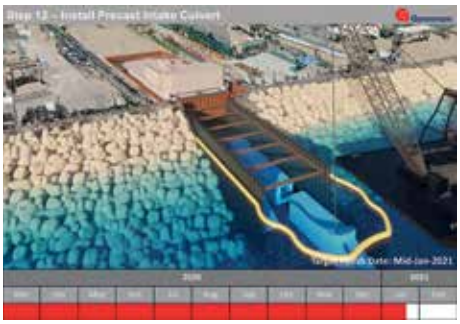
BIM team created shop drawings for 5000+ DfMA components.
Image Courtesy of Gammon Construction Limited and
Hong Kong Science and Technology Parks Corporation



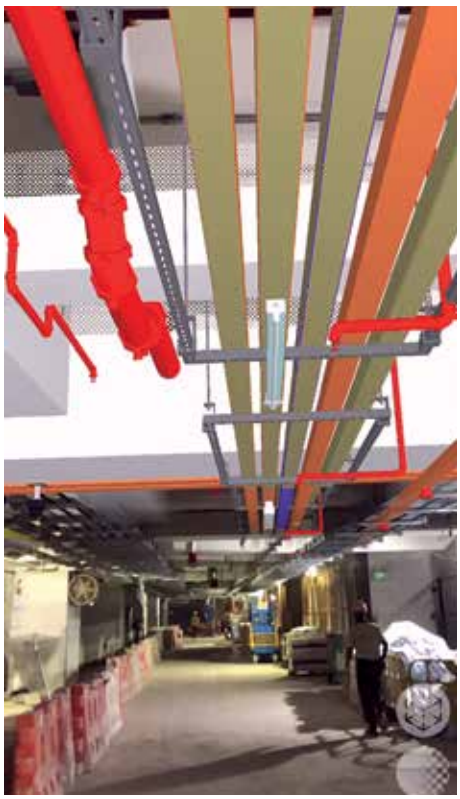
IDPD web interface helps construction teams receive updates on-demand.
Image Courtesy of Gammon Construction Limited and Hong Kong Science and Technology Parks Corporation



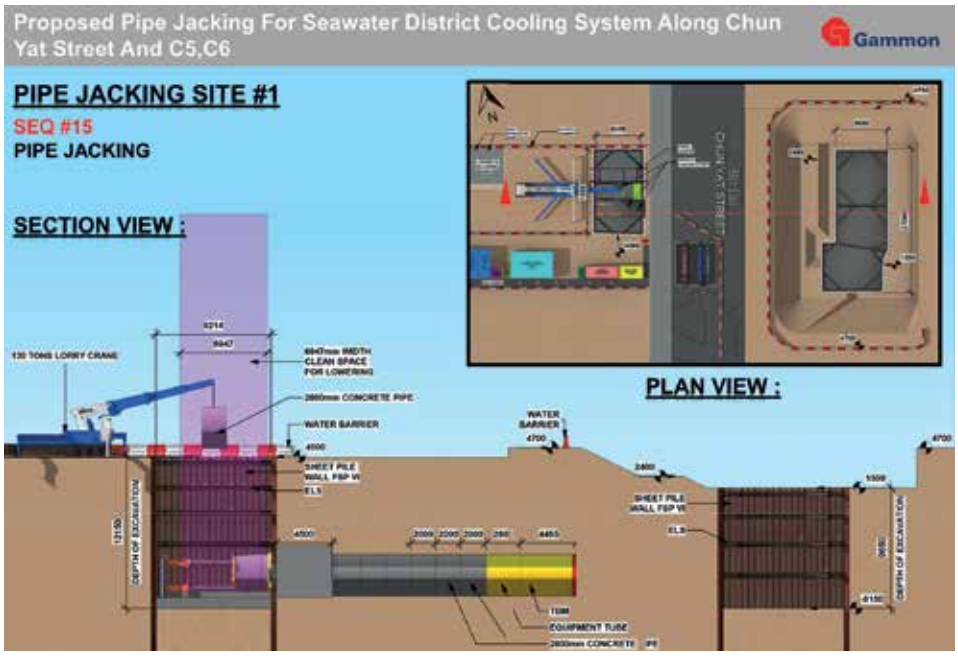
3D modeling helped scaffolding/ temporary works design and submission.
Image Courtesy of Gammon Construction Limited and Hong Kong Science and Technology Parks Corporation



4D programme simulation helped the installation of the seawater plumb house.
Image Courtesy of Gammon Construction Limited and Hong Kong Science and Technology Parks Corporation



AR technology had helped the BIM adoption on the construction site.
Image Courtesy of Gammon Construction Limited and Hong Kong Science and Technology Parks Corporation



BIM helped the construction site's layout planning to further enhance safety standards.
Image Courtesy of Gammon Construction Limited and Hong Kong Science and Technology Parks Corporation

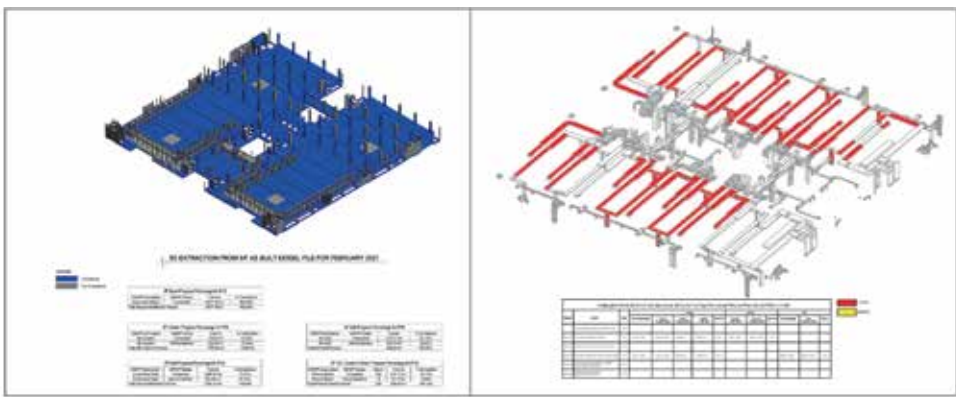
were able to be illustrated in the form of "Mixed Reality" on any mobile device.

BIM 5D for interim payment

The contract required Gammon to use BIM to support monthly interim payment applications. This required the expertise of both the BIM and the commerical teams to collaborate on solutions. As well as correctly recording quantities in the BIM models, we developed a workflow that considered ever-changing site conditions.

The statuses needed for the 5D model to include updates from the construction team, as well as from data held in the digital tools which have been used from the beginning of the project. For example, the interim payment team could review the latest status of works in the IDPD dashboards, check design against the 3D models and verify actual site conditions using 360 photography.

As a result, the 5D BIM model helped with discussing quantities between parties. Since BIM models were being updated to reflect the construction condition, as-built updates were taking place alongside the 5D payment applications every month. This meant the as-built has been produced iteratively, making it more efficient to handover the final BIM model.



5D BIM interim payment helped all parties to agree on the quantities.
Image Courtesy of Gammon Construction Limited and Hong Kong Science and Technology Parks Corporation

AMC is a state-of-the-art manufacturing facility with combination of aesthetic design.
Image Courtesy of Architectural Services Department, HKSAR Government

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.

About Hong Kong Science and Technology Parks Corporation

Hong Kong Science and Technology Parks Corporation (HKSTP) plays a pivotal role in re-industrialisation. The goal is to support innovation and technology-driven re-industrialisation by providing the land resources, suitable multi-storey industrial spaces, and an innovation and technology community to facilitate the development of new industrial operations in the Industrial Estates. The Advanced Manufacturing Centre at Tseung Kwan O Industrial Estate is one of the facilities supporting smart manufacturing in Hong Kong.

COMPANY
Hip Hing Engineering Company Limited
Architectural Services Department, HKSAR Government
Vircon Limited

PROJECT
Design and Construction of Transport Department's Vehicle Examination Centre at Sai Tso Wan Road, Tsing Yi

LOCATION
Sai Tso Wan Road, Tsing Yi

TYPE
Design and Build Contract

SCHEDULED TIME OF COMPLETION
30 Nov 2020

Virtual Environment Collaboration & Value Engineering Construction for Vehicle Examination Centre (VEC)

"Being one of the largest scale of facility buildings in the world, the Vehicle Examination Centre (VEC) at Tsing Yi sets a new benchmark for its kind. Infused with creative ideas and innovative solutions, VEC fuels new energy to the local community by ensuring the safety and quality of every vehicle on the road, and elevating the quality of life."

—Athena Fung
Chief Project Manager 101, Architectural Services Department, HKSAR Government

—Kent Chan
Project Director, Hip Hing Engineering Company Limited

—Ian Ku
Project Manager, Hip Hing Engineering Company Limited

—Billy Wong
Head of BIM, Hip Hing Engineering Company Limited

BIM PARTNERS

Wong Tung & Partners Limited
WSP (Asia) Limited
WSP Hong Kong Limited

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®
Autodesk® AutoCAD®
Autodesk® BIM 360® Design
Autodesk® BIM 360® Docs
Autodesk® Civil 3D®
Autodesk® Dynamo
Autodesk® Navisworks®
Autodesk® ReCap® Pro
Autodesk® Revit®

Vehicle Examination Centre Overview
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

Vehicle Examination Centre

Vehicle Examination Centre is a multi-storey functional building which comprises 30 inspection lanes, 7 storeys of office blocks and 2 sets of scissor ramps. In contrast to conventional building projects, the project includes a big portion of civil engineering works such as slope improvement as well as road widening works. VEC provides a wide range of examination services including visual check, lamp test, brake test, exhaust emission test and under carriage inspection, etc. Therefore, careful planning and due care of interfacing of Vehicle Examination Equipment (VEE) is of utmost importance to ensure smooth operation of its intricate and complex functions.

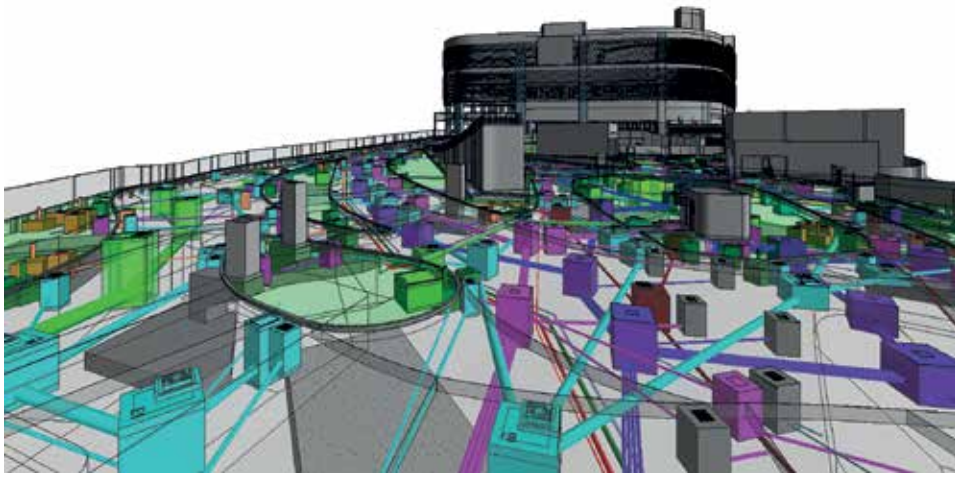
Major Challenges and Site Constraints

With its complex nature, the project presented a number of challenges. Beyond the contract requirements, the top management proactively took the initiative to adopt BIM, with the objectives to mitigate risks and facilitate the operation of the project.

Four Major Site Constraints:

1. Design and build of a vast amount of underground utilities (750 manholes and draw pits and network of 3,000+ pipes, with a total length of 17km), which requires careful coordination with other building elements. (existing underground utilities, the footings of adjacent elevated highways and new gantry footings to be constructed)
2. An extensive area of drainage reserve within the construction site
3. Compacted site bounded by slope and elevated highway structures

Inspection Hall
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited



Underground Utilities BIM Model
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

4. Proposed new building in close proximity to existing traffic sign of highway (600 mm distance)

Through BIM Technology, rock excavation volume of new design was successfully reduced by 40% compared to the original design and the number of manholes was reduced by 20% in final design.

Design Review and Optimization of Underground Utilities and Wayfinding

In this project, the complex arrangement of underground utilities (750 manholes and draw pits) was initially built & integrated virtually in the BIM environment. Drawing on our engineering and BIM technology expertise, our project team was able to visualize the installations, detect clashes and resolve potential conflicts between new and existing utility services and structures prior to construction. The early virtual design and construction enhanced design certainty and accuracy and provided valuable insights for planning the efficient construction to the works, and therefore mitigating the risk of abortive works. In addition, the BIM platform allowed project team to take into account the maintenance requirements of the utilities providers, which prevented disruption to the existing live utility systems and ensured smooth construction in the future,.

Compared to traditional 2D drawing context, BIM environment enables an extraordinary immersive approach to review the design of wayfinding element. For example, virtual camera can be configured to simulate the perspective of drivers, thus the design of wayfinding elements can be more optimized and customized to the client's requirements and user's needs.

Drone Scanning and 3D Scanning

Applying the technology, the accurate spatial information was provided for project team to review spatial relationships between the planned and existing building elements. With reliable information such as the critical clearance between the elevated structure and traffic sign, the construction planners and construction safety officers were able to implement risk management strategy, such as tolerance control for the construction safety.

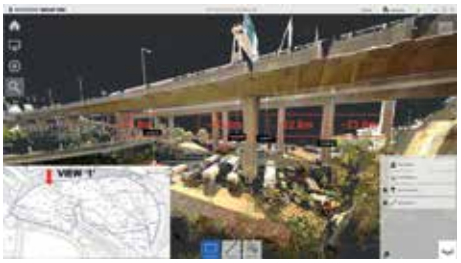
Rock Excavation study

Adopting 5D-BIM for quantity-take off (QTO), the rock excavation volume can be measured by Civil 3D and Revit for project design team to optimize the foundation design and reduce the excavated rock and transportation time. Comparing to the original design, the rock excavation volume adopted in the new design was reduced by 40%.

Value Engineering – Façade

The façade design for VEC is unconventional. We built the model using parametric design. The aim of the design was to block the sunlight using fins. Taking the advantage of parametric modification enabled by BIM, the optimal design can be identified by striking a balance between the degree of sunlight and size of the fins.

With BIM, the project team was able to study the interfacing between design of facades and superstructure to prevent clashes. Modelling the 4D construction sequence and method for planned installation arrangements helped visualise the interfacing between existing highway and existing direction post. As a result, risks of different construction approaches could be identified in advance, and consequently



3D Scanning for Site Surveying
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

Visual Mock-up for Design Review & Kinetic Effect Simulation
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

Off-site_MiC Prefabrication
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

VR Simulation and Demo
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

BIM Coordination-digital video conferencing software
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

delivering the ideal and safest construction solution.

Design for Manufacture and Assembly (DfMA)

In order to shorten the construction period, we proposed an alternative innovative solution – Design for Manufacture and Assembly (DfMA) for the construction of the inspection booth. The Modular Integrated Construction (MiC) method was adopted in Lane Supervision Booths to take advantage of off-site fabrication. It helped achieve better quality and accelerate the construction. Furthermore, we also deployed MultiTrade integrated MEP (MiMEP) for E&M construction to unveil the potential risks for design, to minimize material consumption, production time and fabrication cost. To facilitate MiC and MiMEP, the BIM technology is an essential tool for the complete design and construction process. The BIM model maturity should meet the manufacture requirement without clash and discrepancy between each drawing sheet and each model component.

On-site_MiC Supervisor Booth
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

Vehicle Inspection Process Simulation

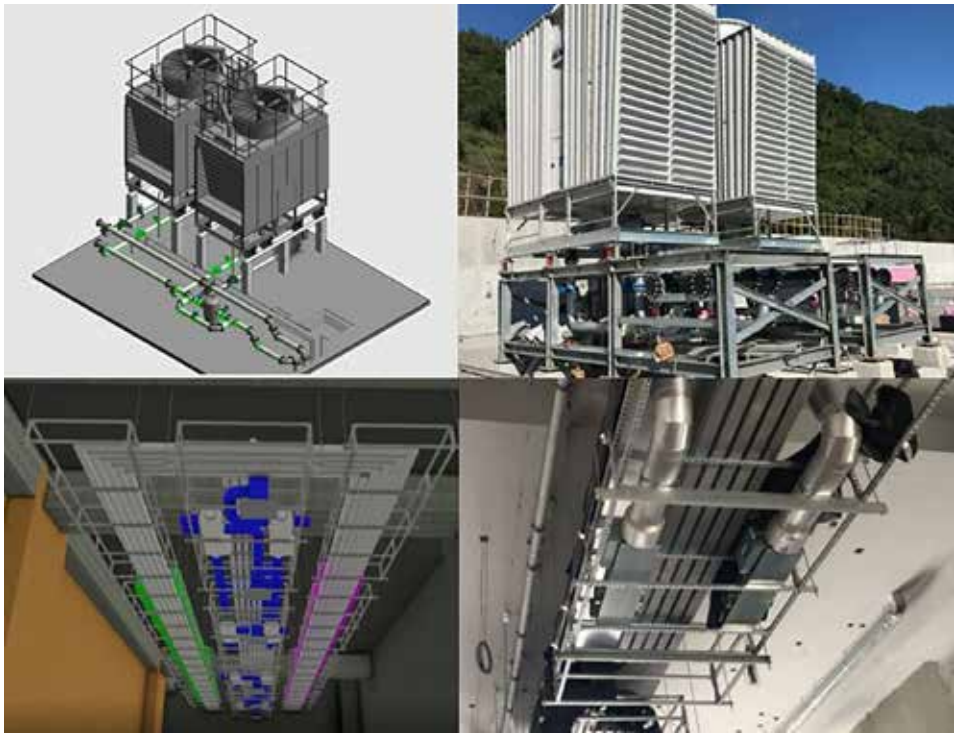
In this contract, we have proposed recommendations to assist client to freeze design of route of vehicle inspection and the supportive signage system. We applied VR simulation (drive-through) to demonstrate the route of the inspection lane from the entrance, Vehicle Examination Equipment (VEE), lane supervisor booths, car ramp and to the departure location. Using the BIM platform, the client can visualize the vehicle inspection process of the bus through the first or third-person perspective. The demonstration speeded up the time of decision making.

