



CONSTRUCTION INDUSTRY COUNCIL  
建造業議會

# Technical Building Design - Structural Engineering, Building Services, Cost Planning Considerations

26 May 2020

By Thomas Tong – General Manager of Innovation and Technology Development



## Before

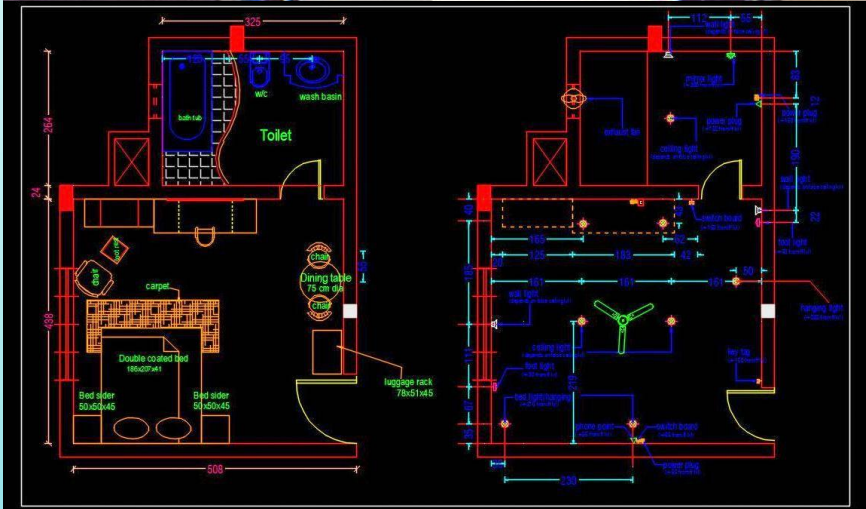


## Now

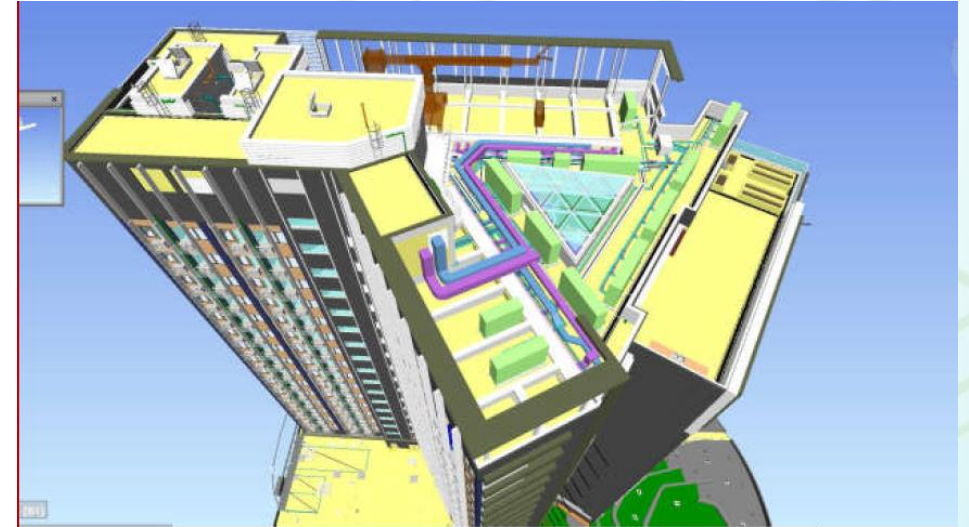




# Before



# Now



## Full Building Life Cycle Design Consideration

# What do you want from the Engineers?

Answer (A)

$$z = d \left( 0.5 + \sqrt{0.25 - \frac{K'}{0.9}} \right)$$

$x = (d - z)/0.45$ , for  $f_{cu} \leq 45 \text{ N/mm}^2$ ; or  
 $(d - z)/0.40$ , for  $45 < f_{cu} \leq 70 \text{ N/mm}^2$ ; or  
 $(d - z)/0.36$ , for  $70 < f_{cu} \leq 100 \text{ N/mm}^2$

$$A_s' = \frac{(K - K') f_{cu} b_c d^2}{0.87 f_y (d - d')}$$

$$A_s = \frac{K' f_{cu} b_c d^2}{0.87 f_y z} + A_s'$$

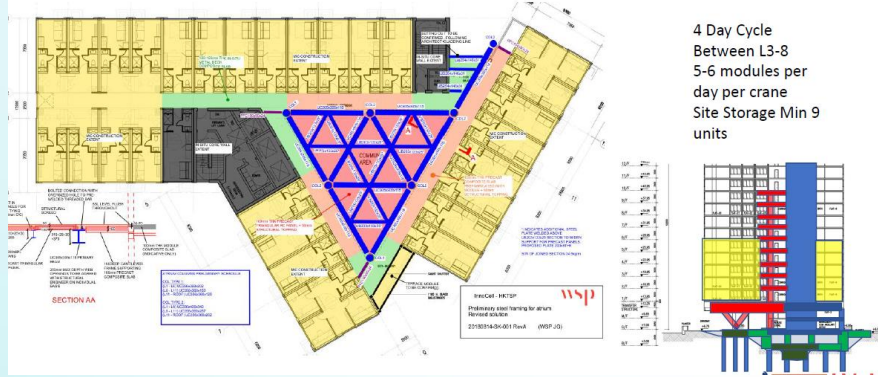
Answer (B)



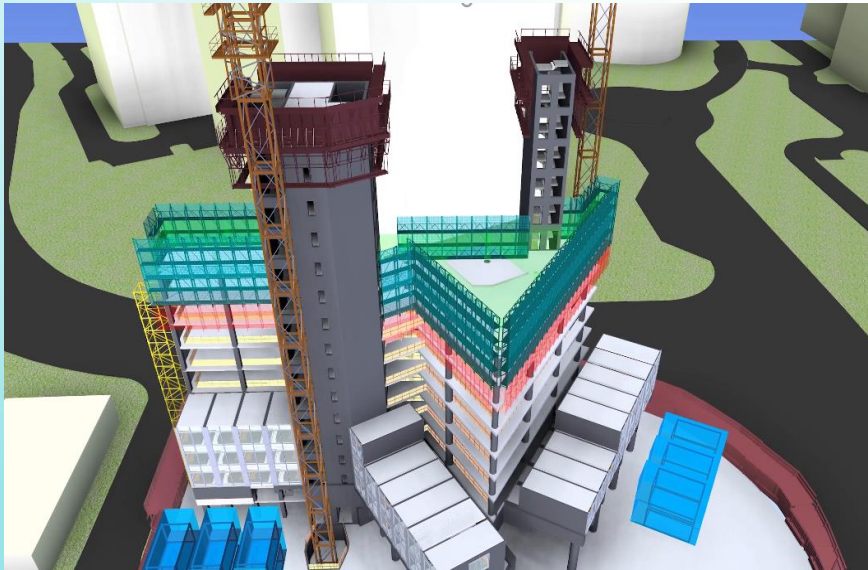


Concrete Core Up to L12, Composite floor to L10  
Module Erection Construction (34nos 3.1m wide modules) L5

Week 24



Design Development Stage



Digital Twin (Virtual 4D Construction Sequencing)

