

# Modular Integrated Construction

## Statutory Requirements under Buildings Ordinance and allied Legislations

*17 September 2019*

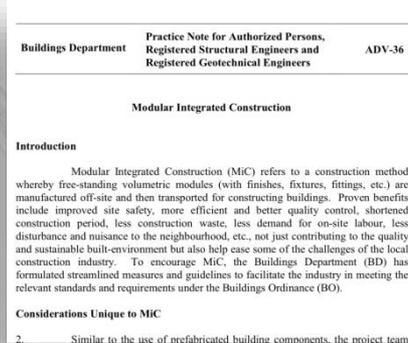
*Alex CHIK Technical Secretary/Building  
Fion AU Technical Secretary/Structural*



# Timeline of BD's Initiatives



**Oct 2017**  
Policy Address 2017



**Dec 2017**  
Issue of PNAP ADV-36



**May 2019**  
Issue of PNAP APP-161

**Nov 2017**  
Launch of Pre-acceptance Mechanism



**Apr 2018**  
1<sup>st</sup> Pre-acceptance Submission Received

**Sept 2018**  
1<sup>st</sup> In-principle Acceptance (IPA)



**Sept 2019**  
Issue of Revised PNAP ADV-36

# Processing of Plan Submissions

## Pre-submission Enquiry

Specific Design Principle/  
Construction Standard

45 Days

## Building Proposal

Modularisation on  
DfMA Concept

## Formal Plan Submissions

Centralised  
Processing System

## Quality Control and Supervision Proposal

Submission of Quality  
Assurance Scheme and  
MiC Supervision Plan

## Site Supervision Proposal

Supervision Plan

14 Days before production

APPROVAL

60 Days

CONSENT

28 Days

PRODUCTION

Technical Services Unit  
Dedicated Team

## Application for In-principle Acceptance

Form MiC1 and Essential  
Information in Appendix C to  
PNAP ADV-36

45 Days

## Granting of IPA

Unique IPA Reference No.  
Enlisted in BD Website

# In-principle Acceptance

## Resolve Non-site Specific Issues Curtailed Assessment on Design and Material Used

As at 31 August 2019

No. of IPA Granted: 7

No. of Application being Processed: 16

### Accepted Lists

Steel MiC System : 5

Concrete MiC System: 2



Steel MiC Systems - Buildings | bd.gov.hk/en/resources/codes-and-references/modula...

Buildings Department  
The Government of the Hong Kong Special Administrative Region

Pre-accepted Modular Integrated Construction Systems / Components  
**Steel MiC Systems**

In-principle acceptance has been given to the following MiC Systems by the BD.

BD's Acceptance Reference No.	Manufacturer, Model and Prefabrication Location (City or Country)
MiC 1/2018	Unitised Building (Hong Kong) Investment Limited and Unitised Building (Shanghai) Building Technology Company Limited (优必(上海)建筑科技有限公司)

Concrete MiC Systems - Buildings | bd.gov.hk/en/resources/codes-and-references/modula...

Buildings Department  
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Pre-accepted Modular Integrated Construction Systems / Components  
**Concrete MiC Systems**

In-principle acceptance has been given to the following MiC Systems by the BD.

BD's Acceptance Reference No.	Manufacturer, Model and Prefabrication Location (City or Country)
MiC 1/2019	Yau Lee Wah Concrete Precast Products Company Limited  Model No. Concrete MiC 1.0 (Module Type: A, B and C)