Asset Information Model (AIM)

During as-built stage, the Asset Information Model (AIM) was developed from construction BIM Model. The model with 2D as-built record drawings comprise customized building attributes and file structure for data submission. The AIM will be used for future development on retrieval of asset and works records mapping in GIS platform. Our team processed data conversion from the native file (revit file) in BIM 360 Docs platform to IFC standard (IFC4) in Asset Information System (AIS) web platform using Dynamo to facilitate smooth data conversion process.

Web Collaboration (Work from Home)

Due to the COVID-19 pandemic and restrictions on face-to-face communications, the project team was confronted with the constraints of communication. However, the adoption of BIM virtual platform such as BIM 360 Docs helped resolve the issue and enhanced our communication and coordination significantly. Besides, applying BIM 360 design enabled the BIM operator to create and update BIM Models anytime and anywhere. Furthermore, collaborations, such as clash analysis and review can be performed to review the design of Architectural/Structural/Building Services Design with other parties effectively.



DfMA – Multi Trade integrated MEP (MiMEP)
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

協興 HIP HING
新創建集團成員
Member of NWS Holdings

建築署 Architectural Services Department

雲建 VIRCON

Design and Construction of Transport Department's Vehicle Examination Centre
Image Courtesy of Hip Hing Engineering Company Limited and Architectural Services Department, HKSAR Government and Vircon Limited

About Hip Hing Engineering Company Limited

Founded in 1964, Hip Hing Engineering Co., Ltd. undertakes the design and construction of building and civil engineering works for public sector clients, and it is one of the members of Hip Hing Construction Group ("Hip Hing"). Over the past decades, Hip Hing has grown to become one of the leading contractors in Hong Kong, and has been trusted by our clients to construct many of the landmark buildings which define Hong Kong. Our experience and expertise in the design, procurement, engineering and construction disciplines enables us to provide comprehensive project delivery services. We have also been embracing advancing technologies to take our services to the next level, so as to meet our clients' needs.

About Architectural Services Department, HKSAR Government

Architectural Services Department (ArchSD) was found in 1986 serving as one of the works departments under the Development Bureau of the HKSAR Government for the development and upkeep of public facilities.

Our aim is to provide efficient and cost-effective professional and project management services for the design, construction, maintenance and refurbishment of government buildings and facilities. We also provide professional and technical advice to the Government and quasi-government organisations.

Our mission is to serve and care for our community by enriching the living environment through high quality professional services; and to promote best practices in the building industry.

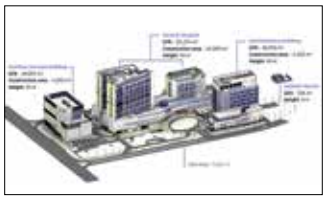
About Vircon Limited

With over 20 years of experience, Vircon Limited is an ISO 19650 certified Hong Kong's premier Digital Twin & BIM solution provider. We have successfully implemented 300+ local and international projects. Vircon is dedicated to providing high quality services and products, customer satisfaction, and continual improvement of our processes. Our Digital Consultants and BIM Specialists help clients to improve safety, optimize production, reduce costs, and mitigate risk throughout the Building Life Cycle. We pride ourselves on supporting innovation, sustainability, and social impact.

Honorable Mentions

ORGANIZATION
Andrew Lee King Fun & Associates Architects Limited

PROJECT
A 30-classroom primary school at Site KT2c, Development at Anderson Road, Kwun Tong



ORGANIZATION
China Construction Engineering (Macau) Company Limited

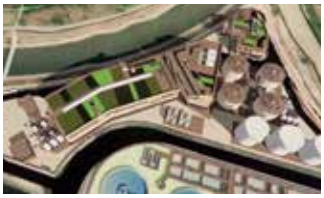
PROJECT
Island District Health Services Complex, Macao - Main Buildings

ORGANIZATION
China State Construction Engineering (Hong Kong) Limited

PROJECT
Hong Kong Palace Museum Work Contract for Main Contract Work

ORGANIZATION
CLP Power Hong Kong Limited

PROJECT
BIM NORMALCY

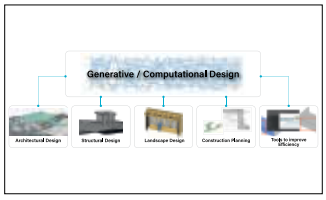


ORGANIZATION
Drainage Services Department, HKSAR Government
AECOM Asia Company Limited
The Jardine Engineering Corporation, Limited

PROJECT
Contract No. DE/2018/03- Shek Wu Hui Effluent Polishing Plant – Main Works Stage 1 – Sidestream Treatment Facilities and E&M Works for Sludge Treatment Facilities

ORGANIZATION
Gammon Construction Limited

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



ORGANIZATION
Hong Kong Housing Authority, HKSAR Government

PROJECT
Innovative Use of Computational Design – A Public Housing Design Perspective

ORGANIZATION
Leighton Contractors (Asia) Limited

PROJECT
East Kowloon Cultural Centre

COMPANY
Andrew Lee King Fun & Associates Architects Limited

PROJECT
A 30-classroom primary school at Site KT2c, Development at Anderson Road, Kwun Tong

LOCATION
Site KT2c, Development at Anderson Road, Kwun Tong

TYPE
Institutional

SCHEDULED TIME OF COMPLETION
2024-25

From Paper Model to BIM Model: Integration of BIM for Building Better

About Andrew Lee King Fun & Associates Architects Limited

Andrew Lee King Fun & Associates Architects was first established in Hong Kong in 1962 and was incorporated as a limited company in 1998. It is now one of the most innovative and experienced architectural practices in Hong Kong.

Andrew Lee King Fun & Associates Architects Ltd. has extensive knowledge and expertise in managing large scale and complex institutional, commercial, retail, residential, hospitality, industrial and infrastructural projects for both the public and private sectors, locally and overseas. Our teams are dedicated to provide clients with the most personalized professional services, innovative design proficiency and efficient project management. We provide services in master planning, infrastructure study, building design, interior design, site supervision, project management, and all architecture related professional practices. Over the years, our portfolio has included 800+ satisfactorily completed projects of high prestige in Hong Kong, China, Macau, United States and Vietnam.

BIM PARTNERS

J. Roger Preston Limited

Siu Yin Wai & Associates Limited

AUTODESK PRODUCTS USED

Autodesk® AutoCAD®

Autodesk® BIM 360®

Autodesk® Dynamo

Autodesk® Navisworks®

Autodesk® Revit®

Project Description

The project is to design and construct a 30-classroom primary school at development at Anderson Road, Kwun Tong, Kowloon (Site No. KT2c). The school consist of 30 classrooms and other programmes including special classrooms, assembly hall, library, basketball courts and other ancillary facilities.

Project Challenges

Starting from 2015, the HKSAR Government initiated to adopt building information modelling (BIM) technology in the design and construction of major government capital works projects. Adopting BIM is being part of the project brief as the mediums of presentation and documentation for this project in different works stages.

The LOD increase in parallel with the progression of the work stages (from LOD 200 in design stage to LOD 400 in construction stage) to allow for adequate time as well as the necessary development of the design whilst cater for the necessary statutory submissions and structural calculations.

Solutions for challenges

Adoption of in-house BIM team from early design stage would encourage early consideration of structural as well as building services elements. Input from all trades (Structural / Building Services / Landscape) of project team into a singular 3D BIM model would enable clashes and area with insufficient headroom to be identified as early as possible and ensuring adequate time to resolve concerned matters.

BIM was particularly useful when we were working to adopt Modular Integrated Construction (MiC) and Design for Manufacturing and Assembly (DFMA) into the proposed development and what implication or adjustment that need to be at the earliest workstage.

How does BIM benefit the project?

Adoption of BIM was initiated from as early as the Feasibility, Inception Study and Planning Stage through to the current Tendering stage. In the upcoming Construction stage, BIM would continue be used to aid site coordination as well as preparation and generation of Shop Drawings, Combined Services Drawings (CSD) and so forth. The benefit of adopting BIM from the inception of the project through each of the different work stages can be summarized in the following:

· Early Start of Coordination between Multiple Trades

· Production of Statutory Submission Drawings and Tender Drawings.

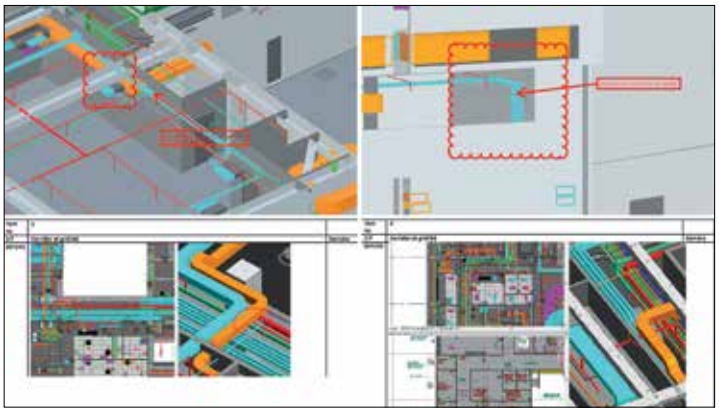
Better with BIM

With enough information inputted into the BIM model, project programme and quantity take off (QTO) schedule could be derived for better construction planning and site logistic.

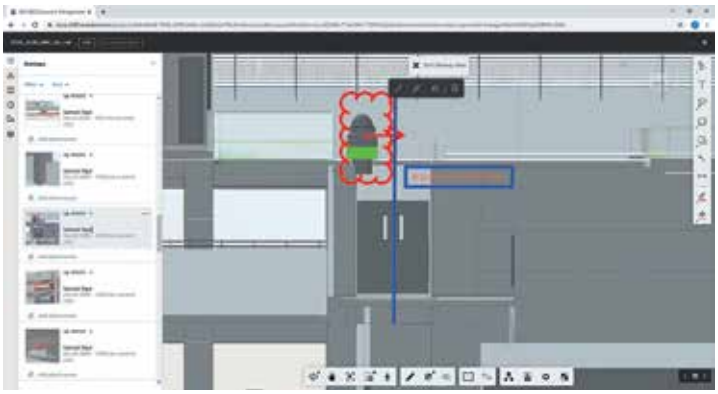
The BIM 360 serving as a favourable common data environment ensuring all parties working on the latest model and also stimulate cross checking of the 3D BIM model from multiple disciples. This was particularly reflected during the COVID-19 Pandemic when there was an extended period where the project team worked from home.

The BIM model also serves as a presentation tool and together with Virtual-Reality (VR) can facilitate better communication with the client though visual walk-through.

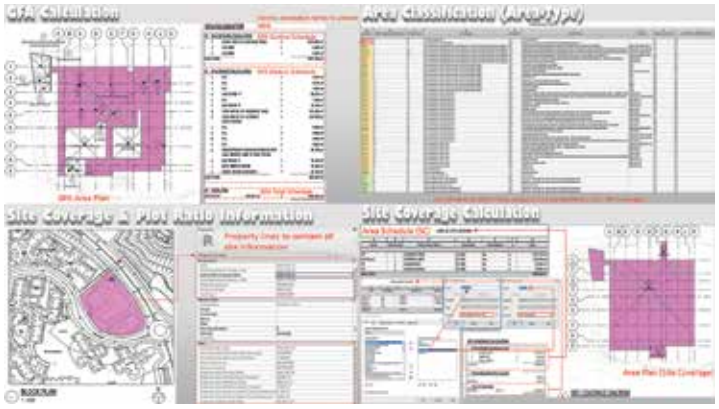
Overall View of Captioned Project (Artist's Impression)
Image Courtesy of Andrew Lee King Fun & Associates Architects Limited



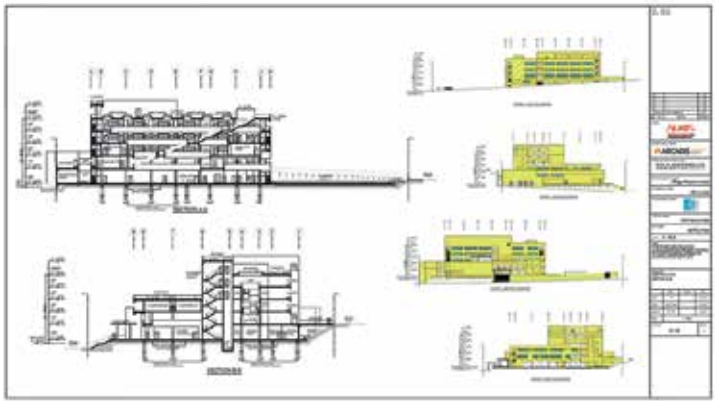
Clash detection of intergraded Arch, MEP & Structure Model
Image Courtesy of Andrew Lee King Fun & Associates Architects Limited



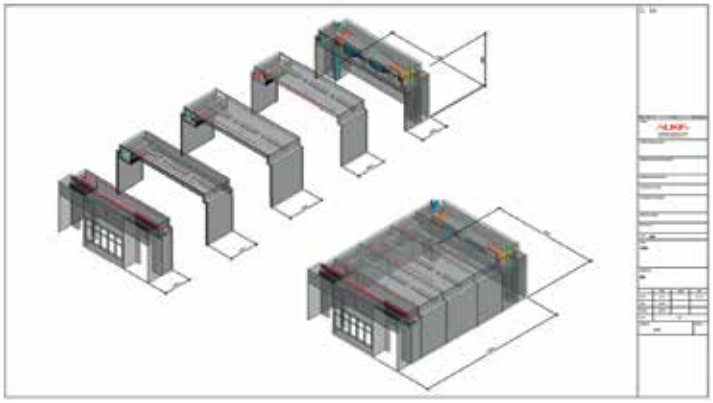
BIM 360 serving as a favorable common data environment (CDE) for design collaboration which is comply to BS EN ISO 19650
Image Courtesy of Andrew Lee King Fun & Associates Architects Limited



Automated calculation using in the statutory submission
Image Courtesy of Andrew Lee King Fun & Associates Architects Limited



Production of Statutory Submission Drawings and Tender Drawings
Image Courtesy of Andrew Lee King Fun & Associates Architects Limited



BIM enhanced design process for Modular Integrated Construction (MiC)
Image Courtesy of Andrew Lee King Fun & Associates Architects Limited

Virtual-Reality (VR) facilities better communication with the client though visual walk-through.
Image Courtesy of Andrew Lee King Fun & Associates Architects Limited

COMPANY
China Construction Engineering (Macau) Company Limited

PROJECT
Island District Health Services Complex, Macao - Main Buildings

LOCATION
Estr. Flor de Lotus, Cotai, Macao

TYPE
Government Project

SCHEDULED TIME OF COMPLETION
Oct, 2022

Deliver Better Hospital Project with BIM

中國建築工程(澳門)有限公司
CHINA CONSTRUCTION ENGINEERING (MACAU) COMPANY LIMITED

About China Construction Engineering (Macau) Company Limited

Setting its footprint into Macao in 1981, China Construction Engineering (Macau) Co., Ltd. ("CCEM"), is a vertically integrated construction and investment conglomerate mainly engaged in infrastructure investment and construction projects. Parent company of CCEM is China State Construction Engineering Corporation that is currently ranked 13th in Fortune Global 500. For construction, CCEM is the pioneer and the leader which maintains long-term cooperation with one-third of local construction companies and provides jobs for the quarter of local construction workers at the peak. In Macao, CCEM is proud of having seven domestic flats per km2 built by CCEM; one out of eight local people who lives in a domestic flat built by CCEM. CCEM leverages its outstanding construction and management expertise to undertake construction projects, mainly including hotel and casino resort, residential building, infrastructures, hospital, and educational facilities; civil engineering projects such as site formation and piling; mechanical and electrical engineering works.

BIM PARTNER

China State Construction Science and Technology Limited

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®
Autodesk® AutoCAD®
Autodesk® Civil 3D®
Autodesk® Dynamo
Autodesk® Navisworks®
Autodesk® Revit®

Project Description

Island District Medical Complex is a public hospital, and comprises seven functional buildings. The Main Buildings with over MOP7.3 billion sum include two blocks of General Hospital, Auxiliary Services Building, and Administrative Building, that spans a site area of approximately 23,200m2 and a total gross floor area of approximately 276,500m2. After its completion, it will provide medical and surgical service with over 1,100 beds for patients, and will equip high-tech facilities for medical protection, radiation therapy, and organ transplant procedures advanced medical rooms.

Project Challenges

Other than some common challenges in typical construction project, there are several challenges which are faced along.

1. To have holistic project scheduling and construction planning to ensure the completion of this project with 838 working days;
2. To design and build of complex ELS for the 3-level basement with construction area over 37,300 m2, including three car ramp entrances;
3. To coordinate and prepare Combined Integrated Services Drawings with limited ceiling zone/ restricted clear headroom requirement and sophisticated building services systems including over 16 ELV systems, medical gas system, automatic waste and linen collection system, and pneumatic tube system.

Solutions for challenges

The following BIM tactics are applied with the aim of dealing the challenges.

1. To produce 4D BIM and 5D BIM to visualize and to simulate the project scheduling and construction planning;
2. To utilize BIM to identify the clashes between ELS and permanent structural elements, and then to improve ELS design;
3. To take advantage of BIM-based design to improve coordination and communication process;
4. To apply Robotic Total Station and Augmented Reality technology integrated with BIM to assist site supervision and monitoring.

How does BIM benefit the project?

- Coordinating and updating various building systems directly in the 3D environment is more efficient and effective than updating 2D platform, especially for areas with high complexity. This practice improves the efficiency of project coordination as well as reduces the unnecessary back-and-forth coordination;
- Comparing to traditional method, it is more efficient to utilize Robotic Total Station for on-site checking and monitoring to significantly minimize manual errors and time saving;
- Better understanding on BIM can be achieved by all levels of project team members – including workers – via Augmented Reality, so as to improve communication and to ensure the accuracy of the installation.