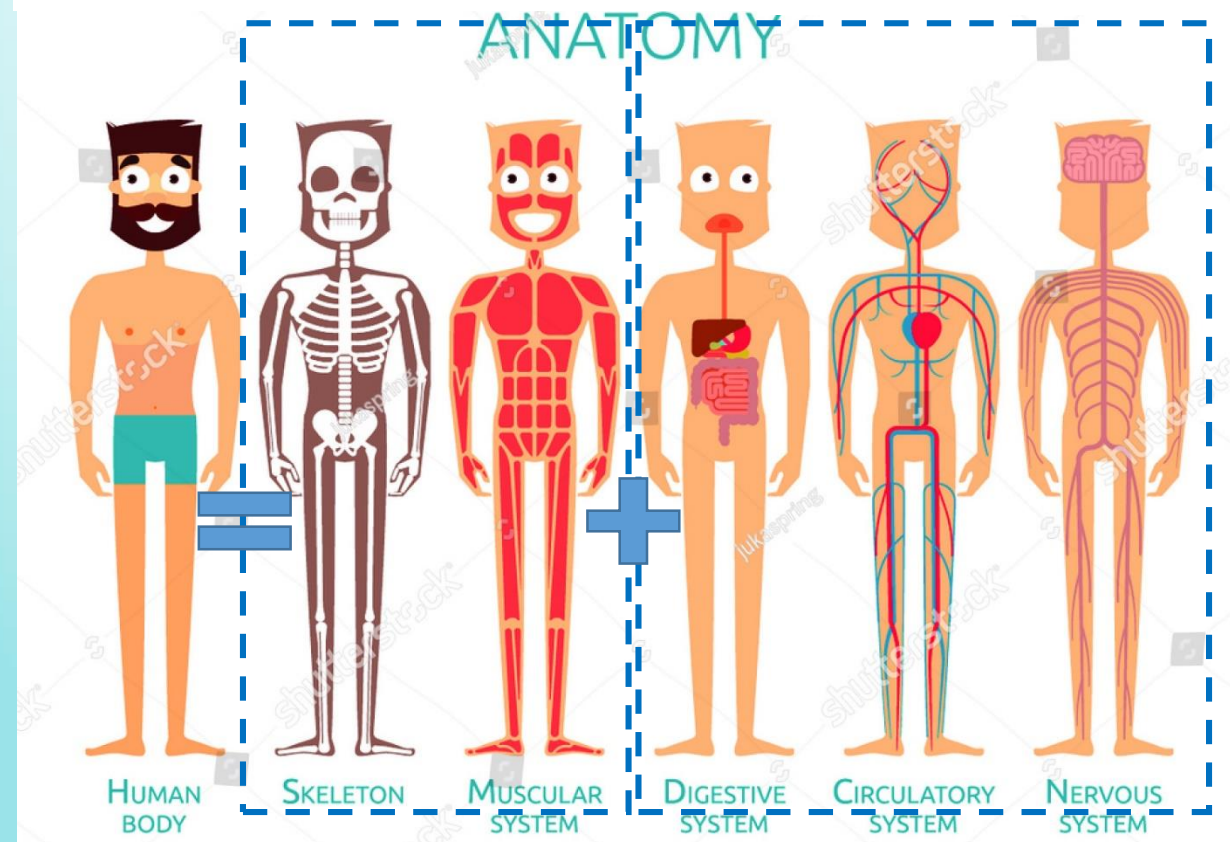


Digital Twin (Reality Site Progress)

Please introduce the roles and duties of a Registered Structural Engineer (RSE), an Authorized Person (AP) and an MEP Engineer in a MiC project.



<b>AP</b>	<b>RSE</b>	<b>MEP</b>
<b>Authorised Person (Architect)</b>	<b>Registered Structural Engineer</b>	<b>Mechanical Electrical Plumbing</b>



Buildings Department

Practice Note for Authorized Persons,  
Registered Structural Engineers and  
Registered Geotechnical Engineers

APP-52

Supply of Plans to Registered General Building Contractors,  
Registered Specialist Contractors and Registered Minor Works Contractors  
Regulation 36 of the Building (Administration) Regulations and  
Section 55 of the Building (Minor Works) Regulation

Under Regulation 36 of the Building (Administration) Regulations [B(A)R], it is the duty of the authorized person (AP) appointed for any building works or street works to supply to the registered general building contractor (RGBC), the registered specialist contractor (RSC) and the registered minor works contractor (RMWC): -

- (a) a copy of plans approved by the Building Authority in accordance with Regulation 30 of the B(A)R;
- (b) a copy of structural details prepared by the registered structural engineer and approved by the Building Authority; and
- (c) a copy of any supervision plan.

Re-issued under new categorization in August 2009 as Practice Note for Authorized Persons, Registered Structural Engineers and Registered Geotechnical Engineers

APP-141

Buildings Department

Practice Note for Authorized Persons  
and Registered Structural Engineers

294

Division of Responsibilities between Authorized Person,  
Registered Structural Engineer and Registered Geotechnical Engineer

**Modular Integrated Construction**

	MIC IPA	MIC General Building Plan (GBP)	MIC Superstructure Plan
Project Specific information	Not required	Required	Required
MiC System Specific Information	Required	Required	Required
Main Applicant	MiC System Vendor	AP	RSE
Prior approval for MiC fabrication on specific project	Not required	Required	Required

MEP (Mechanical Electrical Plumbing)  
ConsultantAppendix C  
(PNAP ADV-36)

## Pre-acceptance Application Checklist for MiC

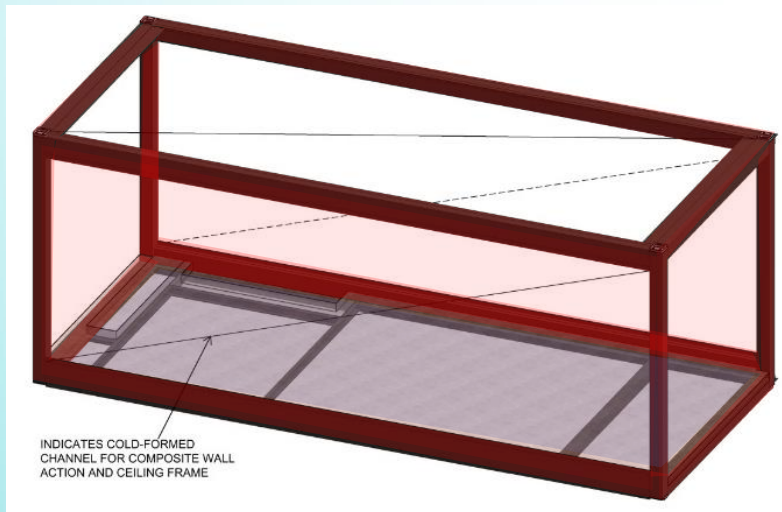
4.	Drainage	<ul style="list-style-type: none"> <li>○ Detail drawings to illustrate compliance of Building (Standards of Sanitary Fittings, Plumbing, Drainage Works and Latrines) Regulations, for example: <ul style="list-style-type: none"> <li>(a) Proper design of discharge for soil and waste fittings including traps, internal dimension, bends, cleaning access and materials of soil and waste pipes, and their connection details to vertical stacks;</li> <li>(b) Provision of anti-siphonage pipes and ventilation pipes;</li> <li>(c) Provision of flushing cisterns, flushing pipes of adequate internal dimension and overflow pipes for soil fittings;</li> <li>(d) Connexions of pipes and fittings shall be designed in a manner to ensure water tightness and to prevent escape of foul air;</li> <li>(e) Proper design of rain water discharge for roofs, balconies, canopies and utility platforms etc. if applicable;</li> <li>(f) Level difference between internal floor and adjoining external ground/flat roof not less than 150mm; and</li> <li>(g) Arrangements for discharge from air conditioner condensate disposal system, planters and landscaped areas to the surface water drainage system.</li> </ul> </li> <li>○ Provision of surface water discharge for cantilevered structures exposed to weather</li> <li>○ No pipework for a domestic unit shall protrude into the unit under separate occupancy</li> <li>○ Common above-ground soil / waste / rainwater stacks and underground drains located in common parts of the building (PNAP APP-93)</li> <li>○ No water-borne pipe embedded in structural elements (PNAP APP-105)</li> </ul>
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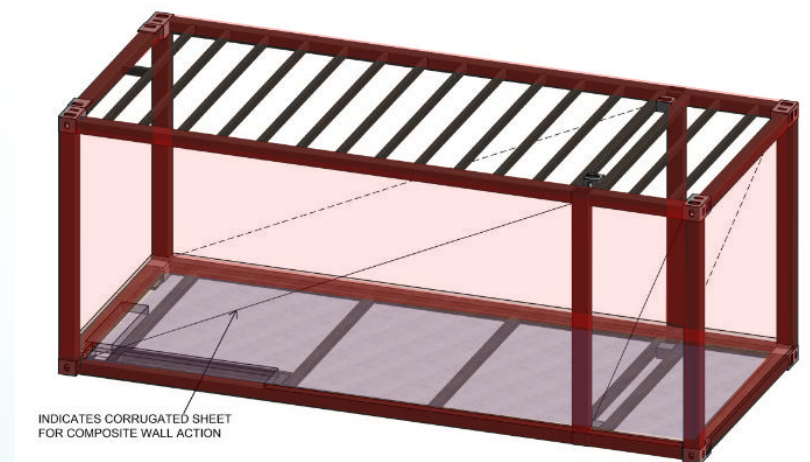


How do the fire resistance requirements affect the design of the structure of a MiC module?