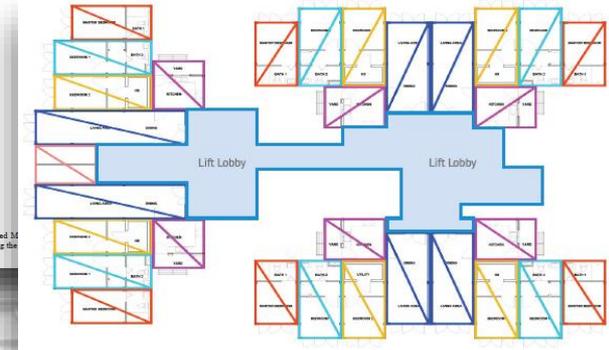
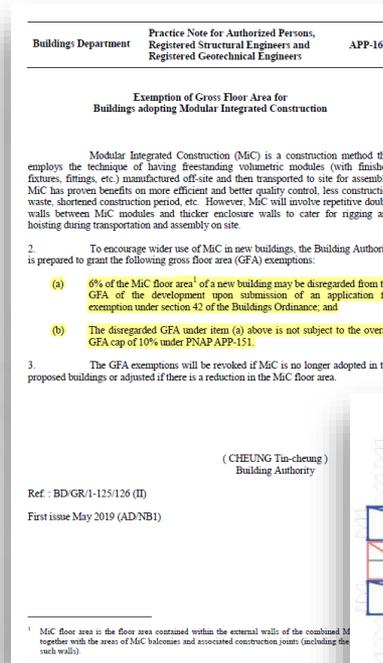
# PNAP APP-161

- Simple & straightforward 6% GFA exemption by MiC floor area
- Separate regimes from extant GFA concessions under other initiatives
- Exempted MiC floor areas NOT subject to 10% GFA cap under PNAP APP-151

# PNAP APP-151

## List of GFA Concessions

	Practice Notes	Features subject to compliance with the pre-requisites in para. 6 & 7 of PNAP APP-151	Features Subject to the Overall Cap of 10% in para.4 of PNAP APP-151
<b>Additional Green Features under JPN</b>			
38.	Buildings adopting Modular Integrated Construction	JPN2 and PNAP APP-161	



# JPN No. 2

## Under the Buildings Ordinance

2. The following green/innovative features may upon application and subject to conditions be exempted from Gross Floor Area (GFA) and/or Site Coverage (SC) calculations under the Buildings Ordinance:
- (a) Non-structural prefabricated external walls;
  - (b) Utility platforms for residential buildings;
  - (c) Noise barriers;
  - (d) Communal sky gardens for non-residential buildings; and
  - (e) Modular Integrated Construction.

# PNAP ADV-36

Buildings Department Practice Note for Authorized Persons,  
Registered Structural Engineers and  
Registered Geotechnical Engineers ADV-36

## Modular Integrated Construction

### Introduction

Modular Integrated Construction (MiC) is a construction method that employs the technique of having freestanding volumetric modules (with finishes, fixtures, fittings, etc.) manufactured off-site and then transported to site for assembly. Proven benefits include improved site safety, more efficient and better quality control, shortened construction period, less construction waste, less demand for on-site labour, less disturbance and nuisance to the neighbourhood, etc., not just contributing to the quality and sustainable built-environment but also help ease some of the challenges of the local construction industry. To encourage MiC, the Buildings Department (BD) has formulated streamlined measures and guidelines to facilitate the industry in meeting the relevant standards and requirements under the Buildings Ordinance (BO).

### Considerations Unique to MiC

2. Similar to the use of prefabricated building components, the project team should engage the MiC suppliers at the early design stage to sort out the issues usually not encountered in conventional in-situ construction. Apart from the extent of standardisation and buildability of such modules, the mode of delivery with due regard to the specific site conditions, the issues that may arise from meeting the relevant requirements including those on supervision as well as the programme of plan submissions to the BD should be considered in advance. General guidelines on the design and quality control requirements under the BO for MiC are given in Appendices A and B respectively.

## Appendix A - Design Requirements

- Fire Safety
- Joints and Gaps
- Structural Design
- Provisions for Maintenance

## Appendix B - Quality Control and Supervision

Appendix A  
(PNAP ADV-36)

### Design Requirements for Modular Integrated Construction

#### Fire Safety

The fire protection or performance of elements should be addressed. Non-code-compliant designs should have equivalent performance as the prescriptive standards and, where applicable, fire engineering assessments as stated in the Code of Practice 2011.

#### Joints and Gaps

2. Modular constructions would usually entail more joints than those in drainage pipes and building envelope which are precast.

