

Current Development of PPVC in Singapore

* PPVC (Prefabricated Prefinished Volumetric Construction)

PRESENTED BY

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Speakers Profile



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- 2) PPVC in Singapore
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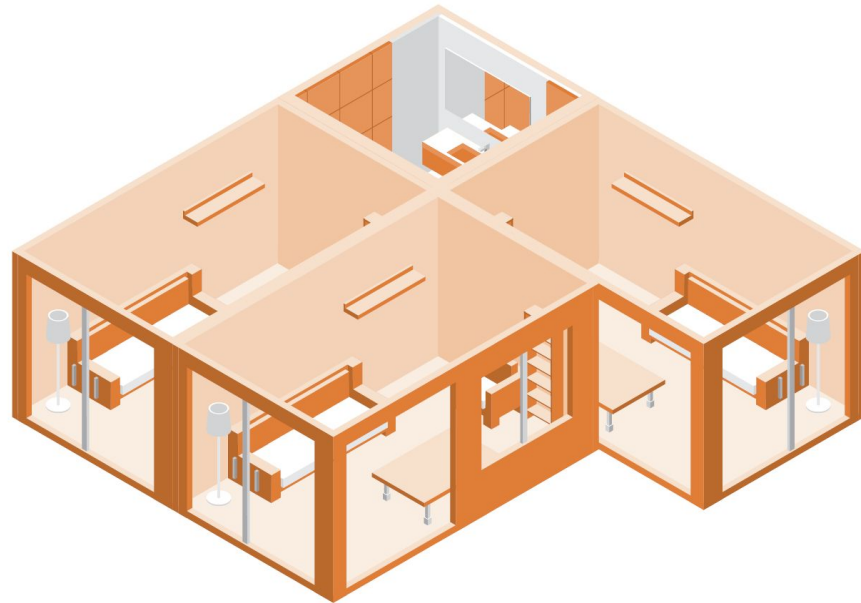


What is PPVC?

What is PPVC?

- ❖ PPVC – Prefabricated Prefinished Volumetric Construction
- ❖ Modular Construction
- ❖ “Factory assembly followed by on-site installation”
- ❖ Integrated free-standing volumetric modules with completed **internal finishes, fixtures and fittings** manufactured in a controlled area off-site (the factory) and delivered to site for installation in a **‘lego-like’** manner