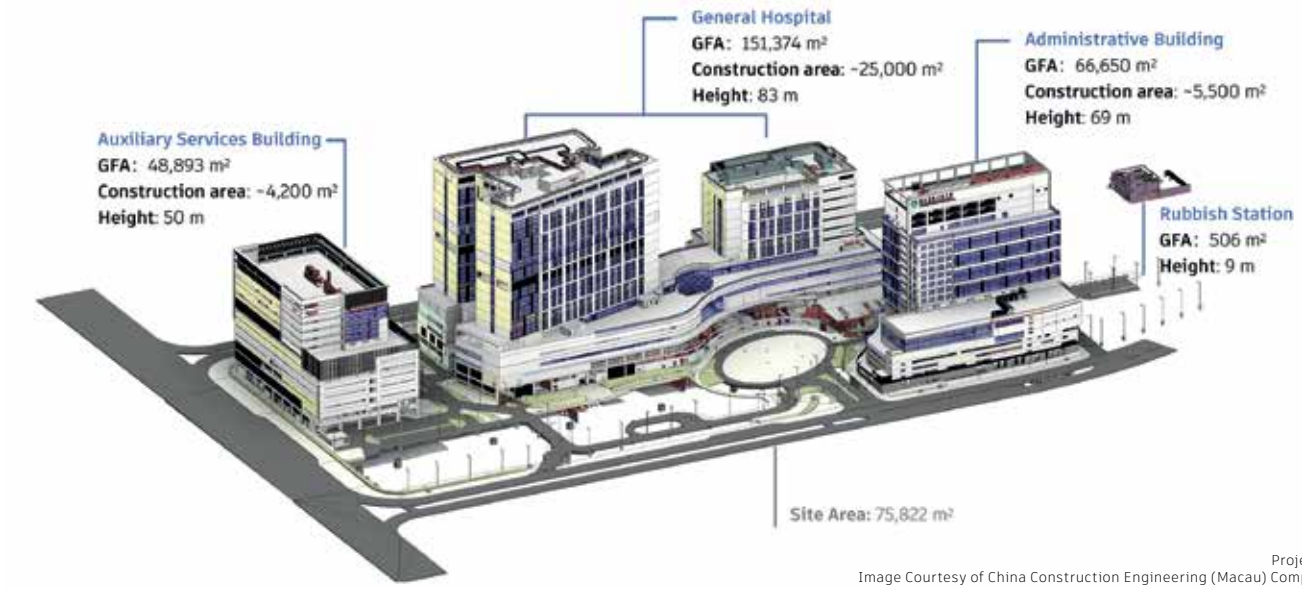
Better with BIM

It is – without doubt – time-consuming and error-prone to create openings, to add dimensions and to tag in Revit; therefore some add-in tools in the market could facilitate automatic creation of openings and drawing generation. However, these add-in tools have some drawbacks for the production of Combined Builder's Work Drawings (CBWD). For example, most of tools only provide automated opening creation function without any automatic annotations added. Therefore, China State BIM Hong Kong Center has developed the CBWD add-in tools that could fully and seamlessly automate the whole process including the generation of plan and sectional views of Individual Shop Drawings.

Island District Medical Complex, Macau
Image Courtesy of China Construction Engineering (Macau) Company Limited

BIM Usage through the Building Life Cycle
Image Courtesy of China Construction Engineering (Macau) Company Limited

Smart Site Management System
Image Courtesy of China Construction Engineering (Macau) Company Limited



Project Overview
Image Courtesy of China Construction Engineering (Macau) Company Limited

Hospital 11F Mockup
Image Courtesy of China Construction Engineering (Macau) Company Limited

Administration 15F Mockup
Image Courtesy of China Construction Engineering (Macau) Company Limited

COMPANY
China State Construction Engineering (Hong Kong) Limited

PROJECT
Hong Kong Palace Museum Work Contract for Main Contract Work

LOCATION
West Kowloon Cultural District, Museum Drive, Kowloon

TYPE
New Building

SCHEDULED TIME OF COMPLETION
November 2021

Hong Kong Palace Museum on Cloud

中國建築工程(香港)有限公司
CHINA STATE CONSTRUCTION ENGINEERING (HONG KONG) LIMITED

About China State Construction Engineering (Hong Kong) Limited

China State Construction Engineering (Hong Kong) Limited ("the Company" or "China State Hong Kong") started its construction business in Hong Kong in 1979. The Company engages in building construction and civil engineering works. China State Hong Kong plays an active role in the construction industry by means of its sound quality management, and has professional expertise capable of undertaking high quality and technically advanced projects. It has undertaken over 800 construction projects in Hong Kong and Macau over the past 40 years and has acquired substantial experience and capabilities in doing so. Projects undertaken range from building works, namely, public housing, private residential, office / commercial, industrial, hospital institutions, educational and cultural facilities, hotels, public institutions; to civil engineering works, namely, site formation, highways, bridges, reclamation and tunnel projects; as well as piling, mechanical and electrical engineering works.

BIM PARTNERS

West Kowloon Cultural District Authority

Rocco Design Architects Associates Limited

Ove Arup & Partners Hong Kong Limited

China State Construction Science and Technology Limited

Transcendence Company Limited

AUTODESK PRODUCTS USED

Autodesk® Architecture, Engineering & Construction Collection

Autodesk® AutoCAD®

Autodesk® BIM 360® Docs

Autodesk® Dynamo

Autodesk Forge®

Autodesk® Navisworks® Manage

Autodesk® Revit®

Project Description

Hong Kong Palace Museum, being the pioneer of high technology histrionic museum in Hong Kong. The museum situated in the heart of the western center in Hong Kong, surrounded by a panoramic view of Hong Kong most famous Victoria Harbor. And the museum will have 7,800 square metres of gallery space, introducing aspects of the fascinating history and culture of the Palace Museum, with exceptional works from its collection, such as painting, calligraphy, the decorative arts, and rare books.

Project Challenges

This museum have a complex inverted pyramid superstructure with unique irregular shape elements, specially the 4000+ exterior aluminium panel and 7000+ feature ceiling panel, it brings numerous challenges to the construction team. It is necessary to coordinate and collaborate with the engineers and sub-contractors earlier to establish the true constructability with construction procedures. COVID-19 forces the construction industry to face the challenge of labour shortages, supply chain issues and financing pressures, our company is decided to accelerate the digitization of construction site operation, logistic and overall construction management.

Solutions for challenges

To build the complex museum building during the COVID-19 pandemic, China State Hong Kong has been fully use the BIM to enhance the safety, quality, and productivity on the construction site. BIM level 2 was adopted and implemented as the Single Source of Truth (SSOT) throughout the entire lifecycle of this project. Especially during construction, BIM acted as a collaborative platform for all parties involved, helped to share real-time design and construction information, fostered effective communications, reduced human error, accelerated construction speed, improved craftsmanship and overall quality of work, and in turn it effectively promotes Integrated Project Delivery System.

How does BIM benefit the project?

To work collaboratively from a single source of truth on Common Data Environment, BIM creates confidence and helps to build trust among the project participants to capture a complete record of the project with a unique data ownership model that eliminates barriers to collaboration, increasing adoption and data sharing across the entire project team. This trust results in greater adoption, which yields more project data and insights. It also creates an unalterable audit trail, helping to reduce disputes and drive faster resolution.

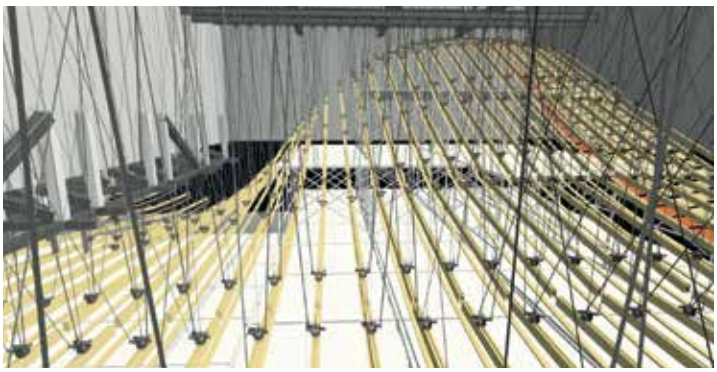
Better with BIM

It is the policy of China State Hong Kong Corporation Technology to become a fully 3D collaborative BIM environment by 2021. All project and asset information, documentation and data are digitized and be used in the whole building lifecycle. The key to provide this environment is the Common Data Environment (CDE), a cloud space for collecting, managing and sharing information with different teams working on a project. This is also a minimum requirement of a construction project to achieve BIM Level 2, and even BIM Level 3 standard.

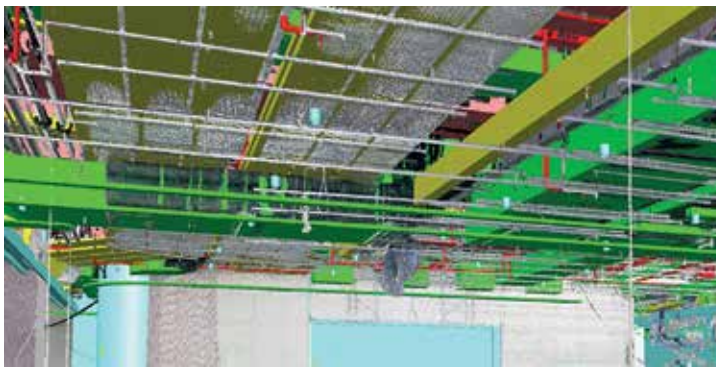
Rendering Image for Night View of Hong Kong Palace Museum
Image Courtesy of China State Construction Engineering (Hong Kong) Limited

Rendering Image for Front View of Hong Kong Palace Museum
Image Courtesy of China State Construction Engineering (Hong Kong) Limited

Digital Fabrication Model for External Perforated Aluminium Panel
Image Courtesy of China State Construction Engineering (Hong Kong) Limited

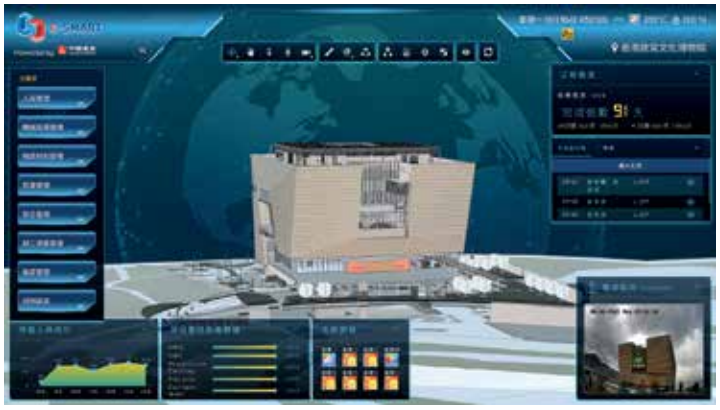


Construction Method Simulation for feature Ceiling
Image Courtesy of China State Construction Engineering (Hong Kong) Limited



As-built Verification using 3D Laser Scanner
Image Courtesy of China State Construction Engineering (Hong Kong) Limited

BIM based VR, AR & MR Application for Safety Training & Supervision of Construction
Image Courtesy of China State Construction Engineering (Hong Kong) Limited



Smart Construction Platform for Hong Kong Palace Museum
Image Courtesy of China State Construction Engineering (Hong Kong) Limited

COMPANY
CLP Power Hong Kong Limited

PROJECT
BIM NORMALCY

LOCATION
CLP Hoi Bun Road Substation, New Kowloon Inland Lot. No. 6118

TYPE
Alterations and Additions (A&A) Works in a "Live" Substation

SCHEDULED TIME OF COMPLETION
2022 Q2

BIM Enhances the Alterations and Additions Works inside a Live Substation

About CLP Power Hong Kong Limited

CLP Power Hong Kong Limited (CLP Power) is committed to supporting Hong Kong's long-term development as a world-class smart city. Being the largest electricity provider in the city, CLP Power develops electricity supply infrastructure continuously to provide a reliable and adequate power supply to over 6.2 million customers. The company has striven to provide the best services to customers and develop smart substations through innovations and adoption of emerging technologies.

BIM PARTNERS

David S.K. Au & Associates Limited

Beria Consultant Limited

isBIM Limited

B BIM Creation Limited

Hip Hing Construction Company Limited

AUTODESK PRODUCTS USED

Autodesk® A360

Autodesk® AutoCAD®

Autodesk® BIM 360®

Autodesk® Build®

Autodesk® Dynamo

Autodesk® Navisworks® Freedom

Autodesk® Navisworks® Manage

Autodesk® Revit®

Autodesk® Viewer

Project Description

Hoi Bun Road Substation (HBR) is a 132kV transmission substation in Kowloon Bay and has been supplying electricity to the local community for nearly 30 years. To meet the need for the transformation of commercial business area in Kwun Tong District, HBR is targeted for plant and equipment upgrading in order to provide a reliable power supply to support the district transformation.

Project Challenges

CLP Power attaches high importance to safety. As HBR is a live substation, construction activities inside must be carefully planned to ensure safety and avoid risk of interference to the in-service plant facilities. The planning of HBR shall be flexible enough to cater for future electricity demand and substation development. The project work shall be cost effective and environmentally friendly. Impact to neighbourhood must be mitigated.

Solutions for challenges

Safety in construction activities and future operations within HBR is carefully planned since the early project planning stage. The construction team therefore can fully understand the site condition and pay special attention to area which requires extra safety awareness and avoids unnecessary accident or injury.

With the collaborative effort of different subject experts, the redevelopment plan of HBR can cater the current and future requirements with good design quality.

Sustainable and green practices are adopted in the design and construction stage to improve the project's overall environmental performance. Site works are well coordinated to prevent re-work which can further help minimise the construction cost.

3D model and 4D animations are adopted to present the construction processes and the future operation of HBR for facilitating the communication with local community. A clear picture about the project development and benefits can be presented effectively to the local residents, green groups and stakeholders.

How does BIM benefit the project?

BIM enhances safety of work inside a live substation by simulating the working environment. Construction team, operators and maintenance team can identify potential hazards, unsafe features, make improvement and formulate safety plan in early stage.

The visualisation feature of BIM model not only allows studies on the possibilities in spatial studies for exploring future substation development, but also more effective options within the virtual environment for cost effectiveness. The virtual design process enables more scenario studies to avoid rework at site and results in a better design quality.

BIM improves the project's overall buildability by enhancing the design coordination and reducing waste due to the abortive works. Through BIM, the 3D model and 4D animations of the project works in HBR are produced quickly for presentation to the local community, the acceptance of the project by the public can be improved.

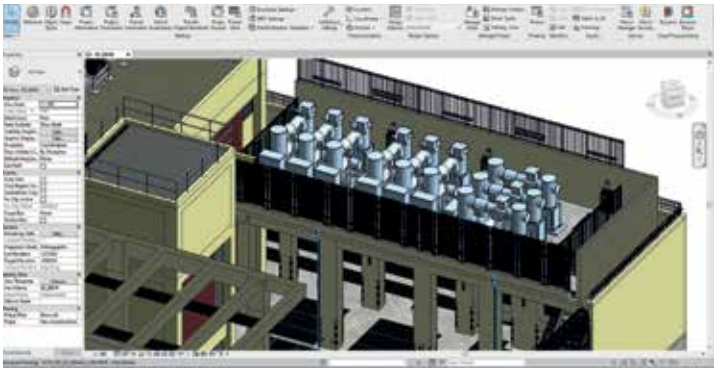
Better with BIM

With the use of BIM, 3D to 7D models, animations of the work processes and programme can be generated easily. Those relevant information enhances the transfer of project information from design stage to operation stage. The performance of the project can be accessed and reviewed easily. BIM helps to manage the knowledge and experience gained from the development works in a live substation which is very valuable for future redevelopment of other live substations.

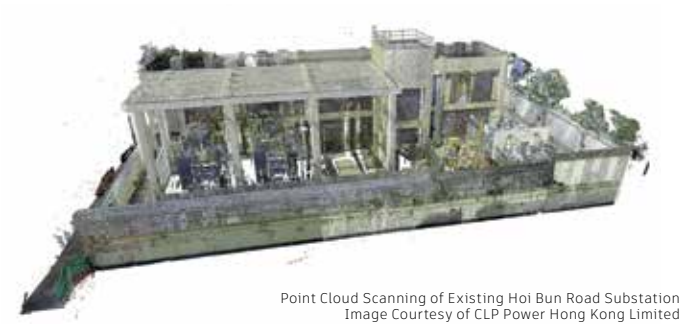
Transmission Substation Achieving BIM Normalcy – Overview of Hoi Bun Road Substation
Image Courtesy of CLP Power Hong Kong Limited

New RMU platform inside Hoi Bun Road Substation
Image Courtesy of CLP Power Hong Kong Limited

Simulation for Safety Training
Image Courtesy of CLP Power Hong Kong Limited



Revit Model Facilities Collaboration Process
Image Courtesy of CLP Power Hong Kong Limited



Point Cloud Scanning of Existing Hoi Bun Road Substation
Image Courtesy of CLP Power Hong Kong Limited

Eagle Eye System
Image Courtesy of CLP Power Hong Kong Limited

Construction Sequences Simulation for construction of new RMU platform
Image Courtesy of CLP Power Hong Kong Limited

COMPANY
Drainage Services Department, HKSAR Government
AECOM Asia Company Limited
The Jardine Engineering Corporation, Limited

PROJECT
Contract No. DE/2018/03- Shek Wu Hui Effluent Polishing Plant – Main Works Stage 1 – Sidestream Treatment Facilities and E&M Works for Sludge Treatment Facilities

LOCATION
Shek Wu Hui, Hong Kong

TYPE
Design and Build

SCHEDULED TIME OF COMPLETION
Q1 2024

Achieving UNITY with BIM: From cross-disciplinary collaboration to full life-cycle management

渠務署 Drainage Services Department

AECOM Imagine it. Delivered.