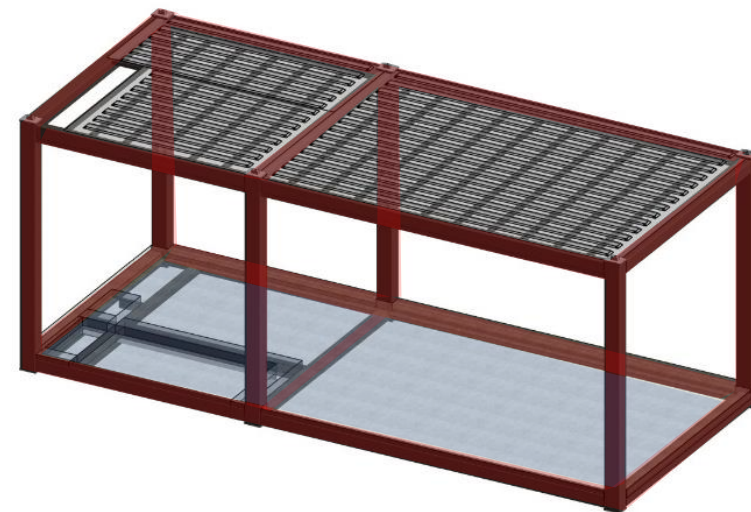
Would the layout of beams and columns of a module affect the position of window openings?



VENDOR 1

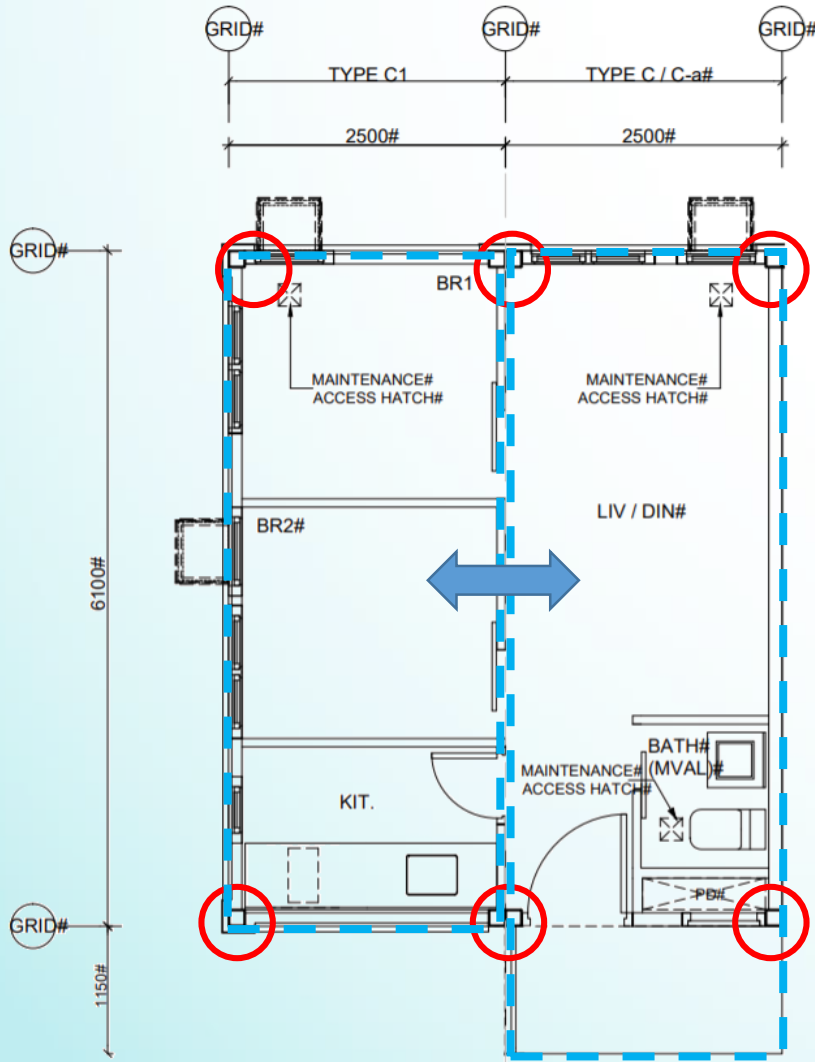


VENDOR 2

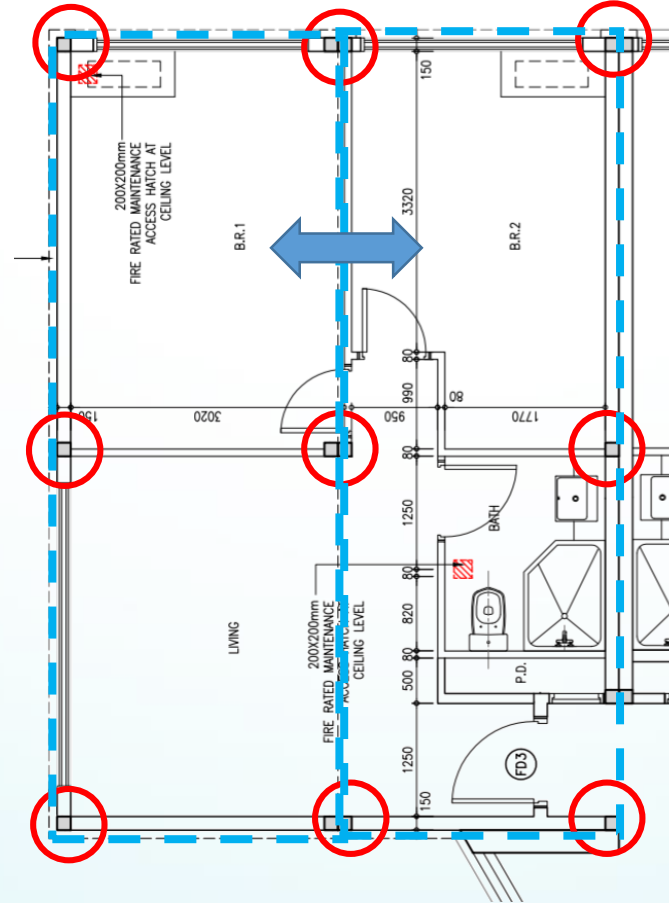


VENDOR 3

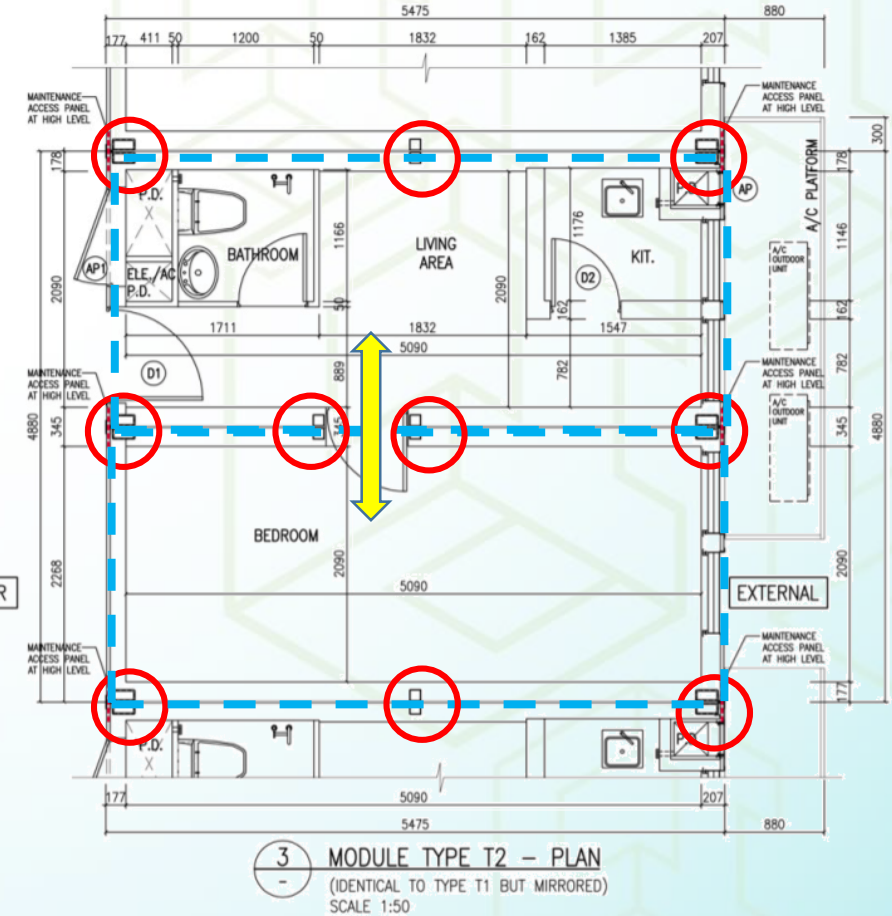




MiC 2/2020  
Paul Y – iMax (4 storeys)