#### Structural Design

3. The requirements on the design and construction of precast concrete and structural steel given in the Code of Practice for Concrete, Code of Practice for Precast Concrete Construction and Structural Use of Steel also apply to MiC elements. Particular attention should be given to the following design aspects:

- (a) Stability

Appendix B  
(PNAP ADV-36)

### Quality Control and Supervision of MiC

#### Quality Assurance Scheme

Modular units are to be fabricated by a factory with ISO 9000 or equivalent quality assurance certification. This will be imposed as a condition under item 6 in section 17(1) of the BO when giving approval of plans.

2. Upon approval of plans, a requirement will also be imposed under regulation 10 of the Building (Administration) Regulations (B(A)R), to require submission of a copy of the Quality Assurance Scheme of the MiC supplier at least 14 days before the commencement of the production work in the prefabrication factory unless such has been covered in BD's in-principle acceptance and remains unchanged<sup>1</sup>. The project Authorized Person (AP) and Registered Structural Engineer (RSE) should provide a written confirmation that the submitted scheme has adequate provisions in ensuring the quality of production complying with the provisions of the BO and the approved plans.

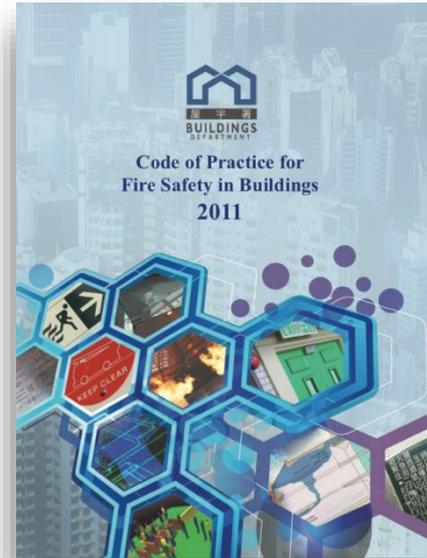
3. The Quality Assurance Scheme should cover the following items:

- (a) Quality control tests of materials;
- (b) Calibration of laboratory equipment for quality control tests;
- (c) Efficiency and proper operation of equipment at the prefabrication factory;
- (d) Production process;
- (e) Testing procedures and requirements;

# Fire Safety

## Code of Practice for Fire Safety in Buildings 2011

- Fire Compartmentation
- Fire Resistance Rating (FRR) of Element of Construction