JEC 怡和機器 Jardine Engineering Corporation

Project Description

The existing Shek Wu Hui Sewage Treatment Works (SWHSTW), commissioned in 1984, is the first large-scale secondary sewage treatment plant in Hong Kong. SWHSTW is located at the North District with a design capacity of 93,000 m3/day in 2018. Owing to rapid population growth in the catchment, the existing SWHSTW is being transformed into Shek Wu Hui Effluent Polishing Plant (SWHEPP) to increase its treatment capacity by two-fold almost and at the same time upgrade the sewage treatment level from secondary to tertiary in order to meet very stringent discharge standards.

Project Challenges

SWHEPP Project is being delivered under different contracts, for which civil & structure is being constructed under a separate contract concurrently with this Electrical & Mechanical contract.

Both contracts are being carried out simultaneously. In order to enhance the design effectiveness, one of the challenges in this project is to collaborate efficiently with information exchanged accurately and timely. To avoid consequential effects on site, whenever there is any problematic design, they should be solved as early as possible.

This is the key to success in delivering multi-disciplinary contracts under the SWHEPP project.

Solutions for challenges

We used Revit as the core platform to conduct E&M system design and exchange these 3D geometric information for collaboration. It is to ensure the quality of information and the data are being collected from the originator. Our design can be presented clearly and been understood easily by other delivery teams in the 3D environment.

For effective collaboration, Independent BIM Consultant (IBC) acts an important role to monitor the BIM operation in SWHEPP. IBC uses the Common Data Environment (CDE) BIM 360 to oversee the collaboration among different contracts based on the agreed protocol. IBC also chairs regular Inter-contractor Task Group to identify and resolve any design challenges.

How does BIM benefit the project?

BIM has been adopted in SWHEPP and fully used from the design stage. We applied different dimensions of BIM uses, and the project is benefited in different areas, such as project management, construction process control, cross-disciplinary collaboration, communication with external stakeholders, decision making and risk management.

During the construction stage, with the BIM model, the complicated system E&M design can be clearly presented to the sub-contractors before site installation. Our team also uses BIM model to manage the site installation and Quality Control matters, to ensure design can be smoothly performed on site.

Better with BIM

With BIM and CDE, the project information is being managed properly and easily in different stages of project, the metadata are recorded by the system automatically and avoid erroneous information due to human mistakes. It makes our information procedure through BIM reliable and valuable.

BIM is the starting point to transform the construction industry into digitalization. The model can be used together with other technologies (AR, VR, BIM to Field, Field to BIM) to perform analysis and forecast any potential issues. Eventually BIM creates a strong connection between the virtual world and the real world.

About Drainage Services Department, HKSAR Government

Drainage Services Department of the HKSAR Government has a vision to provide world-class wastewater and stormwater drainage services enabling the sustainable development of Hong Kong, China. The mission includes improving drainage services in cost-effective and environmentally responsible manner, enhancing a caring, harmonious, safe and healthy work environment that fosters staff development and mindset for change, as well as strengthening relationships with community, industry and worldwide counterparts.

About AECOM Asia Company Limited

AECOM is one of the largest global providers of design, engineering, construction, and management services. The firm serves a broad spectrum of end markets including infrastructure, water, transportation, and energy. Based in Los Angeles, AECOM has a presence in over 150 countries and employs 87,000.

About The Jardine Engineering Corporation, Limited

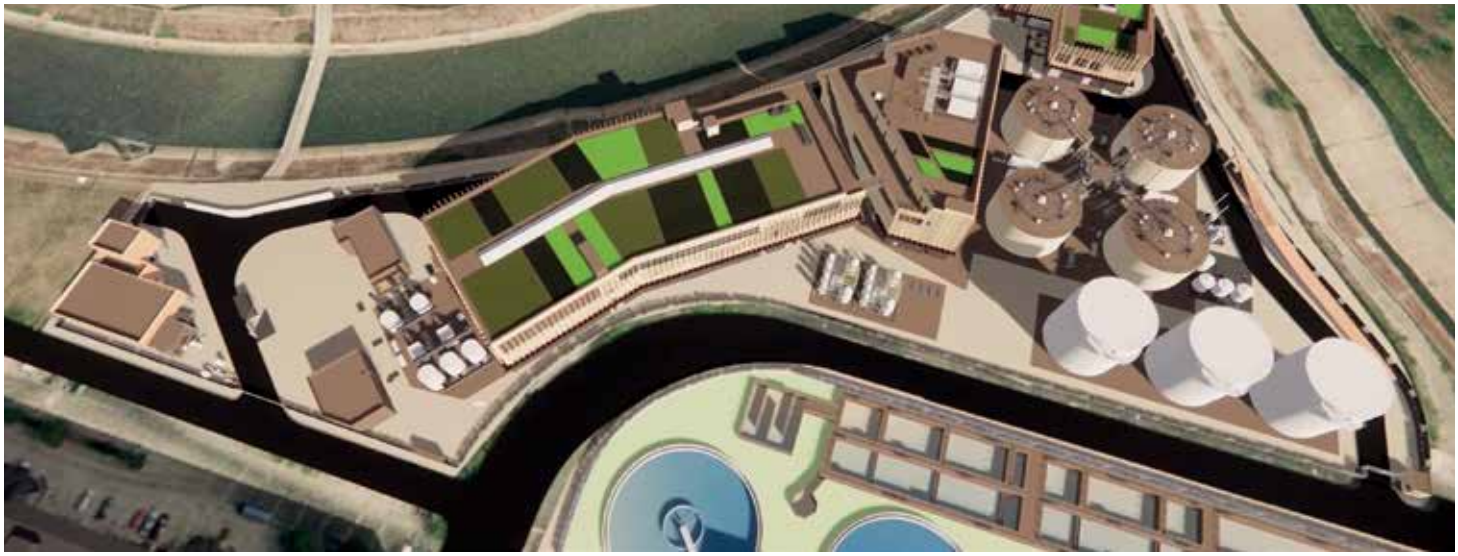
Jardine Engineering Corporation (JEC) is a leading provider of engineering services, sourcing and contracting expertise. The company enables its customers to operate their facilities at world-class standards by providing the contracting expertise to design, supply and install building and specialised processes; facility operation and management; asset enhancement and energy management; and the sourcing of electrical and mechanical equipment and architectural fixtures. Established in Shanghai in 1923, JEC is headquartered in Hong Kong and operates throughout Asia.

BIM PARTNER

Syntegrate

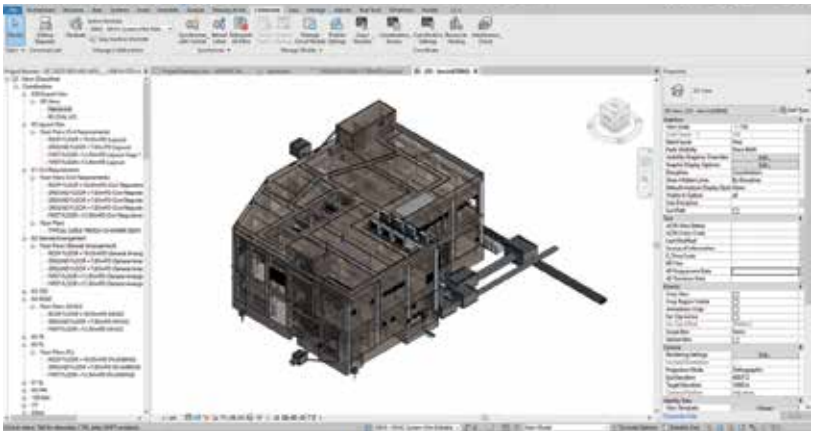
AUTODESK PRODUCTS USED

Autodesk® AutoCAD®
Autodesk® BIM 360® Design
Autodesk® BIM 360® Docs
Autodesk® Navisworks® Manage
Autodesk® Revit®



Overview of Shek Wu Hui Effluent Polishing Plant
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and The Jardine Engineering Corporation, Limited

E&M Design of Deodorization Unit
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and The Jardine Engineering Corporation, Limited



Revit Working Environment of BIM model
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and The Jardine Engineering Corporation, Limited

AR Application on Site
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and The Jardine Engineering Corporation, Limited

As-fitted 3D scan analysis against E&M installation
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited and The Jardine Engineering Corporation, Limited

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.

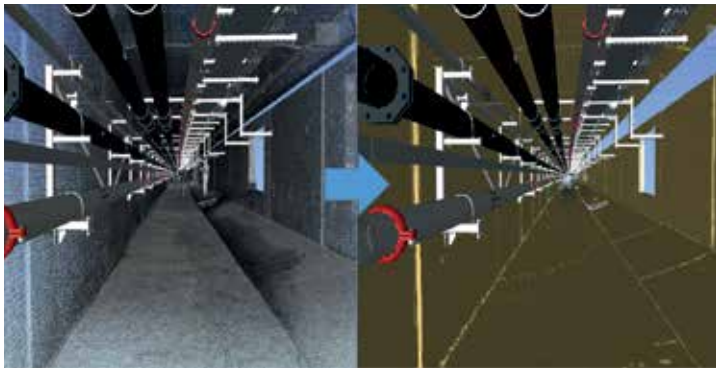
Better with BIM

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

COMPANY
Hong Kong Housing Authority, HKSAR Government

PROJECT
Innovative Use of Computational Design - A Public Housing Design Perspective

LOCATION
Hong Kong

TYPE
Public Housing Development

SCHEDULED TIME OF COMPLETION
On-going

Innovative Use of Computational Design - A Public Housing Design Perspective

香港房屋委員會
Hong Kong Housing Authority

About Hong Kong Housing Authority, HKSAR Government

The Hong Kong Housing Authority (HA) is a statutory body established in 1973 under the Housing Ordinance to provide subsidised public rental housing to low-income families, and to help low to middle-income families gain access to subsidised home ownership. The Housing Department is the executive arm of the HA to help the Government achieve its policy objective on public housing.

BIM PARTNERS

Advanced Construction Information Development Limited

Andrew Lee King Fun & Associates Architects Limited

isBIM Limited

Aggressive Construction Company Limited

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®

Autodesk® BIM 360®

Autodesk® CFD

Autodesk® Civil 3D®

Autodesk® Dynamo

Autodesk® Revit®

Autodesk® Fusion 360®

Generative Design in Autodesk® Revit®

Project Description

HA demonstrated that computational and generative design (GD) technologies could be innovatively applied to resolve complex design problems from architecture planning, structural and landscape architectural design to construction planning:

1. GD for pile supported foundation design
2. GD for paving design and tile-cut patterning
3. Computational design with solar and wind simulations for trellis
4. GD for design of directory signage in modularised panels
5. Computational view assessment tools for domestic blocks
6. Automatic clash-free MEP services routing design

Project Challenges

It was challenging for designers to script the design goal and logic into the GD software, along with various parameters such as spatial requirements (e.g. pile/pave-block size, spacing), analysis methods (e.g. structural analysis) and cost constraints (e.g. total pile/pave-block cost).

There was also limited choice of software that could produce accurate analysis results (e.g. structural, wind, thermal comforts, etc.) but also interoperate seamlessly with BIM or GD software in the trellis and signage design.

Solutions for challenges

After extensive research, study and making reference to the design of some as-built public housing projects, design goal and logic were scripted with Dynamo in various design scenarios for trial runs, and finally generated the optimised design layout for piles and paving units.

Further, through applying appropriate analysis softwares such as Autodesk CFD and Fusion 360, the optimised performance of trellis design and multiple design solutions for supporting frame of signage panels could be respectively evaluated and generated.

How does BIM benefit the project?

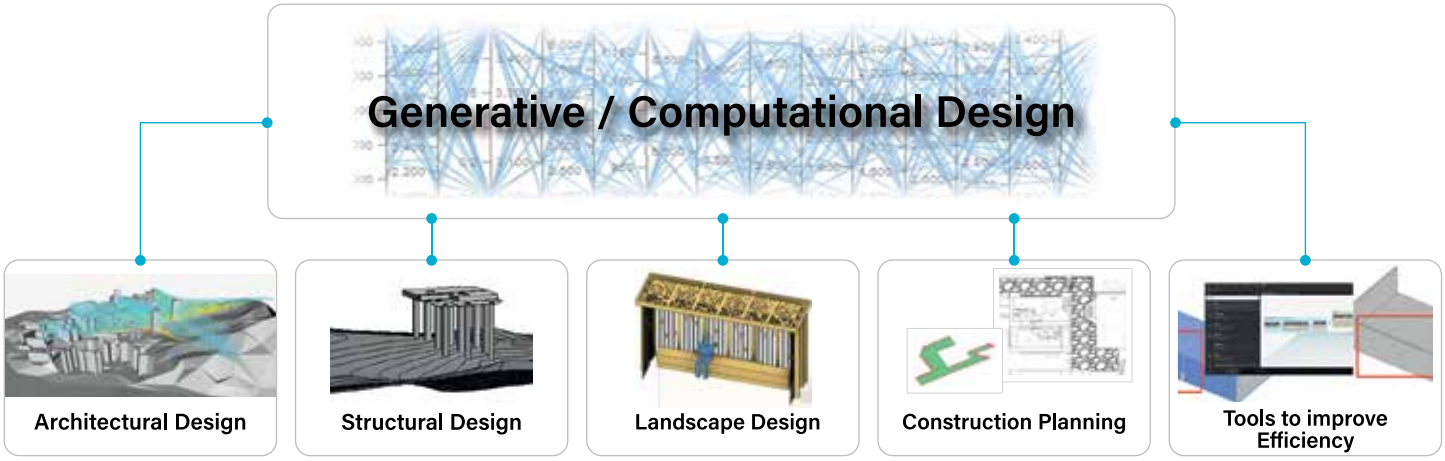
The application of computational or GD technologies attained following benefits as illustrated in the aforementioned design examples:

1. Automatically generated optimal pile layouts which maximised utilisation of pile capacity thus minimised pile cost
2. Reduced wastage of paving units and promoted reuse of cut tiles within site
3. Balanced sun-shade percentage and maximised thermal comforts in trellis design
4. Combined modularised signage panels and structural design requirements to create directional function
5. Provided quantitative view assessment data to assist Architects to make informed design decisions for building dispositions and orientations
6. Automatically generated clash-free services routing design of all MEP trades

Better with BIM

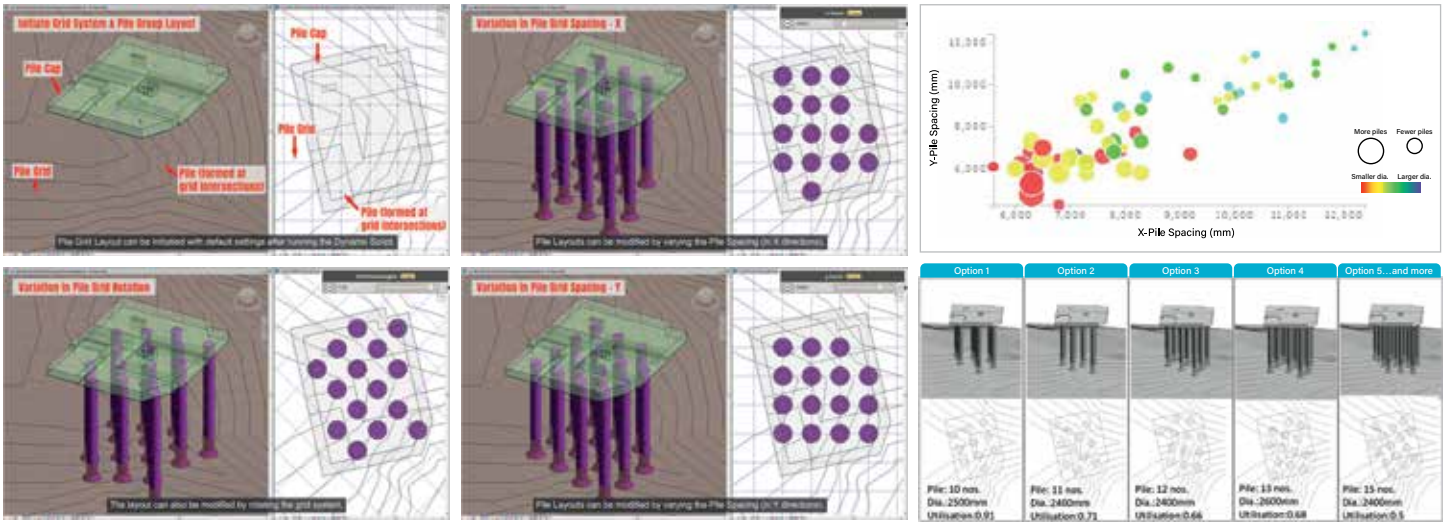
Apart from benefits in terms of design quality, efficiency and accuracy, the use of computational technologies empowered HA and our counter-parties to expand skill sets in the latest trend of design practice and digitialised the design and construction workflow.

The evolving paradigm of human-computer collaboration helped accomplish the holistic goal of sustainability in public housing development and probably a wider ecosystem in construction field. Unlocking the creative power of artificial intelligence in BIM would not make humans redundant, rather design professions could focus more on human and practical engagements to create a better and more sustainable environment.