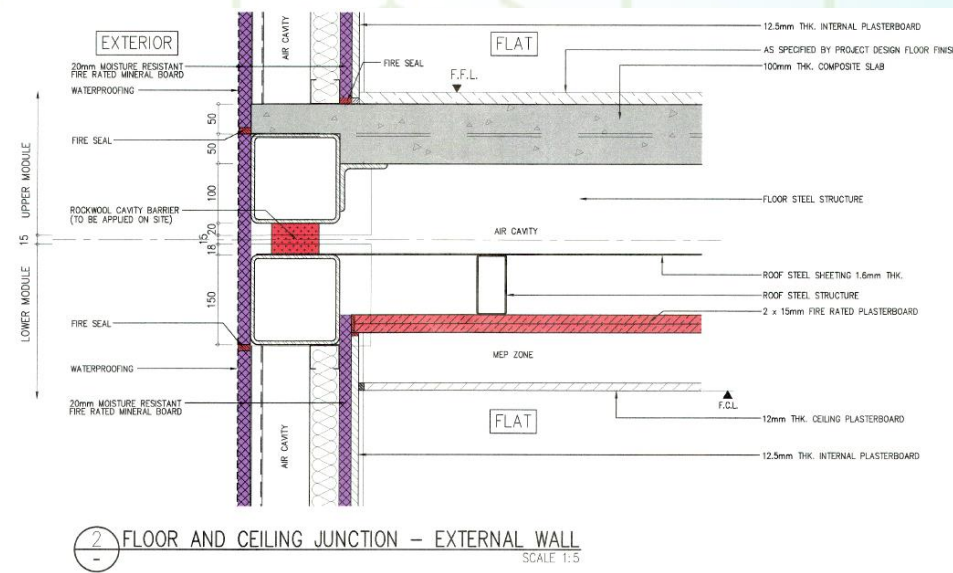
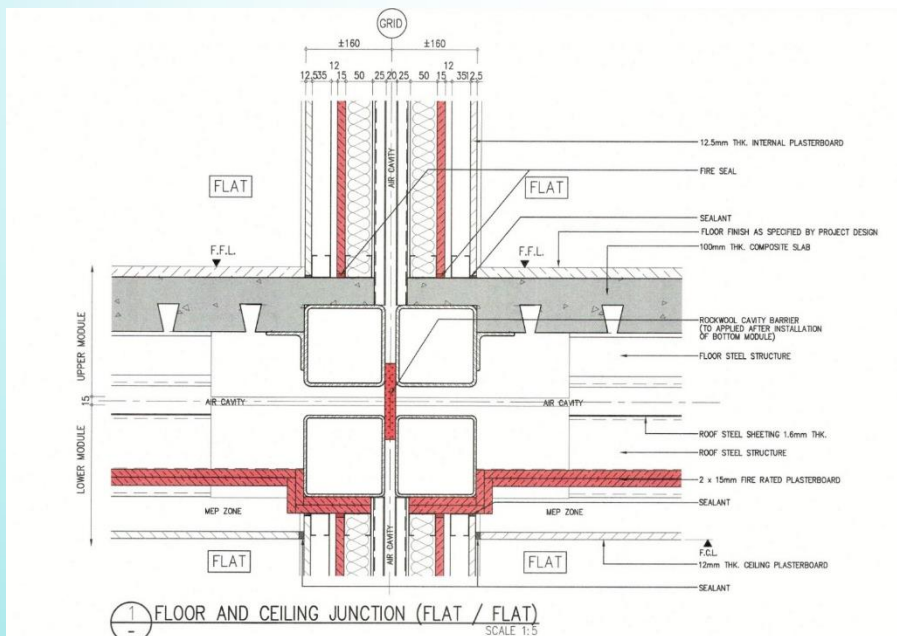


MiC 1/2018  
Unitised Building (15 storeys)



MiC 2/2018  
Aluhouse (3 Storeys)

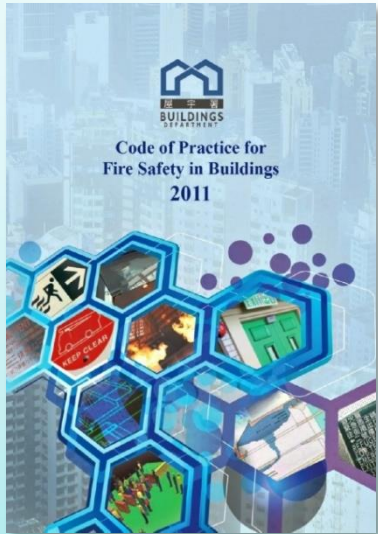
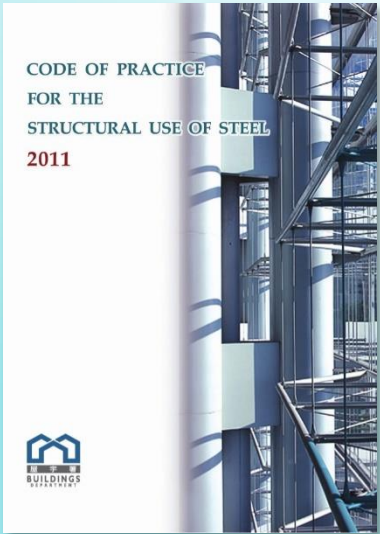
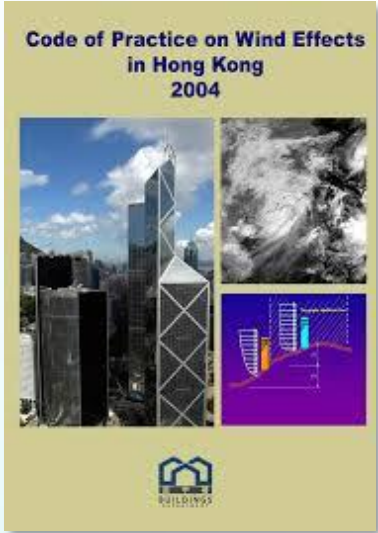
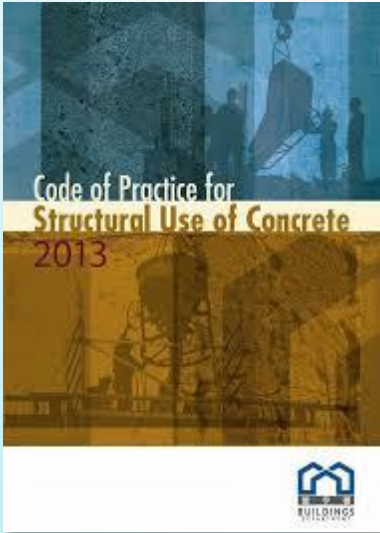
# Wall / Floor Build Up including FRR Construction for Steel MiC



(Courtesy of L&O)



# Hong Kong Code of Practices



## Equivalent Steel Materials HKCMSA

## UK Building Reg. Part B Fire Safety on Cavity Barrier

Fire safety	
APPROVED DOCUMENT	
B	
VOLUME 1 – DWELLINGHOUSES	
B1	Means of warning and escape
B2	Internal fire spread (linings)
B3	Internal fire spread (structure)
B4	External fire spread
B5	Access and facilities for the fire service

At the design stage, what sort of information are required to be provided from module suppliers in order to work out a more efficient design in terms of time, cost and quality?