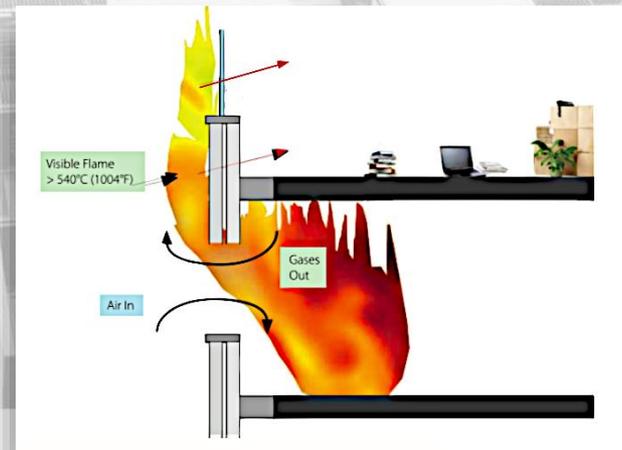
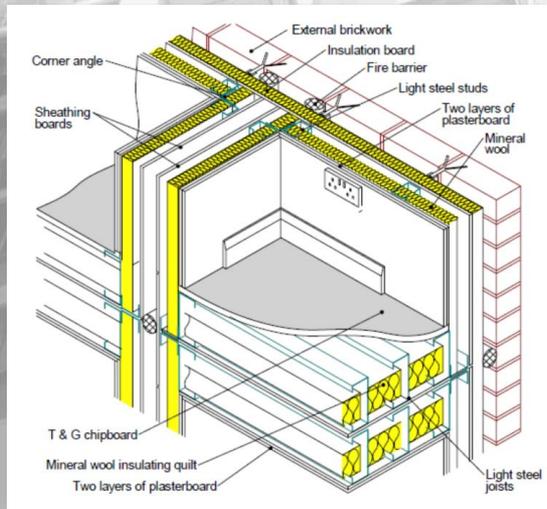
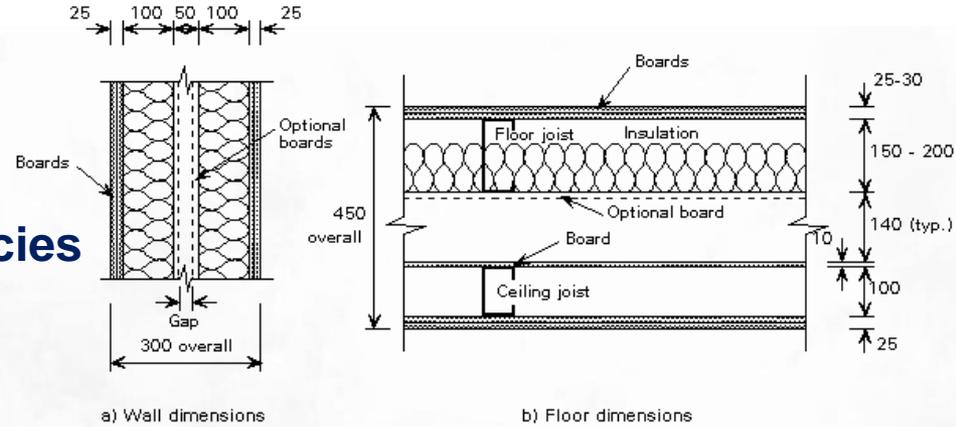
**Table C2: Fire Resistance Rating Criteria for Elements of Construction, Fire Barriers and Other Components**

Elements of construction or other components	Criteria to be satisfied			Method of Exposure
	Stability	Integrity	Insulation	
1 Structural frame, beam or column	Y	N	N	Exposed faces only
2 Floor including fire compartment floor	Y	Y	Y	Each side separately
3 Roof forming part of an exit route or performing the function of the floor	Y	Y	Y	From underside
4 Loadbearing wall not being a fire barrier	Y	N	N	Each side separately
5 External wall	Y*	Y	Y	Each side separately
6 Loadbearing wall being a fire barrier	Y	Y	Y	Each side separately
7 Non-loadbearing wall being a fire barrier	N	Y	Y	Each side separately
8 Protected shaft, lobby and corridor	Y*	Y	Y	Each side separately
9 Fire shutter, fire stop, fire dampers, sealing system	N	Y	N (unless specified)	Each side separately
10 Smoke outlet shaft	Y	Y	Y	From outside
11 Enclosure around services other than Item 14	N	Y	Y	From outside
12 Door (including frame and fixing)	N	Y	N (unless specified)	Each side separately (except lift doors – from landing side only)
13 Fixed light (including frame, glazing & fixing)	N	Y	Y	Each side separately
14 Enclosure around services in required staircase/protected lobby	N	Y	Y	Each side separately



# Fire Safety

- Protection of Flats
- Separation between Use/Occupancies
- Openings through Fire Barriers
- Protection of External Fire Spread
- Fire Properties of Building Elements and Components (Part E of FS Code)



# Joists and Gaps

## Building (Construction) Regulations

- Regulation 38 – External Wall of Impervious Construction
- Regulation 41 – Protection against Penetration of Moisture
- Regulation 48 – Roof to be Weatherproof
- Regulation 90 – Inhibit the Spread of Fire, e.g. cavity barrier