Overview of computational or generative design applications
Image Courtesy of Hong Kong Housing Authority, HKSAR Government

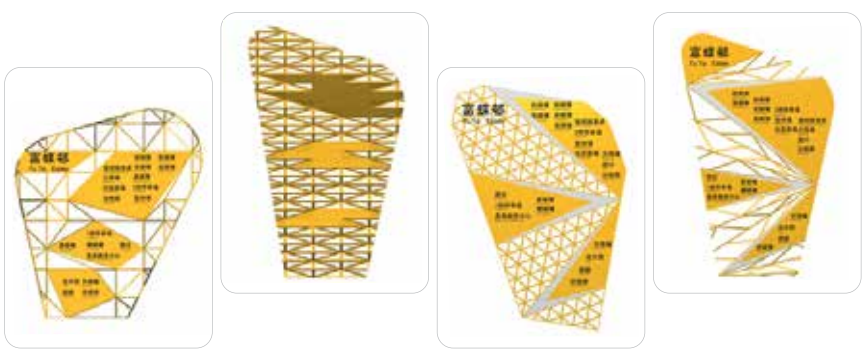
GD for pile supported foundation design



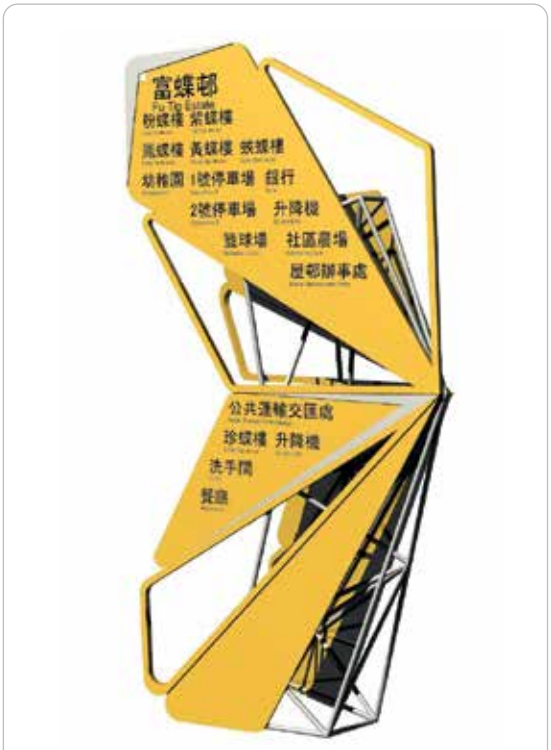
Adaptive grid system for generating pile design layouts and the output results of GD for pile layout design
Image Courtesy of Hong Kong Housing Authority, HKSAR Government

GD for design of directory signage in modularised panels

Phase 1
- Merging the shape of butterfly into signage;
- Maximising number of options with GD.



Phase 2 Modular Panels development



Phase 3 Combining requirements of Directional function, modular panels and structural design

Computational design and manufacturing workflow for modularised signage panels
Image Courtesy of Hong Kong Housing Authority, HKSAR Government

COMPANY
Leighton Contractors (Asia) Limited

PROJECT
East Kowloon Cultural Centre

LOCATION
Kowloon Bay, Hong Kong

TYPE
Building

Moving Forward: Transforming construction with innovation and creativity

About Leighton Contractors (Asia) Limited

For over 45 years Leighton Asia has built a strong track record as an international contractor delivering infrastructure projects ranging from complex civil engineering projects including tunnels, rail and road networks, and renewable energy infrastructure, to building projects encompassing schools, embassies, airports, rail terminus, luxury high-rise residential towers, and large-scale leisure complexes.

Leighton Asia is a leader in digital engineering, being one of the companies in Hong Kong and Asia who has achieved the British Standards Institute Kitemark for excellent in Building Information Management to the new international ISO 19650 standards series.

We currently operate in Hong Kong, Macau, Singapore, Malaysia, Indonesia, Philippines and India.

We are a member of the CIMIC Group, an engineering-led construction, mining, services and public private partnerships leader working across the lifecycle of assets, infrastructure and resources projects.

BIM PARTNER

Hcohtief India

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®
Autodesk® Assemble
Autodesk® AutoCAD®
Autodesk® BIM 360® Design
Autodesk® Dynamo
Autodesk® InfraWorks®
Autodesk® Navisworks® Freedom
Autodesk® Navisworks® Manage
Autodesk® Plangrid®
Autodesk® Revit®

Project Description

Leighton Asia's scope of works include construction of a seven-storey building, three studios with the capacity of between 120 and 250 seats, a 1,200-capacity auditorium, 550-seat theatre and under stage area, semi-basement areas for plant rooms, and other ancillary facilities. The project will also house a large rehearsal room, two connectable rehearsal rooms, a restaurant, box office, cloak room and enquiry counter.

Project Challenges

Given the complexity of the project, such as the irregular shape of the building and the high level of MEP, and the intrinsically complicated nature to visualize all construction disciplines, it is important to have a clear understanding of all construction details and potential coordination issues, especially to interpret the combined service drawings, which can be especially challenging.

Working through COVID-19 also threw up additional challenges with periods of time when members of the team would work remotely from home.

Solutions for challenges

BIM was implemented so that each project stakeholder could perfectly visualize the complex construction details. This is crucial to allow for coordination to take place.

BIM 360 allowed stakeholders to collaborate remotely in a shared environment, allowing a team of multiple modelers and coordinators, spread across different regions, to work on a shared model simultaneously and efficiently to meet project deadlines.

Other Autodesk tools were implanted, such as PlanGrid & Assemble.

PlanGrid for quick and easy access to project drawings and documentation, and Assemble for tracking the manufacture, delivery, and installation of the facades.

Reality capture was also implemented to allow virtual site visits.

How does BIM benefit the project?

BIM and Digital Engineering tools provide construction solutions to gain a better insight and knowledge of the overall construction process. Cross-platform collaborative issue management tools allowed for efficient tracking of both clash and design issues across a multi-disciplinary team, mitigating the risk and avoiding expensive re-working.

Construction cloud tools also resulted in a more efficient and smooth site coordination process with access to the latest models and drawings "on-demand" through mobile devices.

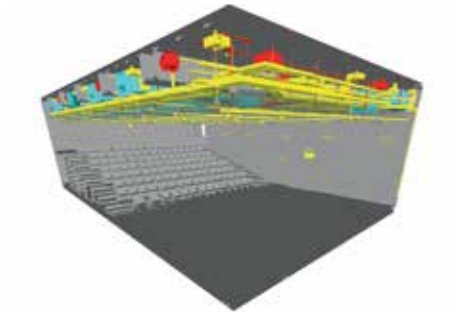
Better with BIM

Leighton Asia are going through a digital transformation and as part of that transition paper-based workflows are now becoming a thing of the past. Working in a traditional environment leaves room for error and can become costly, hence utilising the Autodesk Construction Cloud suite and digital tools such as BIM 360, PlanGrid & Assemble allow for better collaboration in real-time at each stage of the building process.

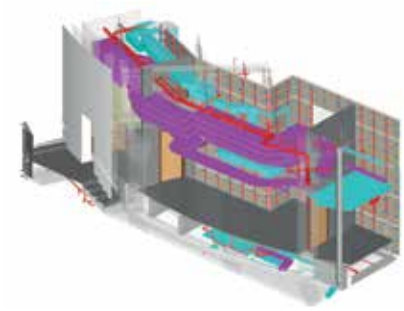
Daily reality capture allows users to track both site progress and conditions and compare against the 3D model to check if there are any discrepancies against the final design. This drives accountability, streamline coordination and keeps better record for future reference.

East Kowloon Cultural Centre external facade
Image Courtesy of Leighton Contractors (Asia) Limited

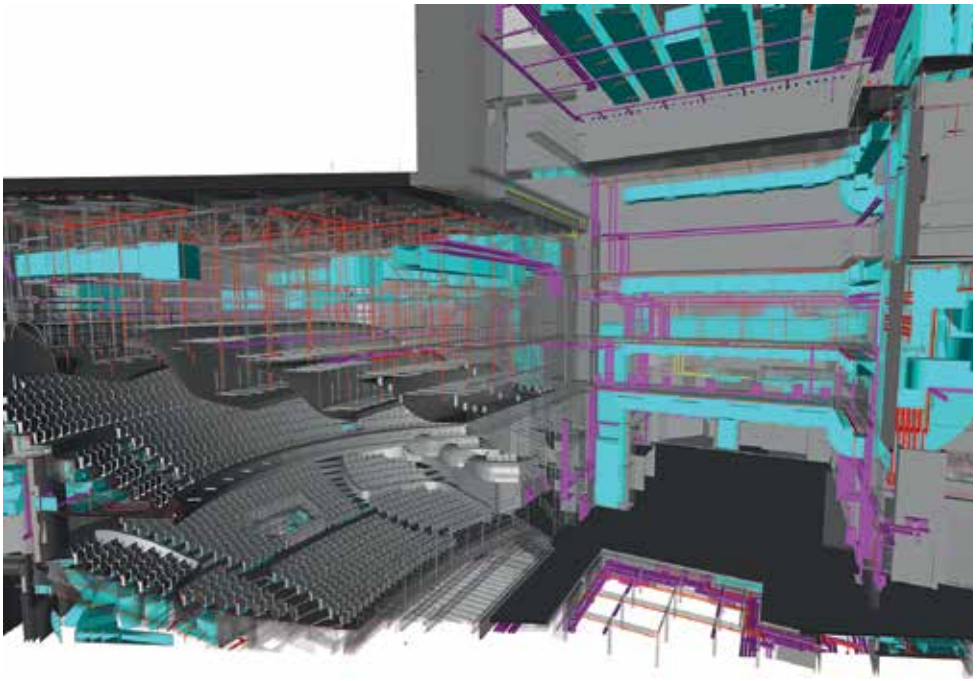
Daily project reality capture via 360 camera allowing for model comparison to existing work
Image Courtesy of Leighton Contractors (Asia) Limited



Music Lab Navisworks Model
Image Courtesy of Leighton Contractors (Asia) Limited



Example of MEP coordination
Image Courtesy of Leighton Contractors (Asia) Limited



Section through Theatre 1 Navisworks Model
Image Courtesy of Leighton Contractors (Asia) Limited

Advisors' Comments – Introduction

This year, we are extremely honoured to receive the invaluable support from the local supporting organisations and overseas BIM advisors. Locally, an advisory panel was formed by the representatives of local supporting organisations to discuss and review the selected projects, and their comments were consolidated and recorded. In addition to the comments of the selected projects, the overseas advisors also shared with us about the BIM development in other parts of the world.

Advisory Panel

Martin Riese
Registered Architect
A Chapter of The American Institute of Architects

Kelvin Tam
Chairman
Autodesk Industry Advisory Board

Ar Ada Fung, BBS
President
Hong Kong Alliance of Built Asset & Environment Information Management Associations (The Hong Kong Chapter of buildingSMART International)

Dr. Francis Chan
Chair of Professional Standards and Accreditation
Hong Kong Institute of Project Management

Stellar Leung
Co-organizer
Hong Kong Revit User Group

Dr. Calvin K. Kam FAIA, PhD, PE, LEED AP, CCBM
Founder and CEO
Strategic Building Innovation · bimSCORE

Sr Daniel Sum
Chairman
The Chartered Institution of Civil Engineering Surveyors (Hong Kong Region)

Michael Leung
Director of BIM Affairs
The Hong Kong Institution of Engineering Surveyors

Jimmy Wardhana
Director of AAM Board of Directors
Architects Association of Macau

Simon James Gallagher
Chairperson
Chartered Institute of Architectural Technologists, Hong Kong Centre

Ir Henry Cheung
Council Member
Hong Kong Information Technology Joint Council

Ir Dr. Eric S W Wong
Council Member
Hong Kong Institute of Utility Specialists

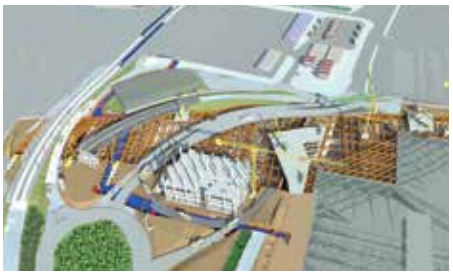
Ir Steven K H Lai
Vice Chairman
Institution of Public Private Partnerships

Wong Hon Fai
Chair
The Chartered Institute of Building (Hong Kong)

Ir Dr George Wong
Vice Chairman
The Hong Kong Institute of Building Information Modelling

Ir Raymond Lui
Committee Member
The Hong Kong Institution of Engineers (IT division)

Advisory Panel – **Award Winners**



Airport Authority Hong Kong
China State Construction Engineering (Hong Kong) Limited

C3801 APM/BHS Tunnels on Existing Airport Island

This spectacular infrastructure project involves excavation and construction of a 4-cell reinforced concrete Automated People Mover (APM) tunnel, 2-cell Baggage Handling System (BHS) tunnel, box culvert on existing airport island and a section of box jacking tunnel underneath the existing Airport Express Line. The contract also includes all associated road / utility diversions and reinstatement and a series of temporary works. Despite the high complexity, the Airport Authority Hong Kong and China State have made it a state-of-the-art showcase of how to fully utilise the digital BIM framework throughout the construction process to achieve effective collaboration between multi-stakeholders, accelerate the design coordination process, and resolve challenges in dealing with the complicated underground and aboveground works.

Architectural Services Department, HKSAR Government

Reprovisioning of Fu Shan Public Mortuary

To meet the goals of increasing capacity and improving service quality while reimagining mortuary through digitalization, various BIM applications were used throughout the project lifecycle from enhancing design visualisation with VR, project management with BIM Execution Plan (BEP), driving collaborations between multi-disciplinary stakeholders, smooth transmission for massive DfMA installation with BIM simulation programme, adopting DIALux for lighting design, to leveraging BIM 360 to conduct regular site safety and environmental supervision. The 4D/5D simulation of construction also enabled the project team to gain better control of the project with enhanced cost predictability and resource management.

Facing the pandemic, BIM 360 has further demonstrated its unique capabilities in facilitating the project team to drive undisrupted coordination with simple clicks, and the effective use of BIM in various stages has collectively brought productivity, cost control, quality and safety to this highly complex project.

Bureau of Public Works of Shenzhen Municipality
Architectural Services Department, HKSAR Government
China State Construction Engineering (Hong Kong) Limited

North Lantau Hospital – Hong Kong Infection Control Center (HKICC)

As the pandemic evolves, everyone needs to act swiftly to changes. In order to cope with the overwhelming demand for healthcare, it becomes crucial to be adaptive and creative with innovation. To promptly address the unpredictable and pressing community needs in the realm of uncertainty, the project of the North Lantau Hospital, likewise, is facing a very compact timeframe of 120 days to meet the explosive medical needs.

To speed up the construction time of such a fast-tracked project comprised of six 2-storey ward blocks, one 2-storey medical block, an energy centre, VIE tank, DG stores and plant room for medical gas, BIM 360, together with VR and Modular Integrated Construction (MiC), were utilised to enhance design and construction efficiency. As the world's first all-MiC negative pressure isolation hospital, the project is an outstanding illustration of how BIM technology helps realise a very challenging project by integrating innovative concept, construction technology, early users' engagement and seamless inter-department cooperation within a very limited timeframe.

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

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

Relocation of Sha Tin Sewage Treatment Works (STSTW) to Caverns is a pioneering project that initiates local cavern development for more sustainable land use. The 10-year project aims to mitigate the long-term shortage of residential land, and upgrade the ageing treatment facility to become more energy-efficient.

The project demonstrates an effective implementation of BIM workflows throughout the design, construction and operational stage. Technologies such as Drill-to-BIM, DfMA for retaining wall, Geotechnical Mapping with 3D scanning are very innovative showcases of significant efficiency enhancement with BIM. The impressive use of AI analysis also exceeds expectations on the power of BIM, while its 6D BIM sustainability initiative is also considered as one-of-a-kind and critical in conducting noise analysis for mitigation measures design. Overall speaking, the extensive adoption of the BIM technology in the entire project lifecycle makes it an impressive demonstration of successful integration of innovative ideas and practical applications in modern infrastructure construction.

Gammon Construction Limited
Hong Kong Science and Technology Parks Corporation

Advanced Manufacturing Centre

The Advanced Manufacturing Centre (AMC) in Tseung Kwan O Industrial Estate is one of the HKSTP's key initiatives for the re-industrialisation of Hong Kong. The 1.2 million square-feet multi-storey industrial building is built to Industry 4.0 standards, and designed to support high value-added production facilities for industries of all sizes. The project owner believes that innovation is the key to stay competitive in the market. With the complexity of this project, the construction team is committed to implementing BIM and various digital tools to help save resources and enhance efficiency, including Gamebot and drone.

The project demonstrates comprehensive use of technology, from algorithm to AI and IoT, with well-defined adoption of specific BIM technology for different purposes, such as ReCap Pro, InfraWorks, Dynamo and Vehicle Tracking for site planning and Navisworks and Revit for workflow acceleration. It also showcases an explicit use of 5D BIM technology that helps save up to 75% of time in IPA valuation approval and keep the as-built drawing record accurate.

Hip Hing Engineering Company Limited
Architectural Services Department, HKSAR Government
Vircon Limited

Design and Construction of Transport Department's Vehicle Examination Centre at Sai Tso Wan Road, Tsing Yi

Being one of the largest facility buildings in the world, the Vehicle Examination Centre (VEC) in Tsing Yi is expected to provide a wide range of intricate examination services. To tackle the challenges including vast amount of underground utilities, extensive area of drainage reserve, compact environment with slopes and highways nearby, and the proximity to existing traffic signs, the project team has proactively adopted BIM to mitigate the risks and facilitate smooth operations and ultimately deliver excellent outcome.

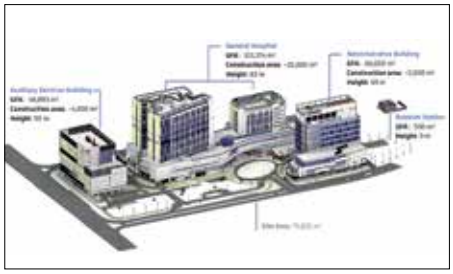
With the aim of resolving complex site interface issues, a variety of BIM technologies were adopted throughout the project lifecycle, from design optioneering, optimisation, overcoming site constraints to reaping benefits, including 40% reduction of material wastage. Leveraging the BIM virtual platform (BIM 360), BIM models were created, updated by BIM operators and reviewed by various fields of professionals anywhere via web collaboration, making it another showcase of how BIM makes things possible even under the pandemic.