# Buildings Department – In Principle Acceptance (IPA) according to PNAP ADV-36

- Fire Safety
- Joints and Gaps
- Structural Design
- Provision for Maintenance
- Quality Control and Quality Assurance

## Pre-submission Enquiry

3. Authorized Persons and Registered Structural Engineers are encouraged to make use of the established mechanism of pre-submission enquiry service mentioned in PNAP ADM-19 to clear with the BD in the early design stage unconventional design or performance of a modular prototype for acceptance under the BO before preparing the detailed designs. A determination would be available within 45 days.

## Enquiries and Feedback

For enquiries and feedback, please contact the following officers:

### Building Matters

Technical Secretary/Building, Mr CHIK Kin Hang, Alex ([khchik@bd.gov.hk](mailto:khchik@bd.gov.hk))

### Structural Matters

Technical Secretary/Structural, Ms AU Pui-ling, Fion ([fplau@bd.gov.hk](mailto:fplau@bd.gov.hk))

# GUIDELINES on Statutory Requirements for Modular Integrated Construction Projects



Q A 圖 電 室 簡 | 附屬機構及項目 HKIC CITAC ZCP BIM CISVP CITF MIC 獎項

關於議會 註冊事務 研究及數據 工藝測試 微軟 合作計劃 安全資訊 培訓



主頁 >

MIC

資源中心

<http://www.cic.hk/chi/main/mic/>

Hotline: 2100 9462/ 2100 9000

Email: [mic@cic.hk](mailto:mic@cic.hk); [mic\\_visit@cic.hk](mailto:mic_visit@cic.hk)

## Resources Centre

News

Events

What is MIC

MIC Development in Hong Kong and Overseas

MIC Display Centre

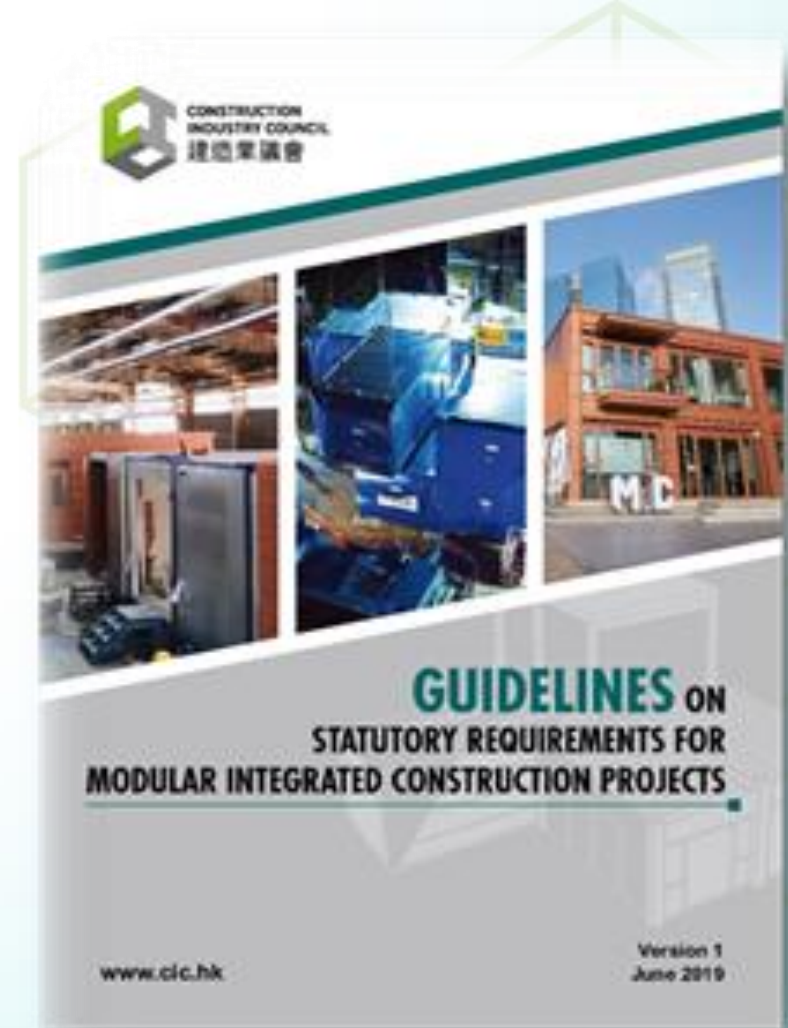
Download Centre

Contact and Enquiry

First Issue 17<sup>th</sup> Sept 2019  
Live Document



CONSTRUCTION INDUSTRY COUNCIL  
建造業議會







What are the benefits of using steel over reinforced concrete for a MiC module?

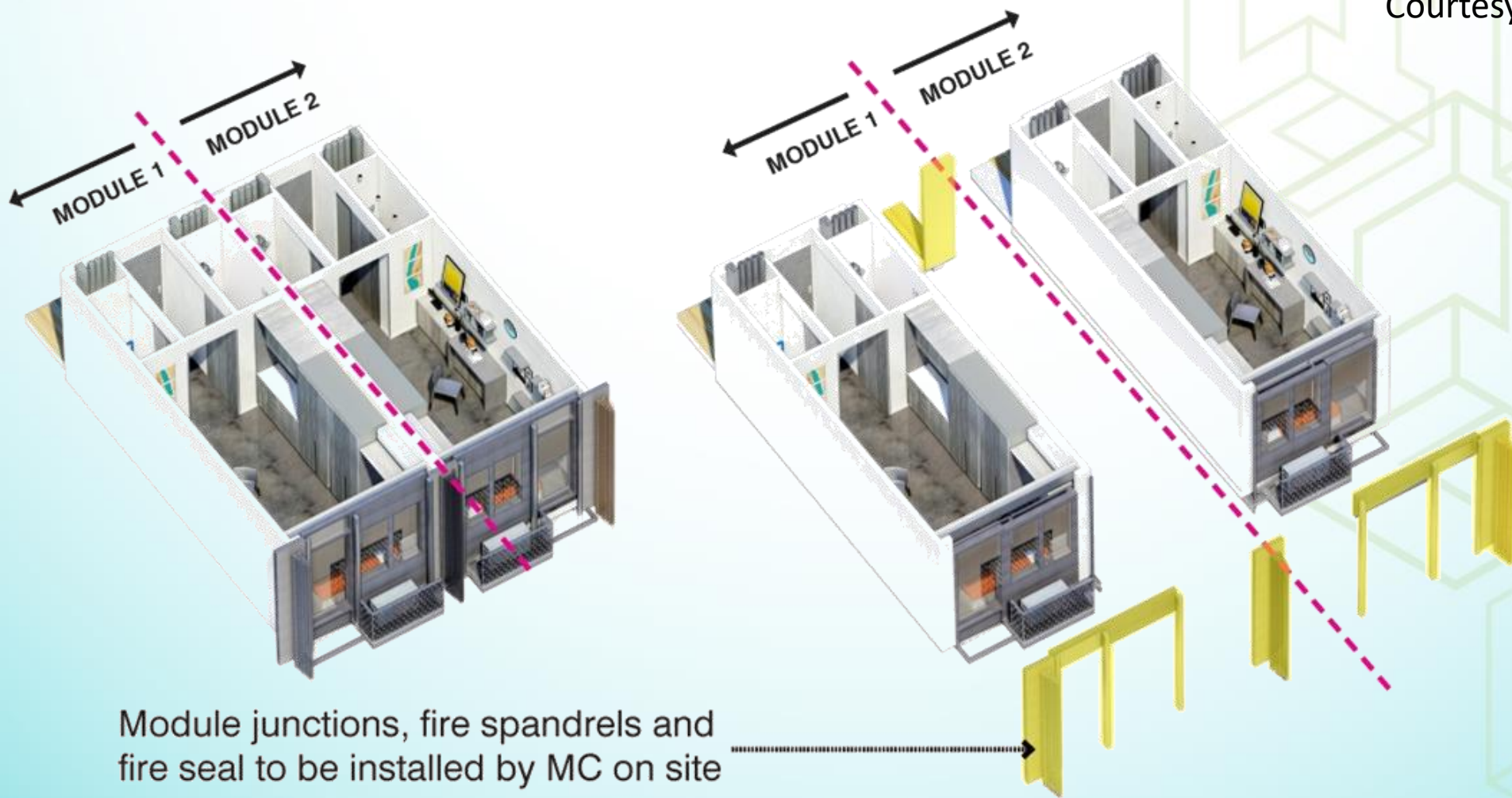
Steel MiC		RC MiC
Weight	About 40% lighter than RC construction	Slightly heavy than RC Construction due to RC twin wall / twin slab requirement
Site Connection	Bolt and mechanical fixing	Cast in-situ / Grouting
Design Life	50 years + design in accordance with HK COP sufficient maintenance provision	
Fire protection	Fire board lining with module interior	Specified concrete cover and min. dimension to meet FRR requirement
Weather Proofing	Corrosion protection paint / GMS	Waterproofing membrane /spray on the ceiling slab of module
Site Erection	More availability of Tower crane to handle 20tons module	Limited Selection of Tower Crane to handle >30 tons module
Maintenance	Inspection hatch as per ADV36	Same as conventional RC building
Experience	Widely used in different countries for two decades	Limited project references availability

With a view to facilitating easier and more efficient way to demolish and re-install MiC modules in the future, is there any concern at the design stage?

