

## COMPANY

Hip Hing Engineering Company Limited  
Hong Kong Science and Technology Parks  
Corporation  
Leigh & Orange Limited

## PROJECT

**InnoCell**

## LOCATION

TPTL 245, Pak Shek Kok, Tai Po, New Territories  
(Science Park)

## TYPE

**Building Project**

## SCHEDULED TIME OF COMPLETION

**Dec 2020**

# Let Innovations Permeate Every Cell

“Echoing “Construction 2.0”, the future of construction industry must be entangled with innovation, technology and more extensive BIM uses. As a pilot practitioner of Modular Integrated Construction (MiC), InnoCell resembles a breakthrough of construction method in Hong Kong.”

## — Michele Lui

Deputy Project Manager,  
Hip Hing Engineering Company  
Limited

## — Simon Wong

Chief Project Development Officer,  
Hong Kong Science and Technology  
Parks Corporation

## — Ivy Lee

Managing Director,  
Leigh & Orange Limited

## BIM PARTNERS

**WSP Hong Kong Limited**  
**Ove Arup & Partners (HK) Limited**

## AUTODESK PRODUCTS USED

**AEC Collection**  
**Civil 3D®**  
**Dynamo for Revit®**  
**InfraWorks®**  
**Inventor®**  
**ReCap™ Pro**  
**Vehicle Tracking**



Rendered Image of InnoCell

Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited

**InnoCell is the first hybrid Modular Integrated Construction (MiC) permanent building in Hong Kong. After completion, it will provide residential units integrating with co-recreational and working space for technology talents. The construction involves an assembly of 418 MiC modules, that constitutes over 70% construction-floor-area on accommodation stories. By leveraging Building Information Modelling (BIM) technology in MiC project, we are committed to resolving inter-disciplinary problems 2 stories prior to site construction, maximize reusability of construction materials, and eventually push forward the conventional construction programme by 6 months. Safety is our top priority, that the team had devoted every effort to enhance safety awareness through disruptive technologies, leading to an achievement of 600,000 man-hours accident free in construction phase.**

## BIM Project and Information Management

To bring safety, quality and productivity to the next level, L&O and major design consultants have been collaborating in BIM environment since design stage. Upholding BIM as the single source of

information, all coordination footpaths and spatial geometries were well recorded in the BIM model towards construction stage. Hip Hing could thus leverage the BIM model for more advanced developments, including 3D printing and incorporation with other technologies (e.g. IoT, GIS and VR). Furthermore, to ensure the inputs of BIM align with the objectives of facility management, HKSTP issued a BIM-AM Standards at initial stage, which defined the standardization and information required for operation. Early involvement of an asset management team and integration of BIM workflows provided soft-landings for desired operational outcomes.



3D Drone Scanning Result Incorporated with 4D Simulation  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited



Design for Demolition-Free Pre-Welded Safety Parts in Permanent Module Frame  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited

### Construction and Cost Planning

During the construction stage, a key challenge was to avoid on-site disturbance such as modules installation. In order to obtain a clear overview of future activities, we adopted 3D drone scanning and compared the scanned point cloud data with virtual 4D construction program simulations. Since the modules are prefabricated, with furniture and fittings manufactured off-site in an MiC factory in Jiangmen China, a prudent quantity surveying management became more essential. To enhance the accuracy and traceability of quantity estimation, Revit-extracted 5D quantity takeoff (QTO) schedules were requested as a reference of monthly Bill of Quantity (BQ) applications. In the long run, we target the as-built model QTO to be served as a benchmark for future MiC projects.

### Design for Manufacture and Assembly (DfMA)

Early buildability study of MiC modules is crucial prior to mass production. By maximizing construction efficiency, BIM modeling proprietary was distributed according to stakeholders' expertise. Besides, installation issues such as rigging and temporary works had already been addressed in module frame design. The module connection procedures were explicitly animated, and the corner-sides of four coherent modules were 3D-printed into components for genuine practice. Thanks to such practicing opportunity, we identified that the gesture of fastening bolts would be constrained by the adjacent steel members, and the problem was eventually resolved by using hydraulic wrench. Other than that, the BIM

models were also leveraged for mock-up renderings and demarcation between pre/ pro module installation works.

### MiC + Internet of Things (IoT)

Our team implemented a robust inspection tool in order to record all inspection and defect follow-up activities in MiC module factory. It allowed the team to take and upload inspection photos, mark comments, and digital sign for approvals in an all-in-one approach via a handy smartphone. The system automatically presented a neat dashboard showing the percentage of completion and sending alerts for overdue items. To further digitalize the inspection process, each module element in BIM incorporated a link to directly access the inspection summary webpage under the application. BIM and cloud inspection platform were merged to pursue IoT, that allowed big data transfer and analysis among project team members despite geographical barriers. This advantage made a profound positive impact to the project amid the pandemic.