Advisory Panel – Honorable Mentions

Andrew Lee King Fun & Associates Architects Limited

A 30-classroom primary school at Site KT2c, Development at Anderson Road, Kwun Tong

The project is to design and construct a 30-classroom primary school with special classrooms, assembly hall, library, basketball courts and other ancillary facilities. BIM tools including BIM 360, Revit, Dynamo and Navisworks were adopted from Feasibility, Inception Study, Planning to Tendering stage which facilitated smooth coordination and effective problem-solving among different stakeholders. BIM 360 also served as a favourable common data environment in the project that ensures all parties working on the latest model and also stimulates collaborations among multiple disciplines, especially during the pandemic when the project team mostly worked remotely.



China Construction Engineering (Macau) Company Limited

Island District Health Services Complex, Macao - Main Buildings

The Island District Medical Complex is a public hospital comprising of seven functional buildings equipped with high-tech facilities for medical protection, radiation therapy, organ transplant procedures, advanced medical rooms and over 1,100 beds. To ensure smooth completion of the project in 838 working days, BIM workflow was smartly adopted to improve the efficiency and effectiveness in coordinating and updating the various building systems in the 3D environment, enabling more efficient project coordination. Robotic total station was also set for automated site tasks, leading to reduction of unnecessary labour cost without compromising accuracy.

China State Construction Engineering (Hong Kong) Limited

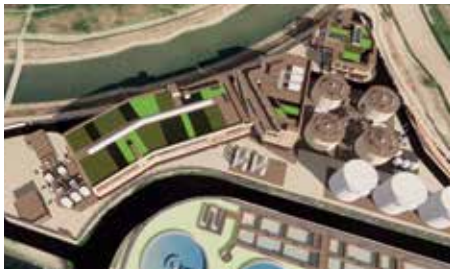
Hong Kong Palace Museum Work Contract for Main Contract Work

The Hong Kong Palace Museum has a complex inverted pyramid superstructure with unique irregular shape elements. The pandemic has created additional issues like labour shortages, supply chain issues and financing pressures, forcing the project team to accelerate the digitization of construction site operation, logistic and management with BIM. BIM 360 was thus adopted to create a collaborative platform for all stakeholders to share real-time design and construction information, foster effective communications, reduce human error, accelerate construction speed, improve craftsmanship and overall quality of work, and in turn effectively promotes Integrated Project Delivery System, making it a stellar showcase of comprehensive application of BIM in complex and iconic projects.

CLP Power Hong Kong Limited

BIM NORMALCY

The Hoi Bun Road Substation (HBR) is a 132kV transmission substation supplying electricity to the local community for nearly 30 years. To meet the evolving needs, the facility needs to be upgraded to provide a reliable power supply. Since HBR Substation is a live substation, safety is so important that BIM technology was adopted to enhance safety of work by simulating the working environment, making it easy for construction team, operators and maintenance team to identify potential hazards, unsafe features, make improvement and formulate safety plan in early stage. With its nature as a community facility, BIM models and 4D animations also enabled quick and vivid presentation to the local community for public acceptance. The project presents successful application of BIM in overcoming challenging site constraints in medium-sized infrastructure projects.



Drainage Services Department, HKSAR Government
AECOM Asia Company Limited
The Jardine Engineering Corporation, Limited

Contract No. DE/2018/03- Shek Wu Hui Effluent Polishing Plant – Main Works Stage 1 – Sidestream Treatment Facilities and E&M Works for Sludge Treatment Facilities

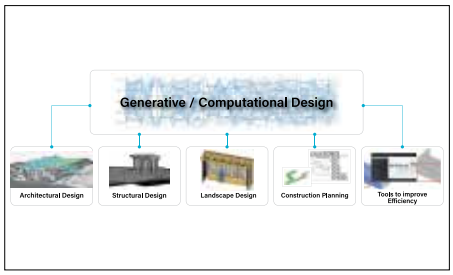
To meet the rapid population growth, the current Shek Wu Hui Sewage Treatment Works (SWHSTW) needs to be transformed into Shek Wu Hui Effluent Polishing Plant (SWHEPP) to increase its treatment capacity by almost two-fold and upgrade the sewage treatment level to meet the stringent discharge standards. Since this project involves 2 contracts implemented simultaneously, it is crucial to collaborate efficiently with information exchanged accurately and timely. BIM was adopted to facilitate project management, construction process control, cross-disciplinary collaboration, communication with external stakeholders, decision making and even risk management, making it a showcase of "Achieving UNITY with BIM" from concept to implementation and from cross-disciplinary collaboration to full lifecycle management.

Gammon Construction Limited

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

The Tuen Mun – Chek Lap Kok link tunnel is Hong Kong's deepest and longest sub-sea road tunnel. To provide E&M facilities to serve the newly constructed tunnel, Gammon has to make effective use of the limited space under the tunnel carriageway and the limited timeframe of 28 months to house all the public and E&M facilities.

To ensure safety and efficiency, Gammon adopted the Design for Manufacture and Assembly (DfMA) and an Integrated Digital Project Delivery (IDPD) approach. The BIM technology integrated well with the construction plans, enabling off-site production, prefabrication and streamlining installation processes, thus reducing on-site risks and boosting efficiency, showing mature and high-level BIM process in the design workflow.



Hong Kong Housing Authority, HKSAR Government

Innovative Use of Computational Design - A Public Housing Design Perspective

To resolve the complex design issues from architecture planning, structural and landscape architectural design to construction planning, the Hong Kong Housing Authority (HKHA) has demonstrated how computational and generative design (GD) technologies could be innovatively applied to improve design process, reduce redundant resources and time. HKHA has proved these are very useful and innovative tools that make this project a success case study for the industry.

Leighton Contractors (Asia) Limited

East Kowloon Cultural Centre

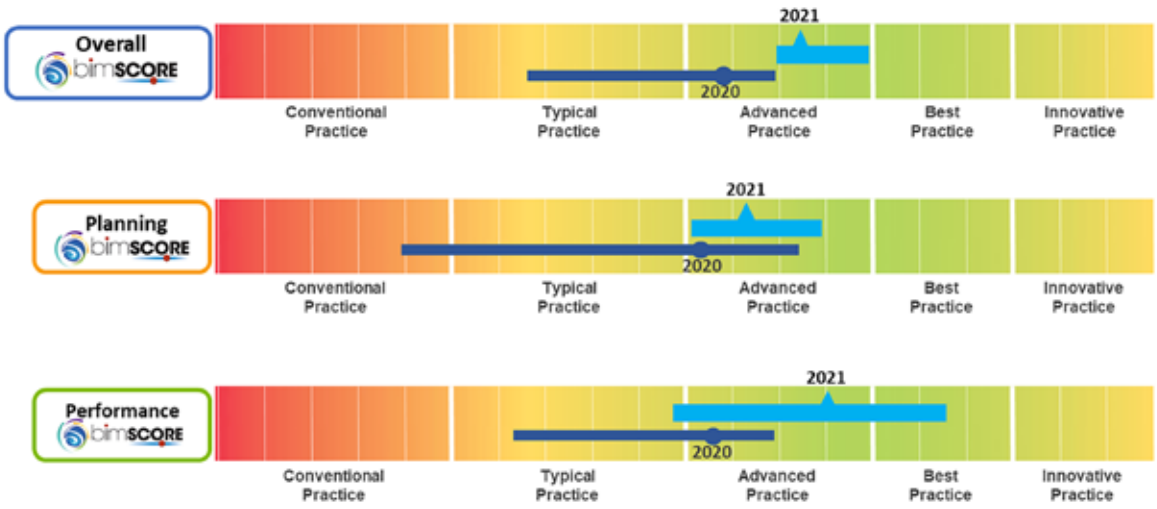
The East Kowloon Cultural Centre is a three-storey building with three studios of up to 250 seats, a 1,200-capacity auditorium, 550-seat theatre with under stage area, semi-basement areas for plant rooms, and other ancillary facilities. Given the complexity of the project, it is important to have a clear understanding of all construction details and potential coordination issues, especially in the interpretation of combined service drawings, which can be particularly challenging.

To mitigate risks especially during the pandemic, BIM was comprehensively implemented with a robust digital engineering strategy in mind. BIM 360 allowed stakeholders to collaborate remotely in real time in a shared environment, which enabled all to work on a shared model simultaneously and efficiently in order to present this iconic cultural landmark to the community.

Dr. Calvin Kam, FAIA, PhD, CCBM

Overview

The 2021 Hong Kong BIM Awards honour a diverse set of projects that champion a great variety of leading-edge and creative BIM-enabled processes and technology adoption supported by highly effective team collaboration. The winning projects have leveraged BIM to innovate and achieve successful outcomes, ranging from Tunnel Development to Re-provisioning of a Public Mortuary, to Infection Control Centre to serve the city during the pandemic period. It is delightful to see several 2017 to 2020 Hong Kong BIM Award winners (e.g., AECOM, ArchSD, CLP, DSD, Gammon, Hip Hing) also appeared as awardees this year, and they have further **expanded on BIM-based collaboration and implementation**, and **advanced new BIM-based technologies, Design for Manufacture and Assembly (DfMA), etc**. for better project performance. Applying the evaluation framework (which was developed by our team - an international management consulting firm "Strategic Building Innovation · bimSCORE") for a preliminary assessment based on the evidence provided in the submissions, we have benchmarked this year's winners against our global knowledge base of hundreds of projects from over 16 countries using our 5 maturity tiers ranging from "**Conventional**" to "**Innovative**" Practices. Within the global context, **2021 winners fit mainly in "Advanced" Practice**. The winning projects are further analysed with respect to the bimSCORE's four evaluation areas: Planning, Performance, Adoption, and Technology. The figures below illustrate the Overall bimSCORE and four area scores of the 6 winning projects in 2021, referenced against the scores of the 2020 awardees. In general, the figures indicate smaller variations of scores and an increase of average scores this year.



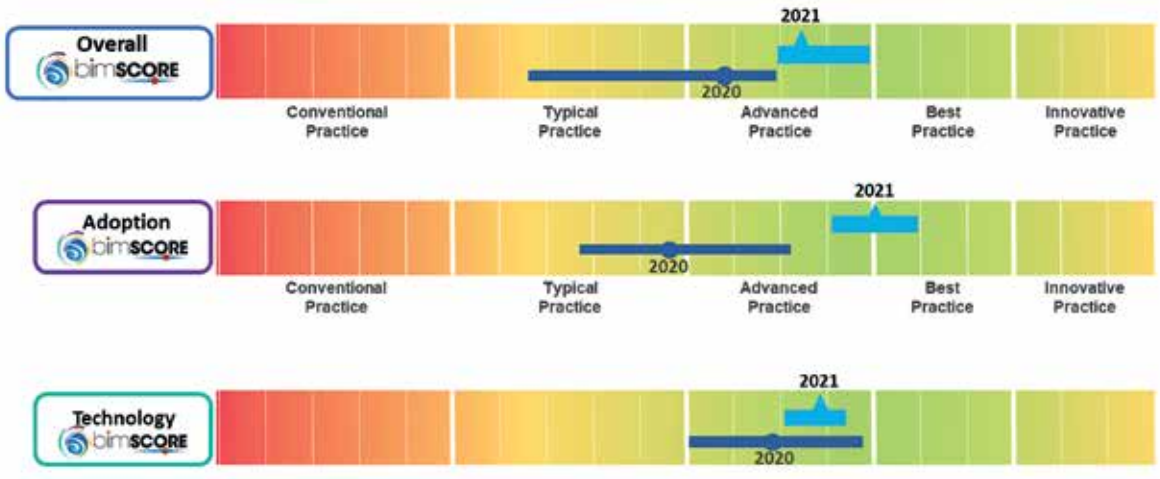
*** Projects were evaluated based on the materials submitted by the applicants without interviews.*

Planning and Performance

Planning for BIM implementation requires targeting objectives for success, supporting achievement with the needed tools and training, technical processes, and developing standards to guide an integrated project team. ***Performance*** monitoring of objectives is enabled through BIM and increased automation in quantitative tracking of project performance metrics to inform design and project management decisions.

The award winners recognize the importance of the alignment of BIM capabilities among project stakeholders. **China State Construction (CSC)** (Tunnels on Airport Island) defined BIM usages for the whole project at the beginning to ensure alignment among the stakeholders. The project reduced the risk by 80% and also managed to minimize the losses. **Hip Hing** (Tsing Yi Vehicle Examination Centre) Top Management took the initiative to implement BIM with the objective of risk mitigation and facilitated operations. The project was also able to reduce the MEP installation period by more than 80% along with a reduction in rock excavation by 40%. **CSC** (Infection Control Centre) referenced numbers of standards such as ISO 19650-1, ArchSD BIM Guide and CIC BIM Standard, and developed BIM Standards (2 volumes) to ensure efficient BIM Implementation. The project was able to resolve 1500+ issues and coordinated design within 6 days only (21 design versions). Overall, more performance metrics were tracked and documented by 2021 awardees including time, labour and resource investment. In a formal setting of bimSCORE evaluation, *Performance* score takes into account the qualitative responses of stakeholders (such as user emotion). Given it was not stated in applicants' submitted materials, the confidence level of the *Performance* scores is relatively low.

Some variations were observed among different projects in the Planning and Performance area, ranging from upper "Typical Practice" to lower "Best Practice" on the global scale. Organizations are therefore encouraged to establish BIM-based objectives, give recognition to exemplary projects that demonstrate auditable, repeatable, and objective quantification of benefits and develop respective quantifiable measures of success to track project performance and realize improvement throughout the project lifecycle.



*** Projects were evaluated based on the materials submitted by the applicants without interviews.*

Adoption and Technology

Adoption of BIM is measured across the project lifecycle (design through operations) and project stakeholders (designers, builders, owners and agencies) to understand the degree of BIM implementation. ***Technology*** considers the informed selection of BIM analyses and tools that are supported by interoperable information exchanges and information-rich models.

We have witnessed a growth in effective BIM-based multi-disciplinary coordination among different stakeholders across multiple project phases, with a deeper level of technology integration using Common Data Environment (CDE). We are also pleased to see openBIM has been implemented in multiple projects in order to further facilitate data exchange and smoother workflow. **Gammon** (Advanced Manufacturing Centre) implemented AI-based tool for Generative Sequencing called Gamebot. The project also implemented technologies using Drones, IoTs, etc. **DSD** (Sha Tin Sewage Treatment Works to Caverns) carried out BIM-based Noise Analysis, Parametric Tunnel Modelling and Laser Scanning for Rock Mapping using Dynamo, Forge, Revit, BIM 360, etc. to save time in surveying and BIM development processes. **ArchSD** (Fu Shan Public Mortuary) applied DfMA of MEP modules for major plant rooms, which has led to 35% labour saving and LEAN construction.

In comparison to 2020 awardees, 2021 awardees have established better Collaboration and BIM Sharing Processes, and had more explorations on openBIM-based workflow. Also, the BIM implementation has involved more project areas from design to maintenance. This has contributed to higher scores in the Performance Area. Moreover, advanced technology use for achieving various use cases has also led to an increase in the score for Technology Area. Projects owners are encouraged to better balance the breadth and depth of BIM uses in response to the project and client objectives, as well as the project team and market capability.

Dr. Calvin K. Kam FAIA, PhD, PE, LEED AP, CCBM
Founder and CEO, *Strategic Building Innovation · bimSCORE*
Adjunct Professor, *Center for Integrated Facility Engineering, Stanford University*

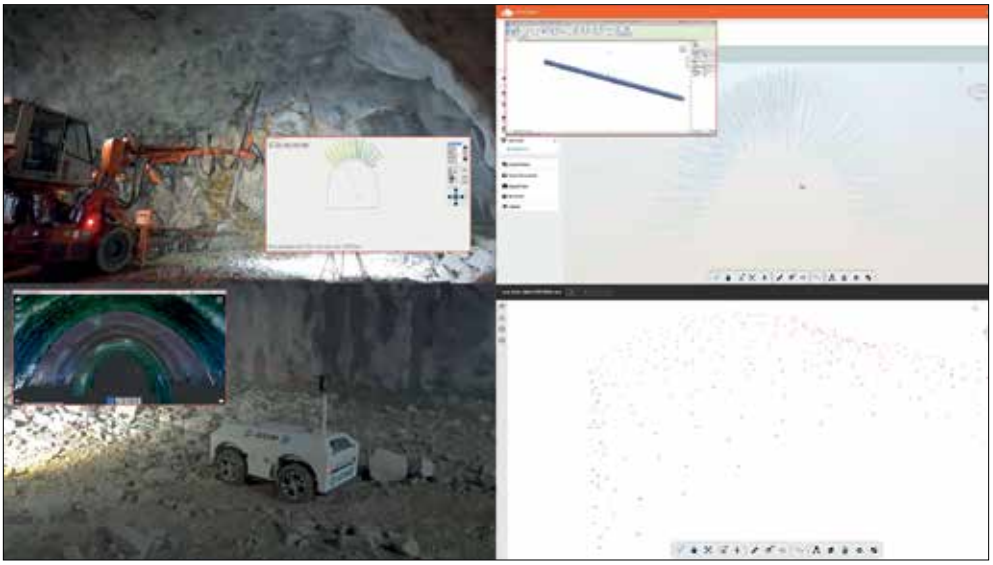
Dr. Calvin Kam is the Founder of Strategic Building Innovation (SBI) and bimSCORE.com - the "GPS Navigator" for any enterprise or project team charting courses for construction innovation. SBI was invited to present and facilitate at both the 2014 and 2015 APEC workshops and to author APEC publications. Dr. Kam teaches undergraduate, graduate, and professional courses and leads research as an Adjunct Professor at Stanford University's Center for Integrated Facility Engineering, where he partners with industry members in areas such as Building Information Modeling, Virtual Design and Construction as well as Smart and Sustainable Developments. Calvin and his SBI global team serve as volunteer leaders, certified training provider, and expert advisors for buildingSMART International as well as a number of chapters including Hong Kong Chapter (HKABAEIMA). Calvin was a former National Chairman of the Center for Integrated Practice and the Technology in Architectural Practice Knowledge Community (supported by 10,000+ professionals) with the American Institute of Architects, for which he had also served on the Board Knowledge Committee.