# Provisions for Maintenance

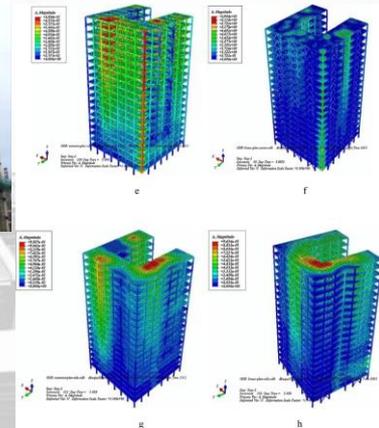
- **User Manual**
- **Inspection Hatches at Strategic Locations**



# Structural Design

## Material

- Code of Practice for Structural Use of Steel
- Code of Practice for Structural Use of Concrete
- Code of Practice for Precast Concrete Construction
- Unconventional materials
  - International standards
  - Performance in terms of structural , fire, durability etc., with considerations of local conditions

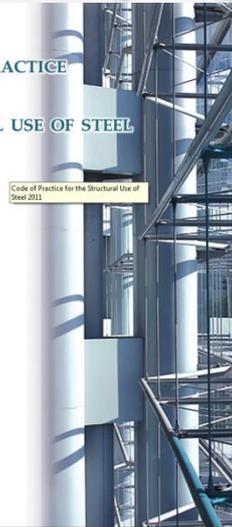


Code of Practice for  
Precast Concrete Construction  
2016

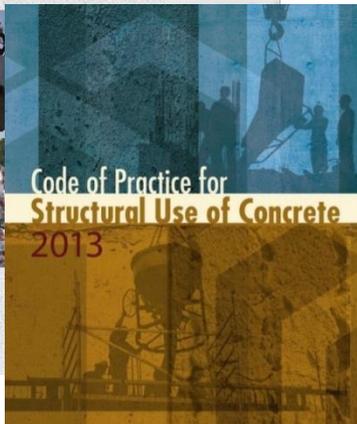


CODE OF PRACTICE  
FOR THE  
STRUCTURAL USE OF STEEL  
2011

Code of Practice for the Structural Use of  
Steel 2011



Code of Practice for  
Structural Use of Concrete  
2013



## Structural Form

- Stability provided by modules only / in-situ portion / both
- Characteristic of modules and connections to be reflected in computer model e.g. joint restraint conditions; diaphragm properties

# Structural Design

## Connections

- Vertical and horizontal
- Overall Stability and Robustness
- Structural adequate
- Easy to install
- Designed for fabrication and installation tolerance

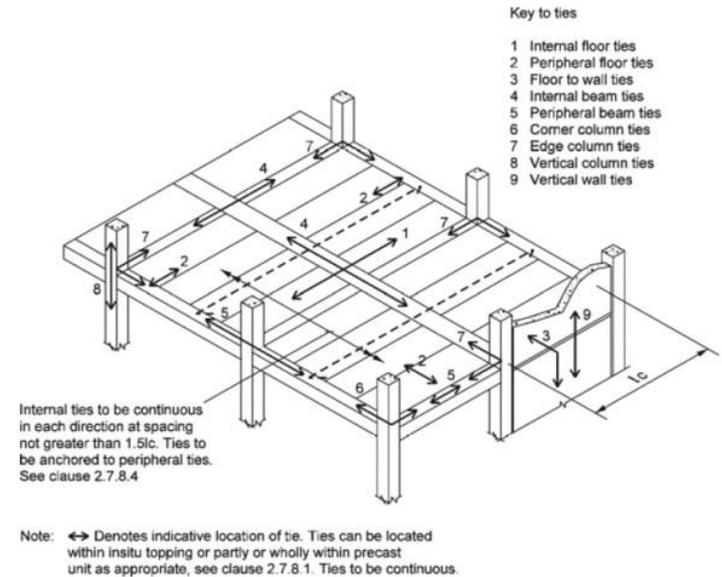
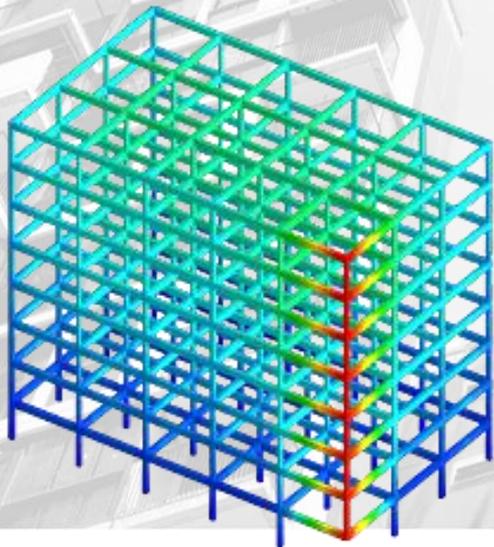