Following the above question, would it be more difficult if a unit is constructed by more than one module?

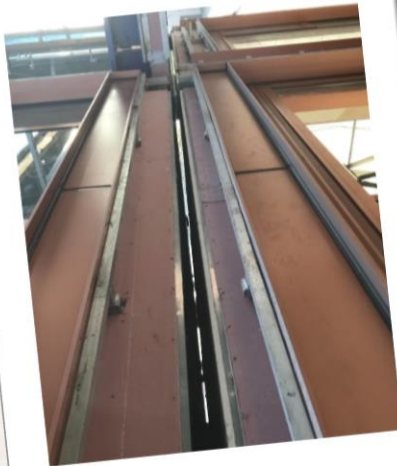


Courtesy of L&O



Module junctions, fire spandrels and  
fire seal to be installed by MC on site

# MiC Display Centre – On Site Stitching Up Work between Modules

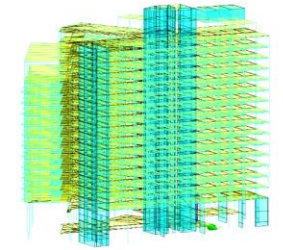
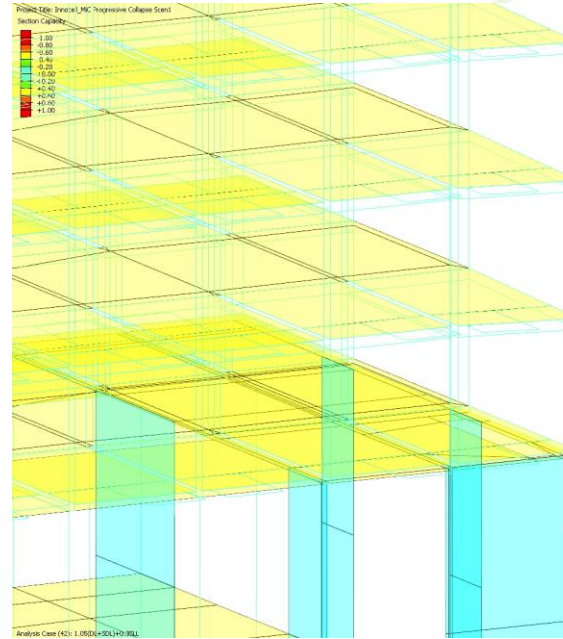


Would there be any adverse effect or damage to the structure of the MiC building if the residents would like to drill holes and to hang a shelf onto the wall?



# Prevention of Progressive Collapse

Courtesy of WSP



How could corroded structural steels be repaired in case that partition walls or any other corrosion protective covers/coating are damaged that leads to water seepage?

Are there any design considerations for future maintenance?

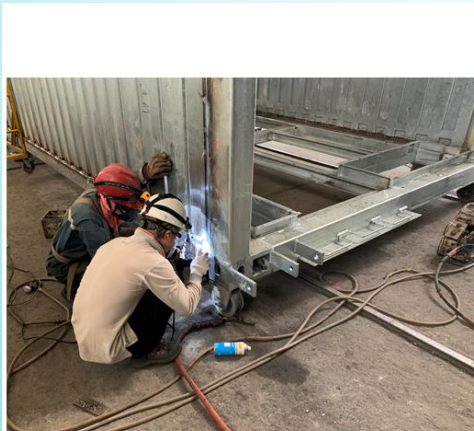






Steel will rust without proper corrosion protection

**No difference** to the conventional building structure for structural or building maintenance



Examination of Weld Joints by Laboratory Technician



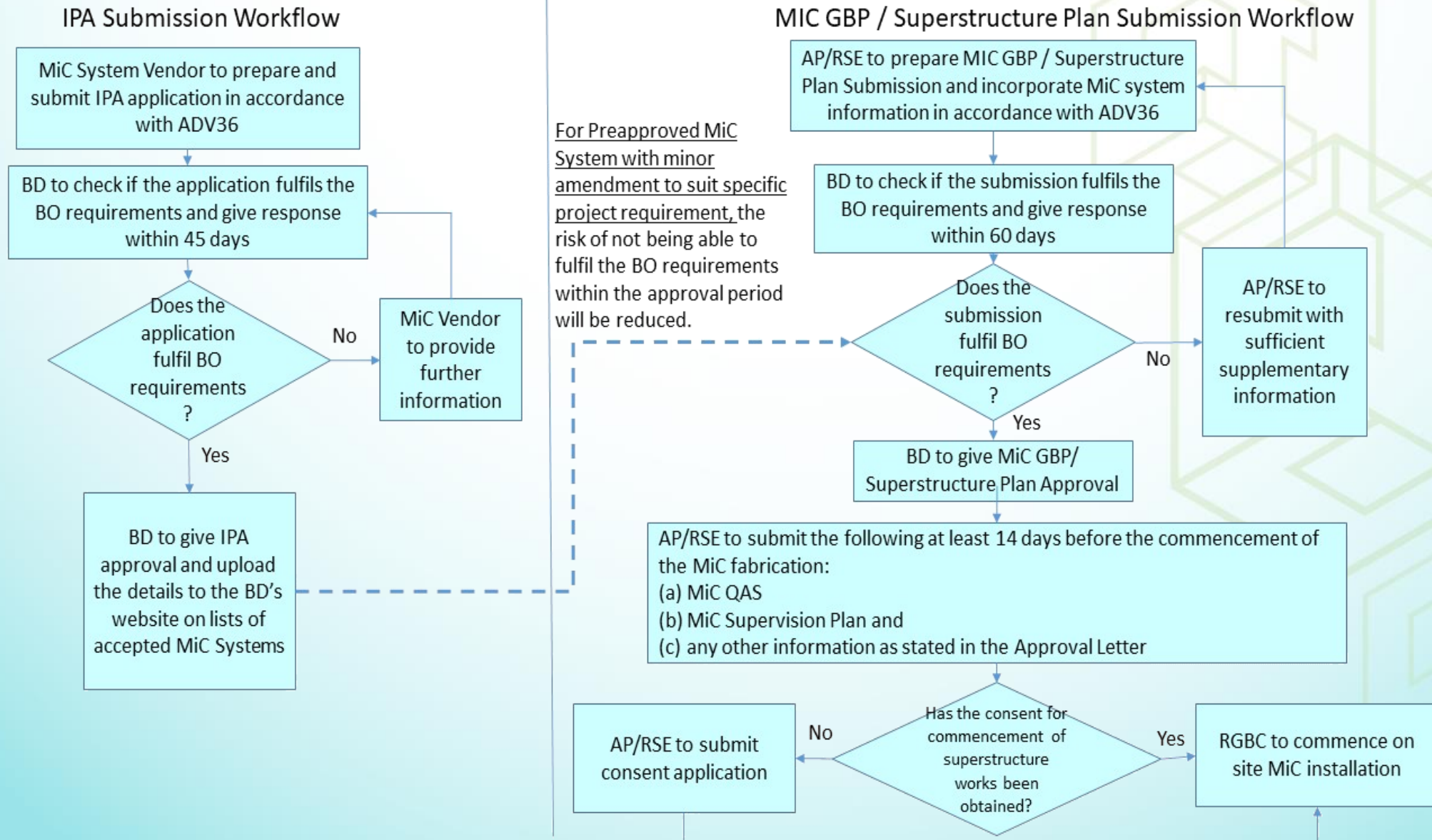
Checking of Thickness of Galvanizing Layer

Proper corrosion protection applied with Robust QA/QC



What are the statutory requirements and procedures before fabrication of modules? What is the timeline and how long does it take?