Dr. Kam has been working with Construction Industry Council, Development Bureau, English Schools Foundation, Hong Kong Housing Authority, Lands Department, Sun Hung Kai Properties, University of Chicago, Walt Disney Imagineering, etc. In 2011, Singapore government's Building & Construction Authority appointed Calvin as an international expert to advise its construction productivity and BIM roadmap. In 2013, China's National BIM Union and Standard appointed Calvin as the only international Honorary Director to advise the international harmonization and collaboration of its nationwide BIM standards/development. In 2015, Calvin was appointed an Expert Advisor to the Shanghai government's BIM advancement center.

A recipient of various honors/awards including ENR's "20 under 40" and BD+C's "40 under 40", Calvin is a Registered Architect, Professional Engineer, and LEED AP in USA with Ph.D. from Stanford University. Dr. Kam has presented at 100+ industry events/ universities across 18 countries and regions and published a number of book chapters and journal publications. Calvin has served as an Expert Advisor of the Autodesk Hong Kong BIM Awards since 2008.

Chui Ho Chun, Eddie
BEng (Hons), CEng, MICE, MIStructE, MHKICBIM, BEAM Pro

Eddie CHUI is currently the Resident Engineer of AECOM Asia Company Limited, responsible for the integration of BIM and technology, digital transformation and contract administration of the Relocation of Sha Tin Sewage Treatment Works to Caverns Project (Sha Tin Caverns Project) . Eddie is a Chartered Civil and Structural Engineer, with extensive experience in construction, engineering design, contract administration and BIM management of mega infrastructure projects. Eddie is also a part-time lecturer at the Hong Kong Institute of Vocational Education (IVE) teaching BIM for Construction.



Drilling holes for rock bolt installation; Parametric modelling using Autodesk® Revit® and Autodesk Forge®; 3D scanning with Robotic system and viewing point cloud with Autodesk® ReCap® Pro; Anchor nuts recognised by AI analysis
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited

Construction Workflow Advancement with Comprehensive BIM Application and Innovative Technology of Sha Tin Caverns Project

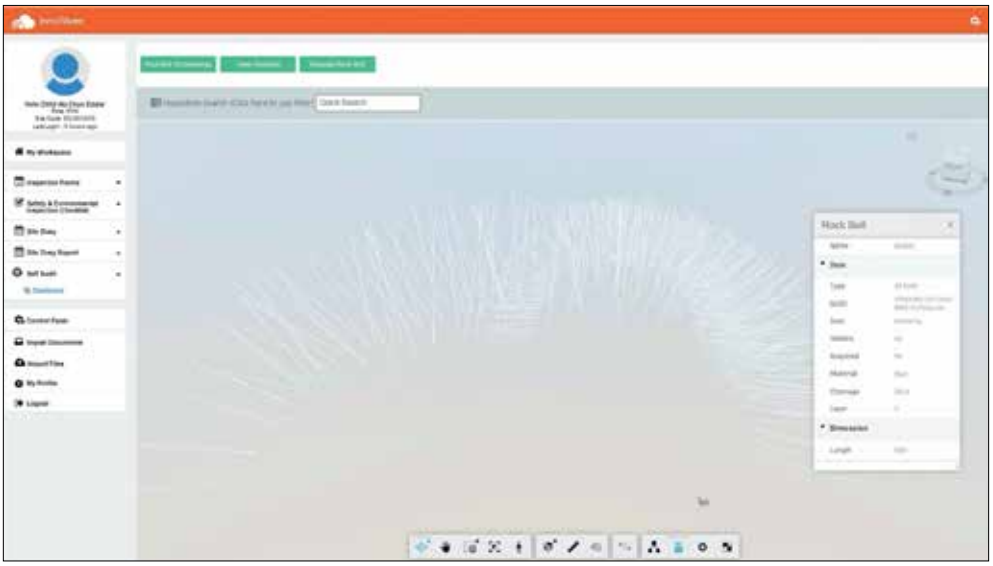
Introduction

Construction projects are dynamic and complicated in nature with many unforeseen conditions. An effective way to facilitate project delivery is to utilize Building Information Modelling (BIM) to construct geometric and informative digital models, which can facilitate design, construction, operation and maintenance of the structure from the origin. In this project, further integrating BIM with innovative technologies, enhances the workflow of asset information modelling and Design for Manufacture and Assembly (DfMA) methodology.

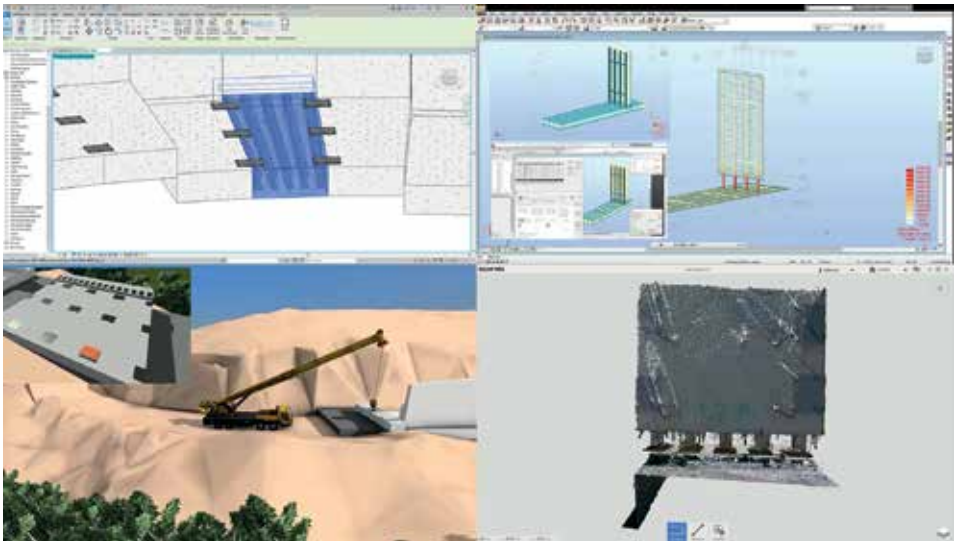
Drill-to-BIM Approach

Rock bolt stabilizes tunnel excavation in our cavern complex. Traditionally, only the exposed part of the rock bolt, the anchor nut, can be surveyed as the bolt shaft is fully embedded. I proposed a new workflow, Drill-to-BIM Approach, for automatic rock bolt modelling to obtain a fully completed Asset Information Model (AIM).

The workflow of Drill-to-BIM Approach is drilling, data collection, modelling, clash detection, 3D scanning and model review. The drill rig data is collected by a customized software in the drilling jumbo machine, which is then transmitted to the



Accepted AIM after automatic review using Autodesk Forge®
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited



Design model of retaining wall modelled using Autodesk® Revit®; Structural Analysis of retaining wall using Autodesk® Robot Structural Analysis Professional; Construction simulation of retaining wall; Survey check and measurement using Autodesk® ReCap® Pro
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited

project server instantly.

Using application programming interfaces (API) offered by Autodesk Forge, a preliminary AIM is modelled with the parametric model and drill rigs data. Real-time clash detection is then performed between the AIM and Project Information Model (PIM) automatically with Autodesk Forge.

A 3D scanner mounted on a robotic system scans the rock face for detailed inspection remotely. Artificial Intelligence (AI) analysis is used to recognize the anchor nut from the point cloud data and obtain the associated coordinates. Another script developed using Autodesk Forge checks whether the preliminary model of the rock bolt is aligned with the corresponding scanned coordinates. Parameters and conditions are carefully considered to ensure the accuracy of automatic alignments.

Construction of Retaining Wall with DfMA Methodology

The construction of Bay 1 to Bay 7 of retaining wall RMZ3 is challenging because of the limited working space and steep slopes. Cast-in-situ concreting is almost impossible. I take advantages of BIM and propose the trending DfMA methodology in retaining wall construction.

Autodesk AEC Collection, Autodesk Forge and BIM 360 are used from the design to the construction stage of that portion of retaining wall. After rounds of design scrutiny, the Revit model of the most suitable design scheme is then exported to Autodesk Robot Structural Analysis Professional for detailed design review. Shop drawings are generated with Autodesk Revit directly and reviewed by the site team.

A construction simulation showing the sequences of lifting and the assembling procedures is prepared for safety demonstration. A pre-assembling check using a 3D scanner can ensure a seamless installation on site. After assembly, the as-built structure is scanned to form the associated AIM.

With the application of Autodesk Forge, a model viewer with a push pin function is integrated into the Digital Works Supervision System (DWSS) to ease the inspection form creation, and thereby, uplifting documentation and quality management.

During the operation stage, strain gauges are affixed to monitor the structural performance of the retaining wall at critical locations. An Internet of Things (IoT) platform is developed for easy data monitoring with the AIM.

Outcomes and sustainable development

The use of BIM and its integration with technology enhances the workflow throughout the project lifecycle, as well as reduces time and cost implications. To conclude, it is proven that BIM application helps in managing the Sha Tin Caverns Project efficiently.

Lifting and assembly of retaining wall; Overview of retaining wall
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited

DWSS with BIM integration using Autodesk Forge®; IoT platform for strain monitoring using Autodesk Forge®
Image Courtesy of Drainage Services Department, HKSAR Government and AECOM Asia Company Limited

Ong Qiao Min

INSTITUTION
City University of Hong Kong

PROJECT NAME
An Innovative Approach to Architectural Design Coordination: BIM-Based Multi-User VR Motion Simulator System

PROJECT LOCATION
Hong Kong

TYPE
Architectural design coordination of a 3-storey community centre

AUTODESK PRODUCTS USED

Autodesk® 3ds Max®

Autodesk® AutoCAD®

Autodesk® BIM 360® Design

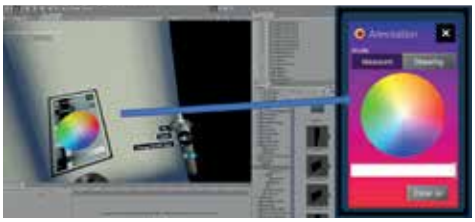
Autodesk® Revit®

Two participants are performing design coordination tasks by using the MUVR motion simulator system in the physical world (left) and virtual world (right).
Image Courtesy of City University of Hong Kong

An Innovative Approach to Architectural Design Coordination: BIM-Based Multi-User VR Motion Simulator System

Project Background

Along with the development of advanced technologies, Building Information Modelling (BIM) offers alternative solutions for traditional on-site design coordination in the architecture, engineering and construction industry. As a rich-information model, BIM is useful in terms of collaboration and coordination in design work. Nevertheless, challenges and inefficiencies remain exist during the design coordination process. For example, the relationship between design conflicts is hardly defined and difficult to understand, ideas for solving clash issues are poorly expressed and documented, and soft clashes cannot be well presented in terms of spatial sense. Thus, innovative technology should be used to promote efficient design coordination.



The user interface of annotation and measurement tools.
Image Courtesy of City University of Hong Kong

Project Challenges and Solutions

The challenges encountered during conventional BIM-based design coordination are due to the absence of an interactive platform for designers to visualize, discuss and directly interact within the BIM model. As such, this study aims to present a Multi-User Virtual Reality (MUVR) motion simulator system that integrates BIM into VR technology to enhance efficient design coordination process in the AEC industry.

Firstly, the system incorporates the client-server approach to involve multiple VR users so that they can interact with each other within the BIM design model in the shared virtual environment. Secondly, the system integrates the locomotion platforms into the MUVR server to resolve the motion constraints when using the conventional VR applications. VR users are no longer restricted to the physical space boundaries. Thirdly, the system includes the VR interaction tools such as annotation and measurement tool to enhance the overall design coordination process in the MUVR environment.

How does BIM help for your project?

A BIM model can maximize the efficiency in design and documentation process because the parametric modelling helps to manage all the geometric and non-geometric information. For instances, the BIM model developed in this project supports automation of repetitive tasks such as updating floor plans and sections spontaneously as the model is developing.

In terms of capacity, BIM model consists of a huge database of project information. With single click of button, all the related information can be traced easily and reduce the potential of information loss. Especially by using the Autodesk BIM 360 Design, all the data such as the architectural BIM model, VR-BIM walkthrough video, etc. can be exchanged, stored and managed in a good order.

Furthermore, Autodesk BIM model always interoperates with its own native products. in this project, the BIM model is further optimized geometrically and graphically in Autodesk 3ds Max to produce an immersive and realistic 3D VR model for design coordination process.

Finally, I would like to express my sincere gratitude to my supervisor, Dr Calvin Keung, who offers resources, guidance and assistance in this research project.

A I A B

Autodesk Industry Advisory Board

About **AIAB**

AIAB (Autodesk Industry Advisory Board) is formed by a group of experts who are willing to share their valuable experience from Building, Civil, Media and Entertainment industry.

Mission

Autodesk Industry Advisory Board (AIAB) is an informal and non-profit making interest group that acts as a bridge between the industry and Autodesk for solid and bidirectional communications. AIAB, as its title suggests, has an advisory role. Its main objectives include, but not limited to:

- Act as a platform for technology exchange and experience sharing
- Advance the professional standards on Autodesk products
- Express and share opinions and views on technology development
- Promote the development, usage and awareness of design technology in HK, mainland China and Macau
- Provide cross-border technology exchange/visit
- Provide latest technology update

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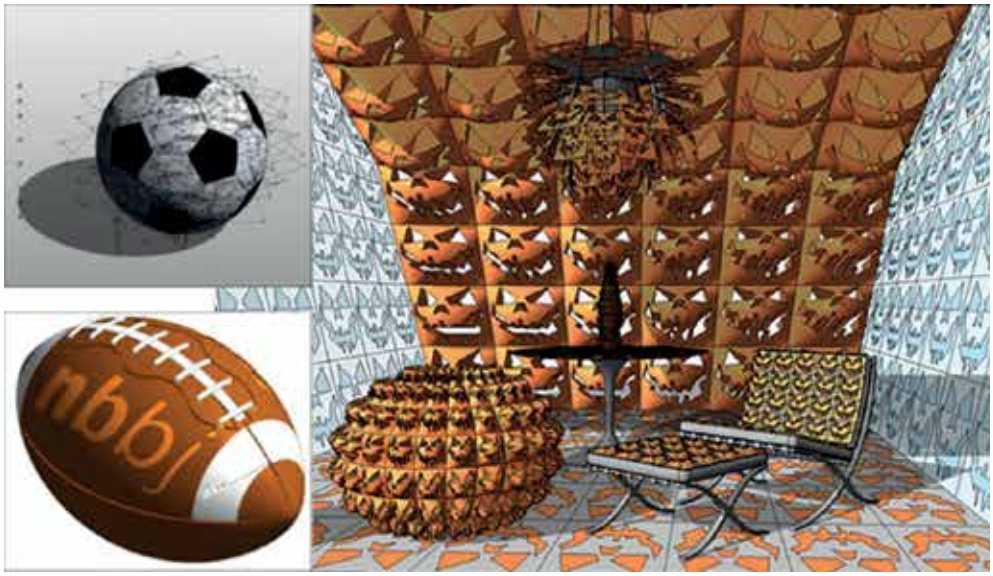
AIAB

Kelvin Tam

Chairman of Autodesk Industry Advisory Board

Kelvin Tam is a well-experienced US Registered Architect and CIC BIM certified BIM Manager with over 20 years of project experience across the USA, Middle East and Asia. He has been a BIM user and leader since 2005. Over the years he has been a BIM leader in corporate architecture firms in the USA, Hong Kong, Qatar, Abu Dhabi and Singapore; leading the effort of migrating from 2D CAD to 3D BIM practice by implementing BIM process in projects, making firm wide BIM strategies and standards, coaching and mentoring internal users. For the past 15 years, he has been focused on the development, implementation and support of advanced BIM/VDC technologies to continuously improve the delivery process to clients.

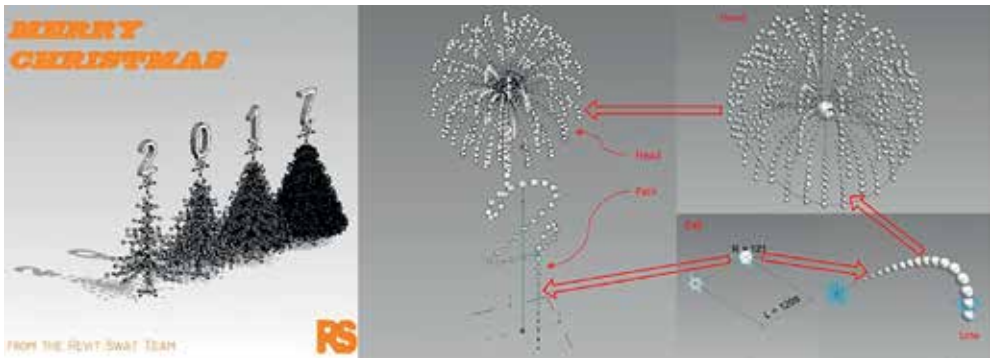
Mr. Tam is a BIM expert well-known in this field and loves to share his knowledge and expertise with fellow BIM learners. Since 2010, Mr. Tam has been actively speaking in major international BIM conferences such as Autodesk University Las Vegas, Autodesk University Extension Dubai, Revit Technology Conference (Australasia, North America, Europe, Asia), Hong Kong Institute of Building Information Modeling Conference, BILT Asia and BILT North America. Mr. Tam is the founder of the Hong Kong Revit User Group, chairman of Autodesk Industry Advisory Board, committee member of Global BIM Centre of Excellence, external advisor (BIM) of the Hong Kong Institution of Engineering Surveyors, BIM Accreditation Assessor of the Hong Kong Institute of Architects.



AIAB - An Intimate Amusing Buddy

BIM has been talked at high management and strategic level while the actual BIM processes and operation are dependent on the operators' skills in specific discipline and software. BIM tools have existed in the market for over 20 years, however they are still not able to gain the popularity or even acceptance from the general users in the industry. While AIAB (Autodesk Industry Advisory Board) is promoting BIM by helping the users to adopt to the new practice of digitizing design and construction by hosting technical seminars in usage of software, there are on the other end frustrated Revit users complaining the tools unable to do this or that and trying by all means to get back to the old school 2D drawing methodology. Is it so difficult to do Revit?