Figure 2.1 – Types of tie in structural frame

## Robustness and Integrity

- Able to resist disproportionate collapse
- Unlike conventional construction, rigid diaphragm may not be provided and only horizontal ties at column connections
  - Hypothetical removal case
  - Capable of redistributing internal forces to prevent disproportionate collapse

# Structural Design

## Design for Temporary Stages

- Load path different from permanent stages
- Stability and integrity of modules at all stages
- Check against temporary stacking height
- Lifting point capacity
- Wind load according to Code of Practice on Wind Effects



# Quality Supervision (PNAP ADV-36)

## Manufacture and Assembly in Off-site Factory

- QA System of Factory
  - ISO 9000 or equivalent quality assurance certification
  - Quality Assurance Scheme (QAS) to be submitted 14 days before **production**
  - If QAS same as the one with IPA, submit amendment only
- Quality and Qualified Supervision
  - MiC supervision plan to be submitted 14 days before production
  - AP, RSE and the AS of RC should inspect and carry out audit checks at least once every month

## Installation on Site

- Quality supervision by AP, RSE and RC
  - Code of Practice of Site Supervision
  - If no audit check to factory by AP/RSE, on-site audit checks to quality of modules delivered to site (Sampling rate at least 1%)



Table 1 Minimum Qualification and Supervision Frequency of QCST and QCCT

	AP Stream	RSE Stream	RC Stream	
Qualifications of Supervisory Personnel	T3*	T3*	T3*	T1*
Supervision Frequency	Weekly	Weekly	Weekly	Continuous

\* T3/T1 refers to Grade T3/T1 Technically Competent Person equivalent as stipulated in the Code of Practice for Site Supervision