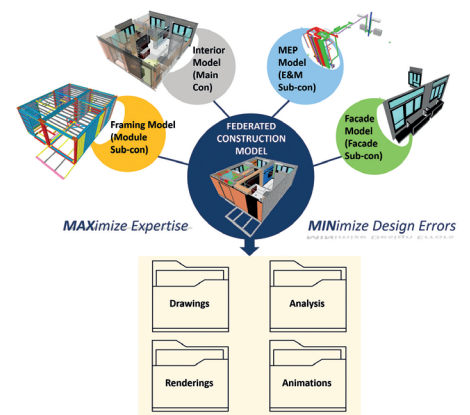
### MiC + Geographic Information System (GIS)

Module logistic plays a critical role to determine the success of this project. In order to minimize the impact to the surrounding traffic and keeping the module intact at the same time, the driving path of module-loading vehicle must be well-planned in advance. Before the commencement of construction, Hip Hing had already leveraged InfraWorks® to acquire basic GIS data around the site. It provided a preliminary background and understanding of the relationship among site gantries and adjacent facilities, it also facilitated the investigation for a

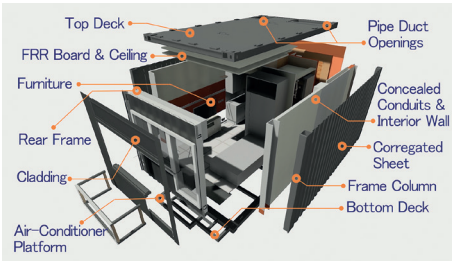
temporary shelter for standby vehicles in the future. Prior to the first batch of module delivery, a thorough 3D laser scanning had been conducted to acquire the most updated and highest level of accuracy of the site layout, the collected data was imported into the Vehicle Tracking add-in under Civil 3D®, for all-rounded vehicle path simulations. It helped unveil some critical points that would have been overlooked in traditional practices. For instance, we identified that one gantry should be widened to offer wider turning radius for vehicles. With the flexible use of technology, we achieved maximum 15 MiC module installations per day. Eventually 418 MiC modules were completely installed in 71 days, with no MiC modules withdrawn due to design errors or severe damages.



Demonstration of MiC Module Connection Using 3D Printed Components  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited



BIM Collaboration Strategy of MiC Modules Design  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited



Exploded View of Co-Living Module Unit for Clear Indication  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited



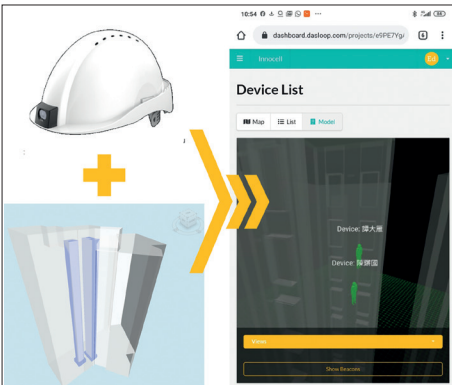
BIM-Rendered Co-Living Unit for Pre-Mockup Visualization  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited

combined with BIM and other technology. Those have helped expedited the construction programme with higher assurance of construction safety and quality. InnoCell shall serve as a valuable example for the operation of future MiC projects.



VR Training of Lifting an MiC Module  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited

out all precautions measures as the lifting animation proceeds. Over 90% of workers appreciated this immersive interaction, which let them experience the site environment in first person perspective.



Operational Procedure of Smart Helmet System  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited

A technology start-up company was also engaged to provide smart helmets for lift shaft workers. The helmets are equipped with smart systems to report workers' positions and health status to the portal in real time. If the portal receives triggering alert, it will automatically send messages to the concerned parties immediately. The role of BIM was to provide an explicit building layout to the system, for indicating the position of workers and their status. This high-esteem technology also leveraged remarkable use of IoT.

The implementation of the MiC has brought tangible benefits to the projects,

### Incorporate Innovations into Safety Precautions

Safety always weighs the highest priority in our project. We have proactively kept abreast with the market and realized innovative ideas to take safety performance to the next level. Conventional safety trainings might not be engaging workers to the fullest. Therefore, we incorporated VR technology to enhance the visuals and maximize the impact of training. Participants were directed to perform different characters in module lifting scenarios, and were encouraged to raise



Swept Path Simulation of Module-Loading Vehicle Along the Site  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange Limited



Leigh & Orange



BIM Model of InnoCell  
Image Courtesy of Hip Hing Engineering Company Limited and Hong Kong Science and Technology Parks Corporation and Leigh & Orange 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 Hong Kong Science and Technology Parks Corporation

Hong Kong Science and Technology Parks Corporation (HKSTP) fosters a culture of promoting innovation and a vision to adopt new technologies, so as to strengthen the industry’s sustainable development and build a future with abundant innovation opportunities for the younger generation. HKSTP upholds supporting infrastructure and works as a connector bridging investor, industry and public stakeholders. InnoCell is an extension of that mission.

## About Leigh & Orange Limited

Founded in Hong Kong in 1874, Leigh & Orange (L&O) is a well-established international architectural design practice which operates throughout China, Hong Kong and the Middle East, and has continued to thrive as a significant force in the markets it serves by focusing on quality. With an unsurpassed depth of experience in a wide variety of building types, the firm prides itself on balancing knowledge and innovation, attuned to each client’s specific needs.