香 港 大 學
THE UNIVERSITY OF HONG KONG

Modular Integrated Construction for High-rises: **Measured Success**

Centre for Innovation in Construction and Infrastructure Development
The University of Hong Kong

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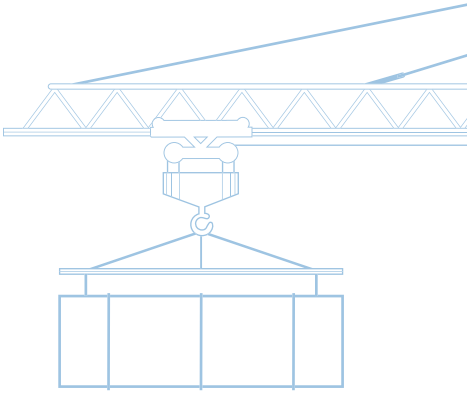
Measured Success



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CICID was established in 2002 and aims to achieve excellence and innovation in construction and infrastructure research. The research topics addressed include modular integrated construction, automation and robotics, industry development, zero carbon building, life cycle assessment, building information modelling, procurement innovations and management, etc. It seeks to continuously drive innovative strategies and practices in construction and infrastructure development.

Foreword

In the past few years, the construction industry in Hong Kong has been facing severe challenges. High construction cost, declining productivity and ageing workforce have aroused concerns on the efficiency and cost-effectiveness of the construction industry. Albeit the improvement in the past few years, we are still under immense pressure to perform safer, greener and more cost-competitive.

Against this background, the Government started to promote the use of Modular Integrated Construction (MiC) in 2017, with a view to enhancing productivity and cost-effectiveness in the construction industry.

Several public projects in Hong Kong have been identified to pilot the adoption of MiC. It is considered a valuable opportunity to measure and benchmark the performance of these MiC projects with their peers using conventional construction methods. It provides evidence-based measurement on how best MiC is performing.

I highly commend the Centre for Innovation in Construction and Infrastructure Development (CICID) of The University of Hong Kong for producing this booklet of Modular Integrated Construction for High-rises: Measured Success. The measured performance of the MiC projects shows considerable benefits of adopting MiC over conventional construction methods and provides good reference for future projects. Through the concerted effort of the industry and academia with support from the Government, I believe MiC will become an important means to modernise Hong Kong construction industry.

Ir LAM Sai-hung, JP

Permanent Secretary for Development (Works)
The Government of the Hong Kong Special Administrative Region

"In history, every industry has its revolutionary change and innovative leap forward. Innovation never ceases and the construction industry in Hong Kong is now on an unprecedented innovative route towards a new era, with advancement on building quality, accuracy and productivity through Modular Integrated Construction (MiC), off-site manufacturing, building information modelling, robotics, just-in-time logistic, digital works site supervision, design for manufacturing and assembly and more to come. ArchSD is proud to join this journey, and together with our working partners, we have pioneered the first reinforced concrete MiC staff quarter building in Hong Kong which provides a solid foundation to enable our very fast delivery of a large quantity of quarantine camps under an extremely short time to combat COVID19. In unity and close collaboration with all stakeholders, more of our potential will be unleashed. We will witness the power of this revolution and excel towards a very exciting future."

Ms Winnie Ho Wing-yin, JP

Director of Architectural Services
The Government of the Hong Kong Special Administrative Region

"InnoCell as the 1st high-rise MiC building in Hong Kong has demonstrated the transformation of construction methodology to enhance innovation, productivity and sustainability. Through this unprecedented journey, the dedicated youngsters of the construction team with great potential have been playing an indispensable and leading role to adapt the generational change towards high-level technology adoption and digitalization. Their energetic effort and commitment are very encouraging for contributing the success of InnoCell as well as future of our construction industry."

Mr Simon Wong Yuk-sun

Chief Project Development Officer
Hong Kong Science and Technology Parks Corporation

Preface

In many developed economies, construction industries face significant challenges, such as ageing workforces and escalating costs. These challenges hinder the enhancement of productivity and sustainability in the construction industry and built environment. To address these challenges and increase productivity and sustainability, the modular construction approach has been widely adopted worldwide.

In Hong Kong, the modular approach has been adopted under the term of modular integrated construction (MiC), which builds on the modular construction approach but emphasises the integration of advanced manufacturing and smart production technologies into re-engineered building and construction processes. This approach offers a golden opportunity to unleash productive forces, shape the relations of production and enhance construction productivity, quality, safety and sustainability. The MiC concept was adopted in the Policy Address 2017 of the HKSAR Government to support construction innovation. The Policy Address 2018 has further promoted the wide adoption of MiC in Hong Kong (e.g. for several MiC pilot projects and quarantine camps). As MiC changes the project delivery process as compared to conventional construction practices, it is important to systematically understand the performances of projects that have adopted MiC. Thus, in this study commissioned by Development Bureau, we evaluate the performances of two high-rise MiC projects.

This booklet reports the performances of MiC projects evaluated using a systematic framework of key performance indicators (KPIs), and aims to demonstrate evidence-based benefits of adopting MiC for high-rise development and uplift MiC to a new height. The methodology adopted for the systematic performance evaluation and the KPIs are elaborated in the *Modular Integrated Construction Performance Measurement Guidebook*.

We are grateful to Development Bureau for commissioning the study on which this booklet reports, and to Architectural Services Department, Hong Kong Science and Technology Parks Corporation, Yau Lee Construction Company Limited, Hip Hing Construction Company Limited, and various individuals for their support of and/or participation in the study. We are also appreciative to Prof CK Mak and Prof Sam Chan for their advice.

Ir Professor Wei Pan

Executive Director
Centre for Innovation in Construction and Infrastructure Development
The University of Hong Kong

Executive Summary

This booklet reports the measured performance of Modular Integrated Construction (MiC) in comparison with the conventional construction practices for high-rise development in Hong Kong. The booklet also illustrates that MiC provides an effective approach to tackling the challenges, such as ageing workforce, declining productivity, high construction costs, etc., being faced by the construction industry in Hong Kong.

Performance of two high-rise MiC pilot projects was measured using a systematic Key Performance Indicator (KPI) framework from the perspectives of economic, environmental and social aspects. The two high-rise projects cover the use of both concrete and steel MiC. To facilitate like-for-like comparisons, a reference project and a scenario adopting conventional construction was identified and developed respectively for benchmarking the performance of MiC.

The results of the analyses suggest that the adoption of MiC in future building projects can achieve cost savings by at least 10%, shortening in on-site superstructure construction by around one third to 50%, improved on-site labour productivity by 100% to over 400%, as well as higher construction quality, better site safety performance and enhanced environmental sustainability.

As reiterated in the 2020 Policy Address, the HKSAR Government has committed to continue promoting the use of MiC for a wider adoption in order to uplift the performance of the construction industry. With the whole construction industry including clients, consultants, contractors and supply chains in public and private sectors joining hands marching for a wider adoption of MiC, we can bring MiC to a new height, contributing an international brand and reinforcing the global status of Hong Kong.