## Pre-submission Enquiry Service PNAP ADM-19

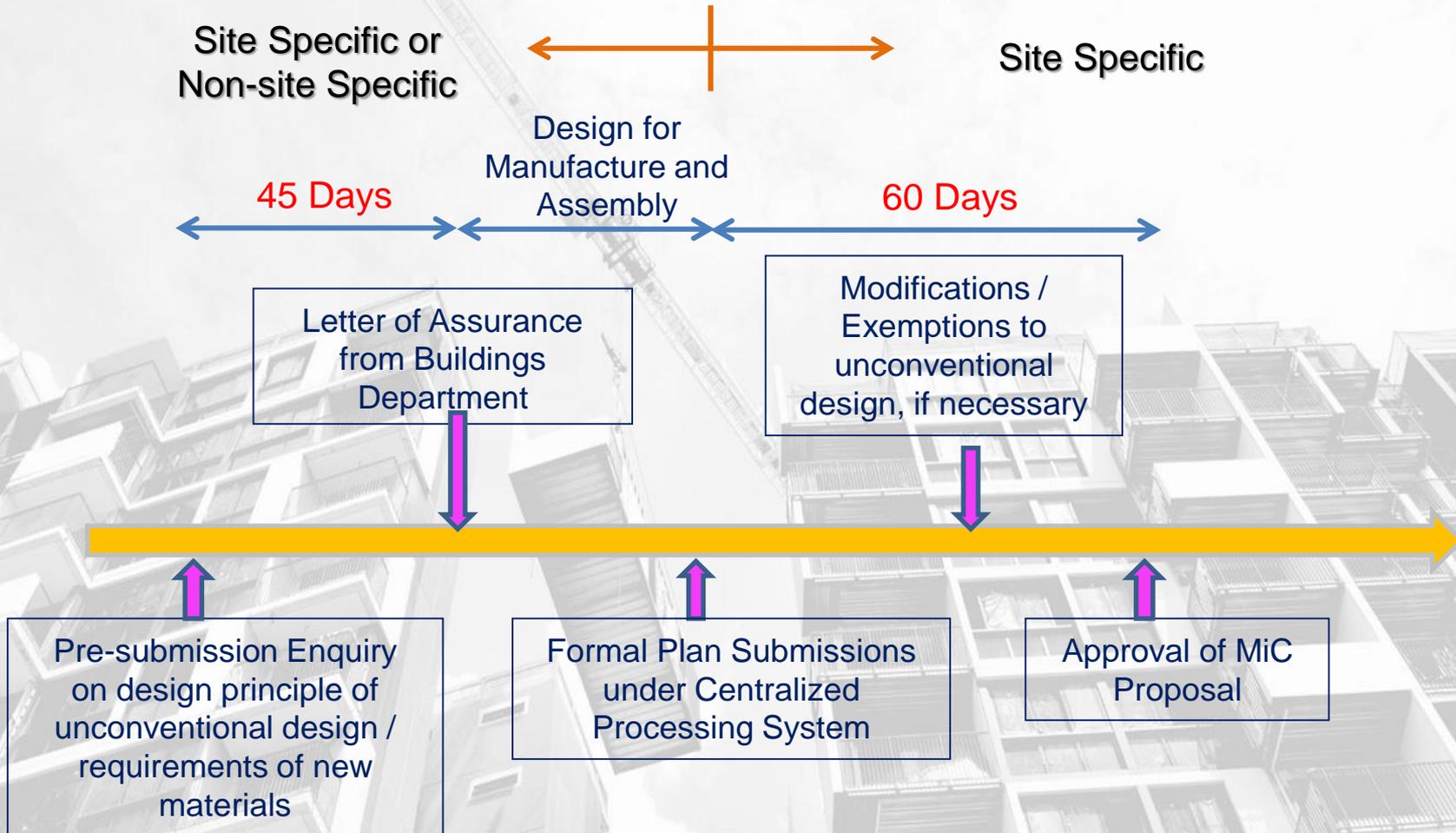
- To settle design principles of unconventional design or performance of modules or new construction materials in early design stage
- Project based, **site specific**
- Unconventional design, new construction material or performance of module at an early stage

## Pre-acceptance Mechanism PNAP ADV-36

- A channel for industry to know MiC suppliers meeting the standards under Buildings Ordinance
- To resolve design and construction matters of MiC system / component
- Applicant based
- Based on assumed layout and **non-site specific** building details
- **Not** a pre-requisite for approval of plans for future projects
- Cover Quality Assurance Scheme (QAS) of factory

# Pre-submission Enquiry Service

- For Client and/or AP/RSE of a particular project



# Pre-acceptance Mechanism

- For MiC Suppliers / Contractors with Off-site Prefabrication Factory
- IPA BD Reference No. can be quoted in future formal plan submissions

Design for  
Manufacture and  
Assembly

45 Days

Appointment  
of AP/RSE

Modifications / Exemptions to  
unconventional design, if  
necessary

Application for In-  
principle  
Acceptance (IPA)  
Submission +  
Form MiC1/MiC2

Grant of IPA with  
BD Reference No.  
Valid for 5 years

# Other Important Information

## Drawings

- Fabrication tolerance in factory and installation tolerance on site
- Temporary stacking height of modules
- Location and capacity of lifting points
- Overall module installation sequence
- Method statement with diagrams for installing each type of structural connections, including measures to ensure quality control
- Provision of access points / inspection pits at strategic locations for inspection and repair / replacement