Being an Autodesk product user for over 20 years, I have been growing with Revit for the past 16 years. To me Revit is another AIAB, **A**n **I**ntimate **A**musing **B**uddy who has been on my side through these years helping both my personal and professional development and more importantly giving me a lot of fun. I would like to take this opportunity to say thank you to **AIAB**.



Certainly, you have to be hardcore modeller before you become a professional. From modelling "Balls" to "Pumpkins", from modelling "Moving Body" to "Ironman", from modelling "Christmas Trees" to "Firework", Revit has been turning me into a thinker in 3D, not only creating 3D but also designing methods to design and explore. It is universally true that no pain no gain.

So be passionate, committed, and addicted. May I invite you to join the party and be the next BIM Revit KOL shining star?

Ir Brian Leung

Ir Brian LEUNG is the Deputy Head, Department of Construction, HK Institute of Vocational Education (Tsing Yi), Vocational Training Council (VTC) cum Programme Leader of the Higher Diploma in Civil Engineering.

Ir LEUNG is an experienced engineer and lecturer. He is a CIC-Certified BIM Manager (CCBM). Currently he serves as Expert of WorldSkills Hong Kong for the Competition Skill on Digital Construction.

He is also a Member of the Hong Kong Institution of Engineers (HKIE) and Registered Professional Engineer (RPE) in Civil and Structural Disciplines. He is also a Chartered Member of the Institution of Civil Engineers (MICE) and the Institution of Structural Engineers (MIStructE) of UK.

Unleashing Young Talents on BIM for WorldSkills Competition

The WorldSkills Competition, also hailed as the "Skills Olympics", organised every two years by the WorldSkills International (WSI), is the biggest vocational education and skills excellence event in the world with an aim to showcase the best in skills and introduce youth to a variety of skilled careers.

Hong Kong has become a member of the WSI and participated in the WorldSkills Competition since 1997. Up to now the WorldSkills Hong Kong (WSHK) has organised 34 Competition Skills.

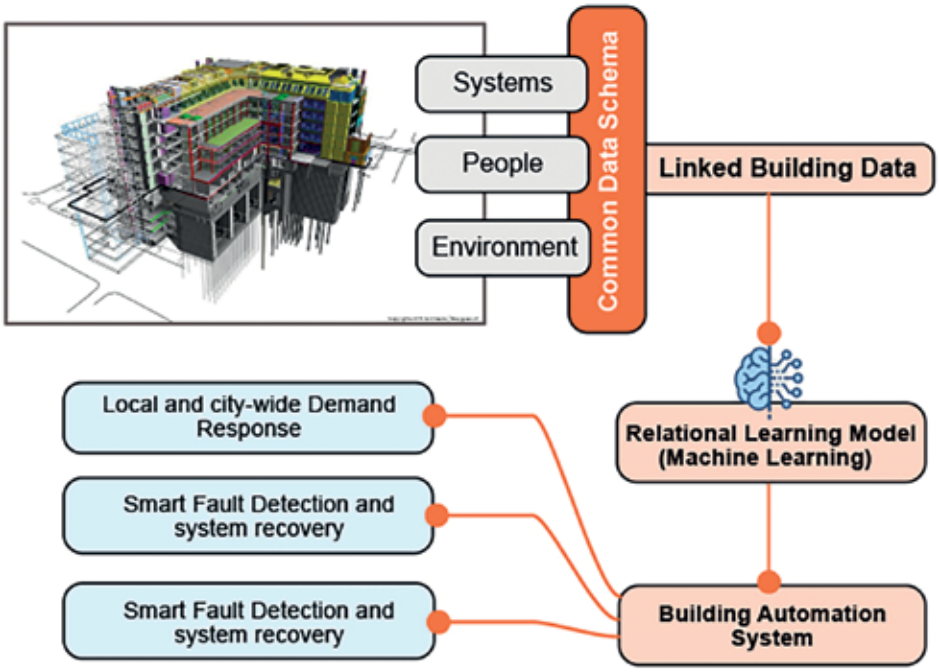
"Digital Construction", which emphasizes BIM talents and skills, is a newly approved Competition Skill in WSI for the WorldSkills Competition to be taken in Shanghai in October 2022. With this regard, WSHK has organized a local competition in April 2021. Hong Kong permanent residents with relevant BIM work experience or knowledge of respective skills born on or after 1 January 1996 were eligible to apply. The competition was broadly promoted in Hong Kong secondary schools and teritiary educational institutions. Around 40 students were enrolled and shortlisted. Online briefing and BIM training workshops have been organized so that the students could be familiar with BIM skills and requirements of the competition.

The local competition was successfully conducted in the BIMiHub of Vocational Training Council (VTC) on 15 April 2021. During the competition, each competitor was required to complete BIM tasks including Architectural Modelling; Structural Modelling; Coordination; Corrective Modelling; Drawing Production and Visualization Task with Autodesk BIM software provided. It was our honour to have Ir Francis LEUNG, founding Chairman of the Hong Kong Institute of Building Information Modelling (HKIBIM); Mr. Kevin WONG, current Chairman of HKIBIM and Dr Wendy LEE, the Regional Manager (HK & Macau), Autodesk Far East Ltd to serve as judging panel to assess the performance of competitors. Three young winners have been identified for further intensive BIM training arranged by VTC and industrial partners. Competitor with the most outstanding performance would be chosen as the representative of Hong Kong for the Digital Construction Skill in the WorldSkills Competition in Shanghai in 2022.

Kevin Luwemba Mugumya
MEng

Kevin Luwemba Mugumya holds a Masters (2018) and PhD degree (ongoing) in Civil Engineering from the University of Nottingham, Malaysia (UNM). In collaboration with MES Group; a project management consultancy, Kevin's research investigates the usage of advanced data analytics in the facility management (FM) life cycle of buildings. Specific focus is placed on the application of machine learning, semantic web technologies and linked data in the building automation domain.

Kevin has successfully led a team of research assistants towards the design of a robust framework for extracting asset control information from the campus' Building Information Models for smarter FM. Also, as a research assistant at UNM, he has been involved in teaching undergraduate students to develop Virtual and Augmented Reality built environments, MATLAB, ANSYS and Dynamo scripting in Revit. He is a recipient of the University Postgraduate Award Prize 2020/21 for his contributions to the Post-graduate (PG) research community while serving as chair on their students' council during the rough COVID tide of 2019-2020.



Redefining Building automation via linked building data

"Find me all rooms on the top floor not affected by the leakage in room 401. Of these, filter those with no more than 4 air supply ducts but an area greater than 300sq. ft., and precool them for one hour commencing at 0800. The remaining rooms should be precooled for 15 minutes, commencing at 0845."

Imagine that this is an automation task assigned to a facility manager of a convention centre in preparation for an upcoming series of conferences. Building Automation Systems (BAS) hold much of the asset's data, but not in ways that allow facility managers to really use it for such an automation task. This is because, at the handover stage, building owners often inherit multiple systems in a building, which cannot intercommunicate or share any contextually relevant information. In turn, facility managers are faced with the reality of not being able to easily comprehend or assess holistic system performance, which inhibits the development of optimization strategies.

A research project, jointly funded by MES Group and the University of Nottingham Malaysia, is rigorously investigating and finding solutions to this conundrum. A critical part of this work is the identification of a common data schema to describe all critical aspects of a building's operation - the asset itself, its environment, its systems, the people and the relationships between them. Such a schema creates the glue needed to integrate building information such that it cannot only flow seamlessly between building systems but can also be shared across city-wide platforms for smart city applications. It should be noted that the schemas making this data integration possible are neither applications, new building systems nor new pieces of software running on a server, but rather machine-interpretable languages that describe important aspects of a smart building and model the respective relationships between them. This research also develops machine learning models that discover rich patterns in Linked Building Data and investigates their evaluation and optimization strategies. These can be exploited by building automation systems for smarter downstream tasks such as energy-efficient indoor environment control, fault detection, and demand response.

Simon Ng

Simon is the Head of BIM in China State Construction Engineering HK Ltd. Simon leads a team of more than 100 BIM specialists to support BIM implementation across project, his team also serves as central support in development of corporate BIM standard, workflow of various BIM application, training plan, new BIM technology adoption, automation tools, etc.

Being awarded as the "Young BIMer of the Year 2014" award by the CIC of Hong Kong, Simon has extensive experience in BIM management such as modelling standard, execution plan, template, family database, skills development, training, etc.

Simon is a Mechanical Engineer and had a wide range of experience in engineering design, project management and application of Information Technology in construction industry.

BIM 3D 4D 5D, what's next?

I am glad to see that most of winning projects have a wide range of BIM uses. Most of BIM projects has already managed to use BIM for 3D design authoring and coordination, 4D construction sequence and 5D quantity take off and cost estimation. So 3D 4D 5D is becoming a Norm in the industry.

So what's next?

Obviously people are looking for more "D"s, 6D, 7D and so on… What should they be?

6D – There is no common agreed standard of 6D, if people search over internet various explanation of 6D can be found, sustainability, quality, safety, etc. In my point of view I will define 6D as "using Digital surveying to improve sustainability, quality and safety"

Common digital surveying method are i) Laser scanning ii) Photogrammetry. The first one can give accurate results but time consuming, the later one can cover wide range area in one goal but lower accuracy.

Digital surveying can help projects a lot in the following aspects:

- To check as-built condition, against design / construction BIM models.
- To create existing model for project team to understand between the relationship between the design and the surroundings
- To check initial site conditions for better design decisions

7D – is commonly known as "BIM for Facility Management (FM)". The common understanding is to develop Project BIM model (PIM) into Asset Information model (AIM). To achieve that, the project team need to define the Asset Information Requirement (AIR). It contains:

- The definition of an Asset
- What attribute is required in objects in a BIM model
- What is the management for asset documentation (e.g. Catalogue, Commissioning record)

Apart from AIR, one should consider the use of BIM model in operation stage, considerations includes:

- What is the good way to let FM staffs to view BIM models. E.g. how can one search for an equipment? How can one easily isolate a MEP system?
- How to maintain the BIM model after modification work?
- How to integrate BIM model with other operation systems? E.g. Computerized Maintenance Management System (CMMS), Building Management System (BMS)

I hope that 6D and 7D will become another norm of BIM projects in near future.

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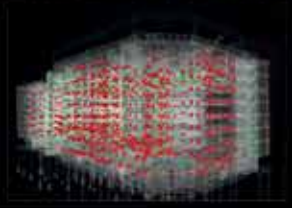

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HP ZBook G8 擁有超卓GPU表現，配合Autodesk AEC Collection讓建造業設計者更輕鬆執行繪圖工作。Autodesk用戶可透過搭配使用AutoCAD與Revit，輕鬆過渡至BIM 360，有助跨團隊進行溝通，以更快、更精確交換及傳送檔案，提升生產力。Revit同時可滿足控制視圖圖像的高度要求，用戶能在3D視圖模式下多次模擬設計，更逼真的建築設計體驗促進設計及創作效益。

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針對市場對 AutoCAD 及 3ds Max 設計需求日益增多，我們特別開辦 Certificate for Autodesk AutoCAD & 3ds Max 證書課程，並由專業的設計師設計及教授，從最基本教授，深入淺出，利用不同的方案教授實用的 CAD 及 3ds Max 技巧，直直正正做到市場需求。課程內容涵蓋工程施工圖、產品設計圖到環境設計圖等等，務求令每學員了解在現實中的需求及技巧，提升能力，從而達至專業。

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Facilitate faster, more impactful decision-making throughout the entire building lifecycle.
Unity Reflect is also customizable so you can create your own real-time BIM applications by building on top of the platform with Unity Pro.

"Not just about how something looks, it's about the feel of it."

"Give client an extra experience to put them within a space to feel the environment and the design"

- P+H/S Architects

Scan the QR code to watch the P+H/S case sharing and Product Highlight video

A BIM design review and coordination solution

Faster decision making
DATA FEDERATION AND LIVE LINK

Generate interactive, immersive experiences that are live-linked to the original design models. Designers and engineers working in Revit, Navisworks, SketchUp, and Rhino can bring their data sets into the same project.

Communicate design intent
DETECT CLASHES

Effectively communicate design intent to owners and occupants by making real-time 3D collaboration accessible to stakeholders. Catch mistakes and clashes earlier in the process to prevent costly rework

Any platform, anywhere
CONNECT STAKEHOLDERS

Make changes to projects on-premise or in the vcloud to enable greater collaboration with users outside of your network. View on any device or platform, including VR, AR, iOS, Android, PC, and Mac.

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2017
增設課程 "BIM for Constrcution Managers"，讓工程管理者更有效融入BIM流程

2013
擴充BIM培訓系統，常設MEP, Strcuture及Navisworks等課程，讓學員更全面學習BIM應用

2012
成為Autodesk Ahthorised Academic Partner，推動學界應用Autodesk軟件於專上教育。

2008
提供教授Revit的持續進修基金認可課程。同期亦引入Autodesk專家認證服務。

2007
榮獲Autodesk頒予香港區最佳認可培訓中心榮銜。

2006
開設 Civil 3D 課程，並獲持續進修基金 (CEF) 認可。是本港最早期的BIM訓練課程

2003
Welkin Systems Limited 成為Autodesk Authorise Training Centre，提供Autodesk認可培訓服務

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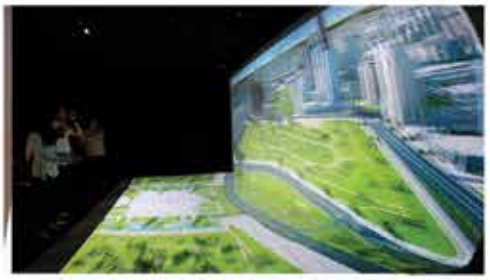

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GET STARTED IN ENGINEERING & DESIGN

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Computer Aided Design (CAD) professionals with such skill sets are not abundant in Macao. These skills are in high demand abroad

Growth of digital technology makes it all the more important for the expansion of CAD disciplines.

Early introduction to CAD will impact students career paths. Aeronautical engineering, mechanical engineering, electrical enginnering and aerospace engineering all require a high level of CAD expertise - complimenting the high starting salaries.

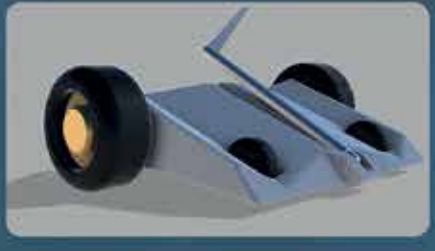
Computer-aided design (CAD) is used by engineers, architects, designers, and drafters to create digital 2D and 3D drawings. It can be used to design something as simple as a perfume bottle or as complex as a jet engine.

Robotics Design

Robotics is a topic that offer opportunities to introduce students to complex subjects like programming and engineering; but in a way that's fun and interactive.

Being comfortable around computers and technology of any kind will not just be a boost for your future, but a necessity. With this in mind, it's essential to introduce yourself to as many different types of technology as possible, such as autonomous programming and artificial intelligence.

AUTODESK® FUSION 360™



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WHY US?

Nutech is a leading BIM (building information modelling) training specialist. Nutech has been partnering with Autodesk in providing BIM training for over 10 years and has been appointed as Autodesk Business Partner since 2004.

We have been providing advance BIM training courses to the HKSAR Government departments, property developers, contractors and consultants since the development of BIM. With a team of BIM training experts each with over a decade of training experience in this field, Nutech offers unparalleled BIM training in the market.

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The Challenges

Having entered the Construction 2.0 era, our construction sector is steered towards digitization with proliferation of BIM implementation and recent mandate of DWSS for improving productivity, efficiency and project delivery outcomes. Yet there exist numerous challenges especially in the construction phase while disconnect may occur between Design BIM Model and actual site conditions. Given the various discreet solutions at sites generating different datasets, project leaders lack holistic views and insights about the real time construction work progress, which may in turn lead to possible consequence of increased reworks and project delays.

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Spatial Technology provides end-to-end **Integrated Digital Construction Platform (IDCP)** comprising 3 pillared solutions to help you acquire the best knowledge about the site landscape & corresponding data efficiently through **Aerial/Terrestrial Scanning Service (ATSS)**, facilitate seamless fusion of such data with BIM Models visualized in **3D Data Management System (3DMS)**, and ultimately provide the **Construction Data Management Portal (CDMP)** which consolidates all site data generated from EDMS, DWSS, IOS/AI devices, allowing project stakeholders to conduct real time monitoring, make timely decisions, manage potential risks and increase productivity.

Integrated Digital Construction Platform

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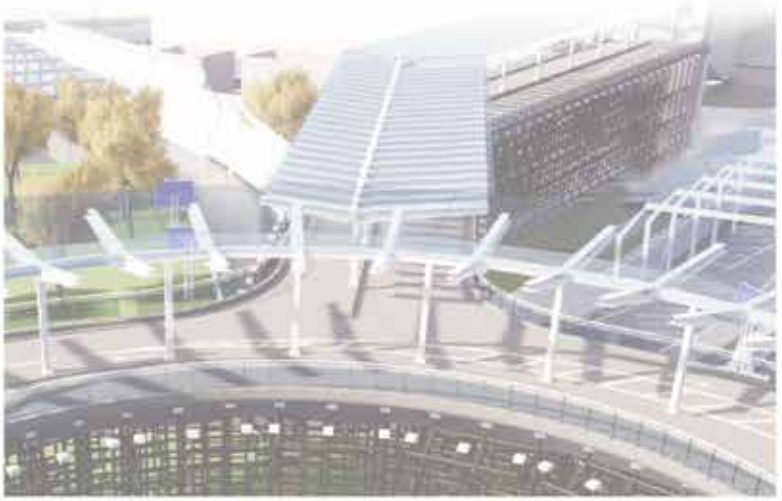

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