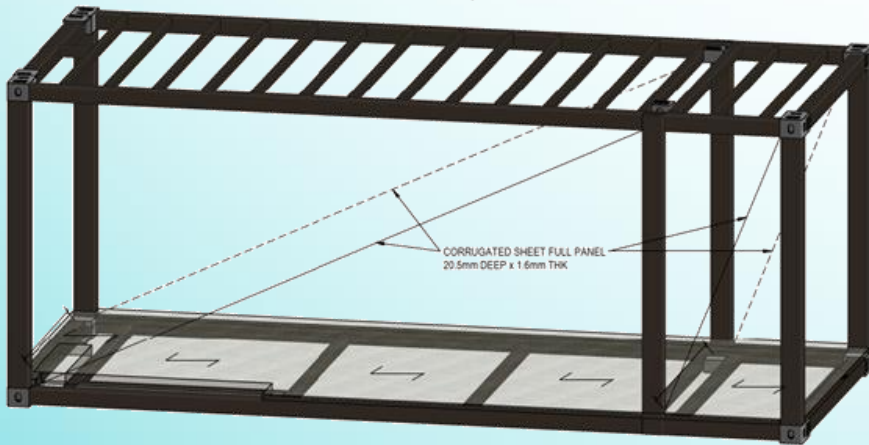
# Submission Workflow Related to MiC



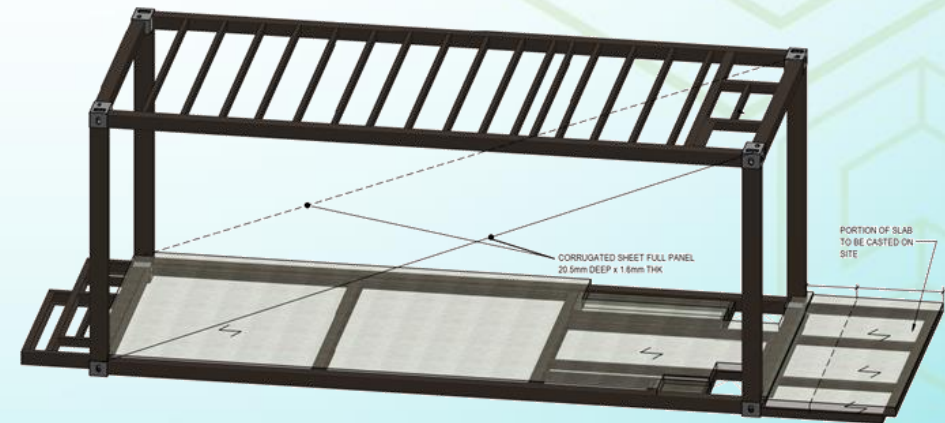
Is there any advantage to the Client for MiC suppliers to obtain the in-principle acceptance (IPA) before award of the contract?

Would it take a longer time to get BD's approval if MiC suppliers submit GBP and Structural Plan, etc. after the award of the contract but not obtaining the IPA in advance?

Layout accepted in IPA



Layout approved in Superstructure



Courtesy of HKSTP and WSP



What are the procedures to obtain a wide load permit for transporting modules wider than 2.5m?

Would the 2.5m limitation be relaxed in the future?

- Traffic impact assessment on the proposed delivery routes and Consultation with the relevant Traffic Engineering Division / Regional Office of TD and the Road Management Office (RMO)/Hong Kong Police Force (HKPF) during project planning/design stage.
  - Swept Path Analysis
  - Traffic Impact Assessment or Traffic Review
  - Temporary Traffic Management (TTM) Scheme
  - Contingency Plan
- Wide Load Permit

# Wide Load Permit

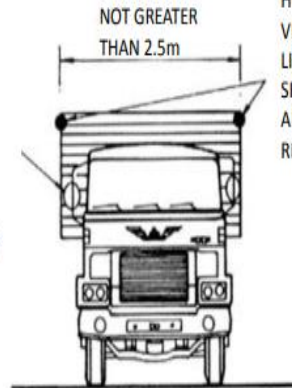


Transport Department

The Government of the Hong Kong Special Administrative Region

## Code of Practice for the Loading of Vehicles

SIDE MIRRORS SHOULD BE EXTENDED SO THAT DRIVER CAN SEE THE TRAFFIC CONDITION BEHIND PROVIDING ANY EXTENSION IS IN ACCORDANCE WITH THE RELEVANT REGULATIONS



PERMITTED WIDTH DIMENSIONS

IN DAYLIGHT: A RED FLAG AT THE REAR EXTREMITY; DURING THE HOURS OF DARKNESS OR IN POOR VISIBILITY CONDITIONS: A WHITE LIGHT SHOWING AHEAD AT EACH SIDE OF THE FRONT EXTREMITY, AND A RED LIGHT SHOWING TO THE REAR AT THE REAR EXTREMITY

### PERMITTED WIDE AND LONG LOADS

February 2019

DIAGRAM 5.9.1

### Guidelines on Application for Wide Load Permit

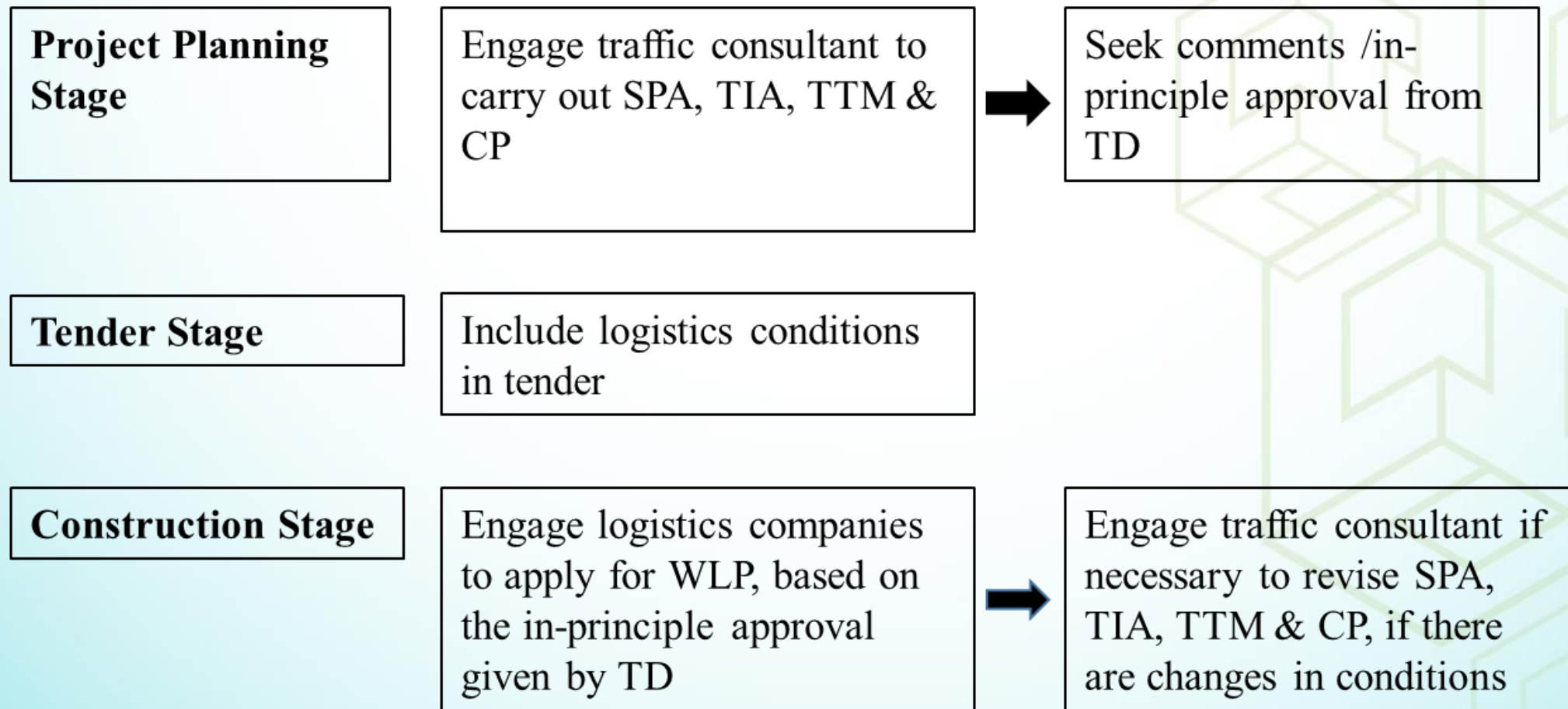
According to Regulation 55 of the Road Traffic (Traffic Control) Regulations (Cap. 374G), no driver shall drive on a road a vehicle that is so loaded that the load:

- (a) in the case of a vehicle other than a trailer, extends forwards more than 1.5 m from the foremost part of the vehicle;
- (b) extends backwards more than 1.4 m behind the rearmost part of the vehicle;
- (c) extends sideways so that the total width of the load is in excess of 2.5 m; or
- (d) rises to such a height in excess of 4.6 m or to such lesser height as may cause damage to any object or wires lawfully erected above the road.

2. Road users must apply for a Wide Load Permit (WLP) from the Transport Department's (TD's) Licensing Office for delivering a load of width exceeding 2.5 m by vehicle. A vehicle may be driven loaded within the limits prescribed in the WLP issued under Regulation 54 of the Road Traffic (Registration and Licensing of Vehicles) Regulations (Cap. 374E).

November 2019





	Routine	Case by Case	Case by Case
	Overall Width ≤2.5m	2.5m<Overall Width≤3m	Overall>3m
WLP Required	No	Yes	Yes
SPA, TIA, TTM & CP Required	No	Yes	Yes ( <u>with more careful consideration of the traffic implications and proposal of more sophisticated TTM schemes</u> )
Time of Delivery	No time restriction	The permitted hours of delivery will depend on the selected route, traffic flows, road conditions, etc., and the results of the TIA acceptable to TD	
Self-arranged Escort (Notes 1 and 2)	No	Yes	
Police Escort (Note 1)	No	No	
Note:	1. Self-arranged escort is the practice recommended by the police. There are however situations where police escort may be needed, for example, when the delivery crashes with a VIP convoy on the day, there is an accident along the route, etc. <u>Under the above-mentioned special situations</u> , there is no charge for the police escort provided. 2. Reference can be made to Section 5.9 of the CoP for the Loading of Vehicles (TD, 2019) on the duties of escort vehicles.		

Design-wise, is there any suggestion to reduce cost?



# Extent of Pre-installed MEP abroad

## Extent of Concealed Pipe Duct, Fire Compartmentation for Service Riser

Courtesy of HKSTP & Hip Hing



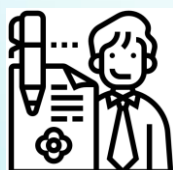
# Development Bureau Technical Circular (Works) No. 3/2020 Digital Works Supervision System (DWSS)



## Scope



The adoption of the Digital Works Supervision System (DWSS) in capital works contracts under the Capital Works Programme, with pre-tender estimate exceeding \$300 million and to be tendered on or after 1 April 2020. This Circular takes immediate effect



## Policy

Capital works contracts, including capital subventions contracts under Head 708, shall adopt the DWSS with an aim of enhancing the standard and efficiency of works supervision as well as the quality and safety of works. Bureaux/Departments are encouraged to adopt the DWSS in other works contracts, such as maintenance and term contracts, with a view to strengthening works supervision

# i-Club

An interactive platform to cultivate collaboration in adoption of construction technologies in Hong Kong. <http://www.citac.cic.hk>



About CITAC

Exhibitions

i-Club

Join i-Club 人 地球 問 鈴





# 建造業創科基金 (CITF)

成立目的為鼓勵建造業廣泛採用創新的建築方法和技術，以提高生產力、提升建築質量、改善工地安全和改善環境質素。CITF將涵蓋兩個方面，分別為技術採用和人力開發。CITF將被用來鼓勵建造業在香港境內或境外採用所認可的新技術。資金總額為10億港元。



## 資助方式

由CITF共同資助，涉及費用最高為70%

## 資金上限

採購/場外生產MiC組件（每個項目每個申請人500萬港元）

Consultant

支持項目顧問聘請專業的MiC顧問（每個項目每個申請人250萬港元）

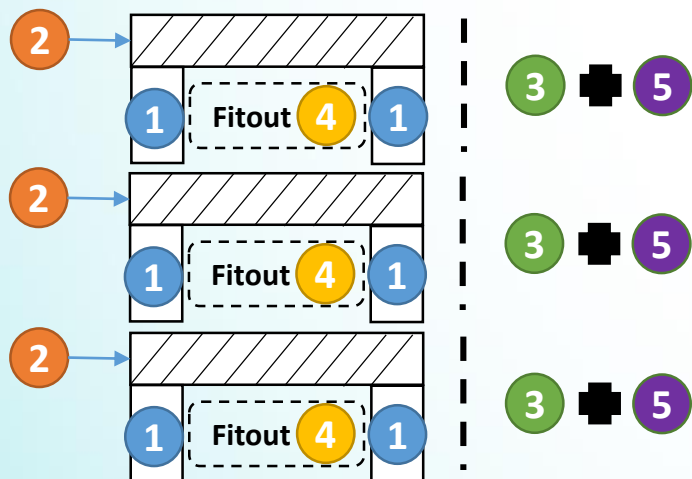
承建商

承建商

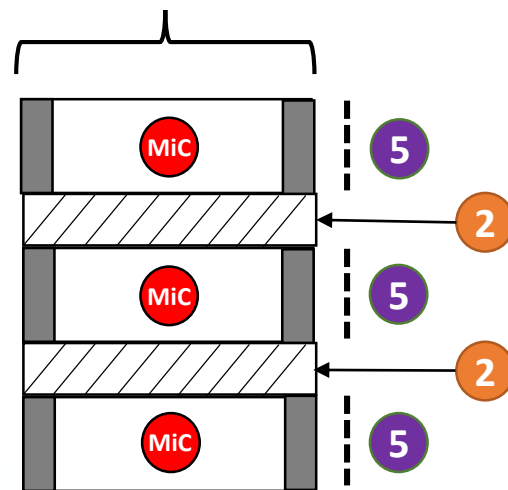
購買/租賃MiC特定的建築工廠（每個項目每個申請250萬港元）



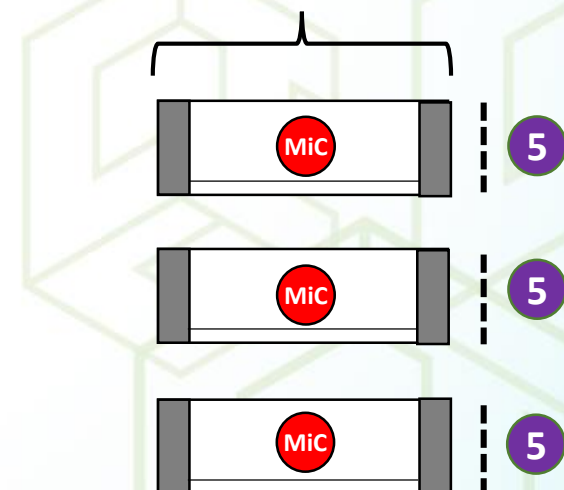




MiC Extent



MiC Extent



1 Insitu Structural Vertical Cement Construction

2 Insitu Structural Floor Construction

3 Prefab/Insitu Façade Work

4 Insitu Fitout Work

5 Insitu Architectural Feature/  
Insitu MEP Fitting Splicing

MiC (Vertical Structural element  
+ Full / Semi Structural floor  
+ Fitout  
+ Façade)

2 Insitu Structural Floor Construction

5 Insitu Architectural Feature/  
Insitu MEP Fitting Splicing

MiC (Vertical Structural element  
+ Structural floor  
+ Fitout  
+ Façade)

5 Insitu Architectural Feature/  
Insitu MEP Fitting Splicing