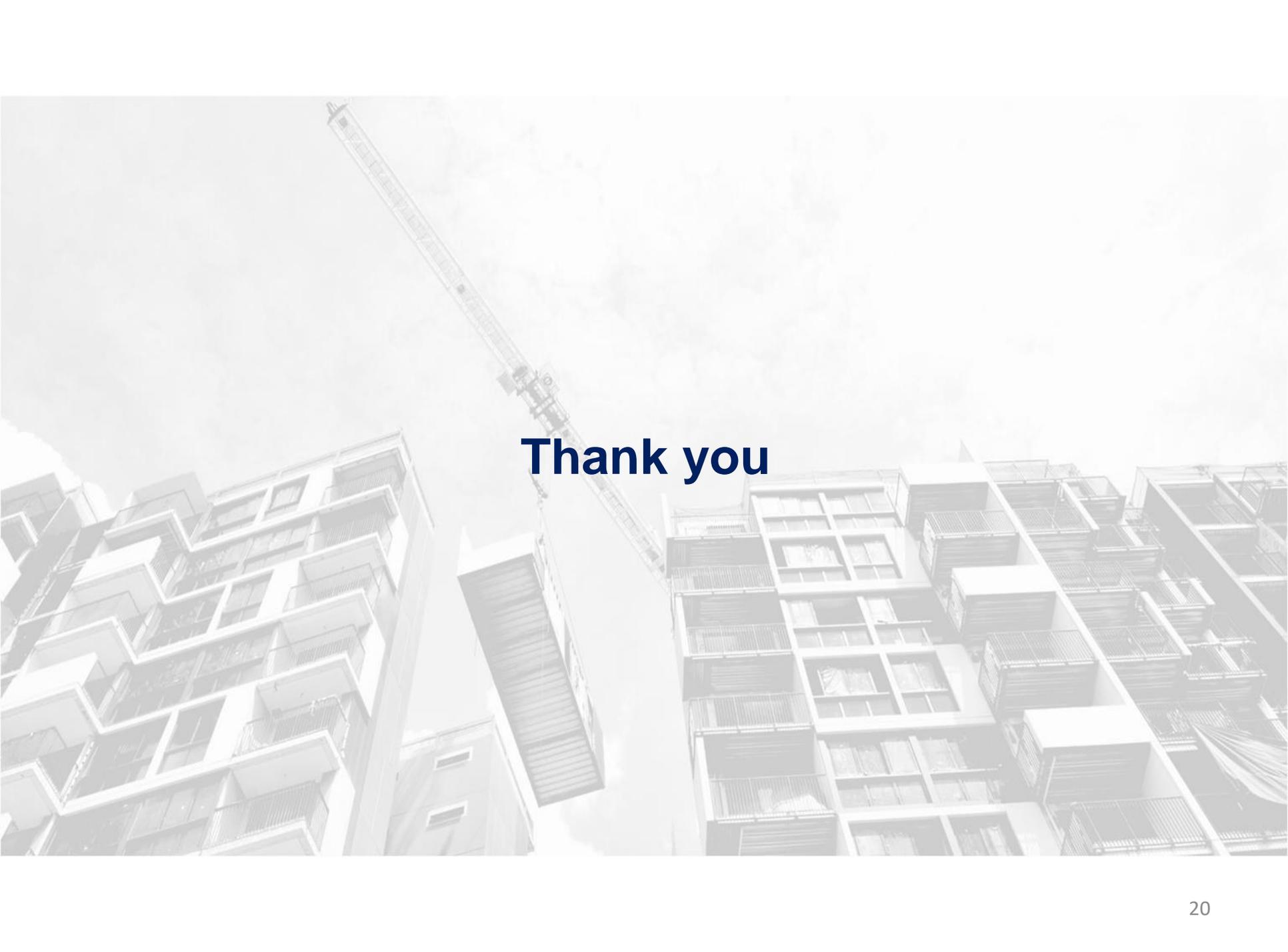


# Other Important Information

## Documents

- Form MiC1
  - Manufacturer
  - Prefabrication Factory
- Quality Assurance Scheme
  - Appendix B of PNAP ADV-36
  - Traceability of modules
- Fabrication process in Factory
- User manual with safety notices and instructions for alterations





**Thank you**