PPVC vs Precast component

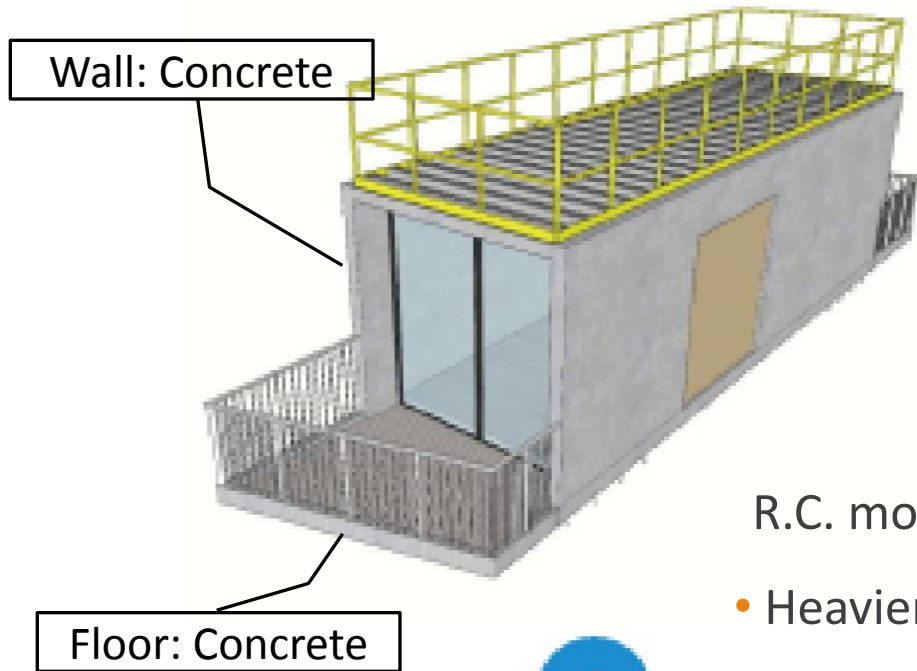


PPVC illustration



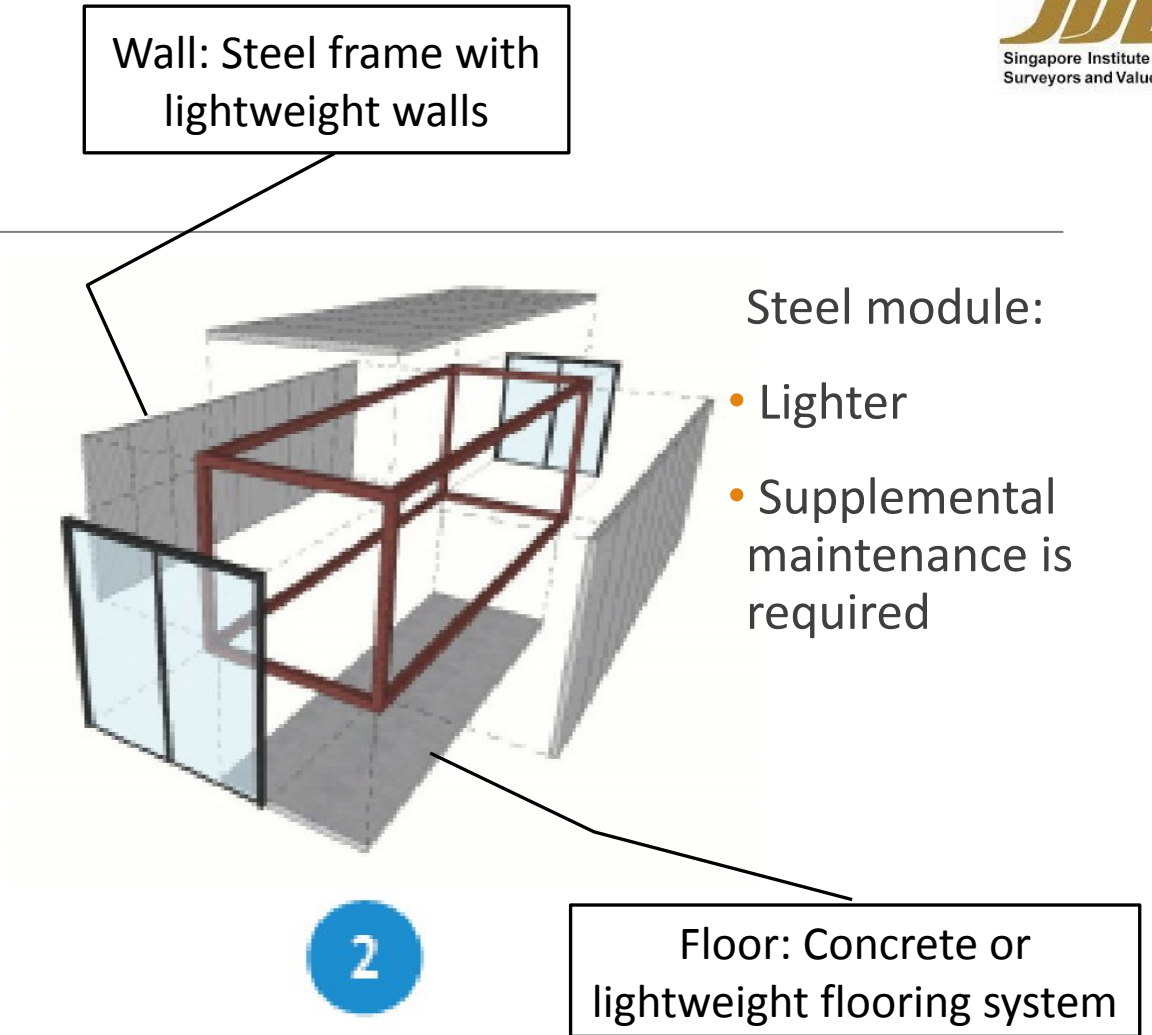
Precast Component illustration

Types of PPVC



R.C. module:

- Heavier
- Maintenance similar to conventional construction



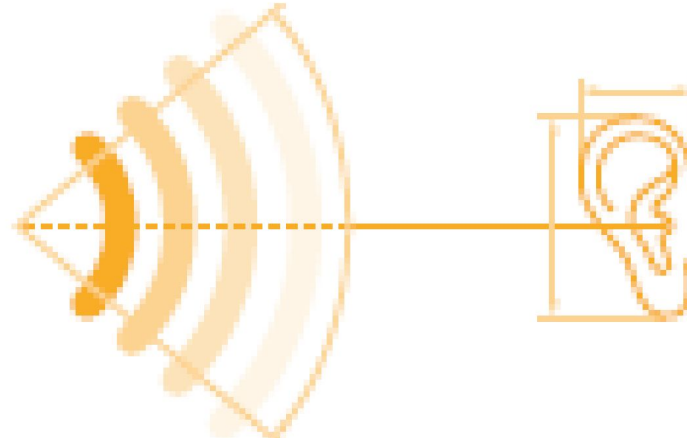
Advantages of PPVC



Improve productivity



Reduce on-site labour



Improve work environment



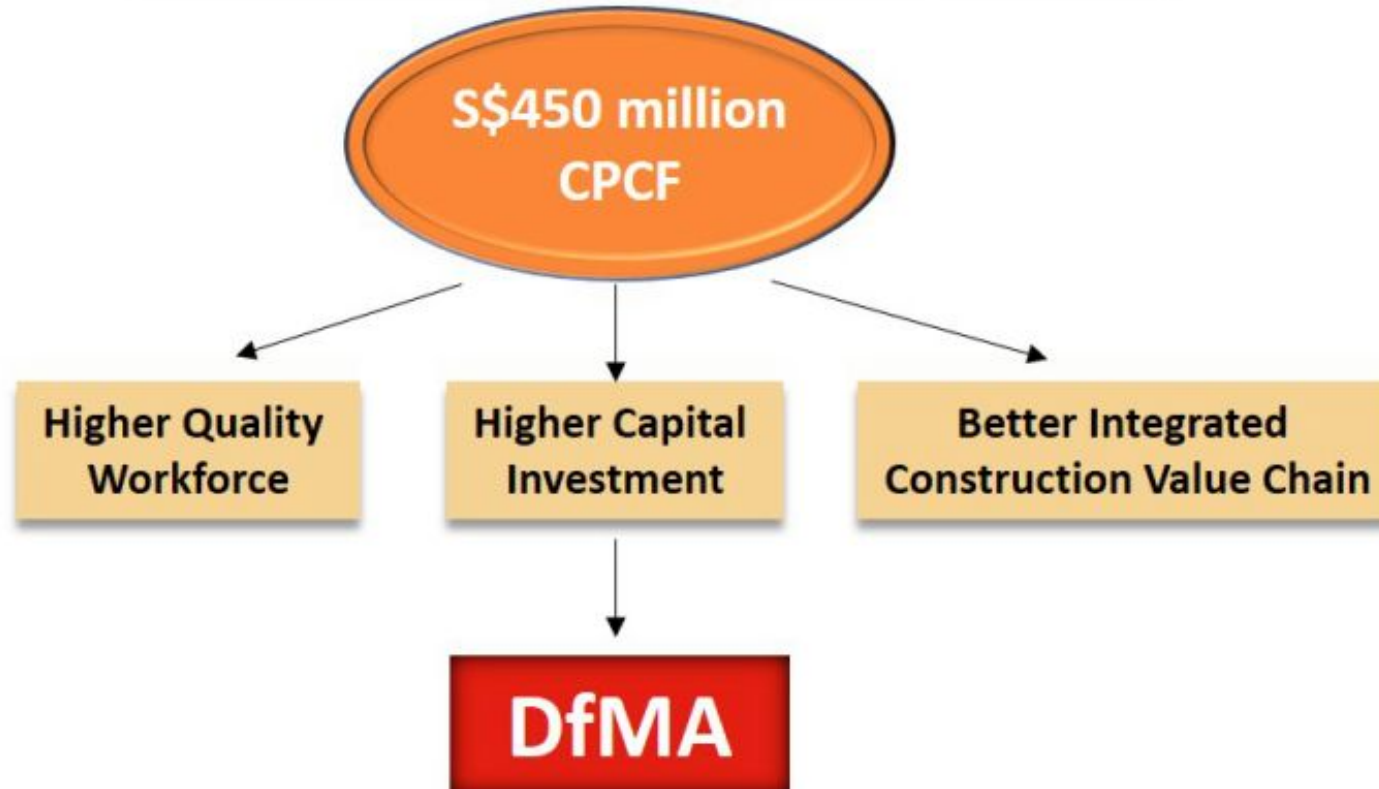
Improve quality of work



Prefabricated Prefinished Volumetric Construction (PPVC) In Singapore

Why PPVC?

2nd Construction Productivity Roadmap



Examples of Design for Manufacturing and Assembly (DfMA)



PPVC



Mass Engineered Timber (MET)



Prefabricated MEP System

Government Regulation

Mandated requirement to adopt PPVC as a land sales condition for selected non-landed residential and hotel Singapore's **Government Land Sale (GLS)** sites from Nov 2014 to generate demand for consultants and builders.

**SALE OF SITE
FOR RESIDENTIAL DEVELOPMENT
LAND PARCEL
AT DAIRY FARM WALK**

TECHNICAL CONDITIONS OF TENDER

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5.3 Prefabricated Prefinished Volumetric Construction (PPVC)

5.3.1 For the purpose of adopting the PPVC method of construction, the successful tenderer is required to set aside some space within the Land Parcel for storage and/ or holding area for PPVC modules. No additional space outside the Land Parcel will be granted on TOL basis for this purpose.

5.4 CONQUAS Assessment of Construction Quality

5.4.1 The successful tenderer shall be required to refer and submit the proposed development to the Building and Construction Authority (BCA) to be assessed for the construction quality of the building works under the Construction Quality Assessment System (CONQUAS).

5.4.2 The successful tenderer shall for the purpose of this Condition comply with all requirements, procedures, directions and request of BCA and shall pay all fees, charges and other amounts payable to BCA for and in relation to the assessment of the construction quality of the proposed development under CONQUAS. The successful tenderer shall also render his full co-operation to BCA, its officers, employees and agents in relation to such assessment under CONQUAS.

**Example of Tender Document
of GLS Land Parcel**

BCA's Guideline (1) - Minimum Requirements of PPVC

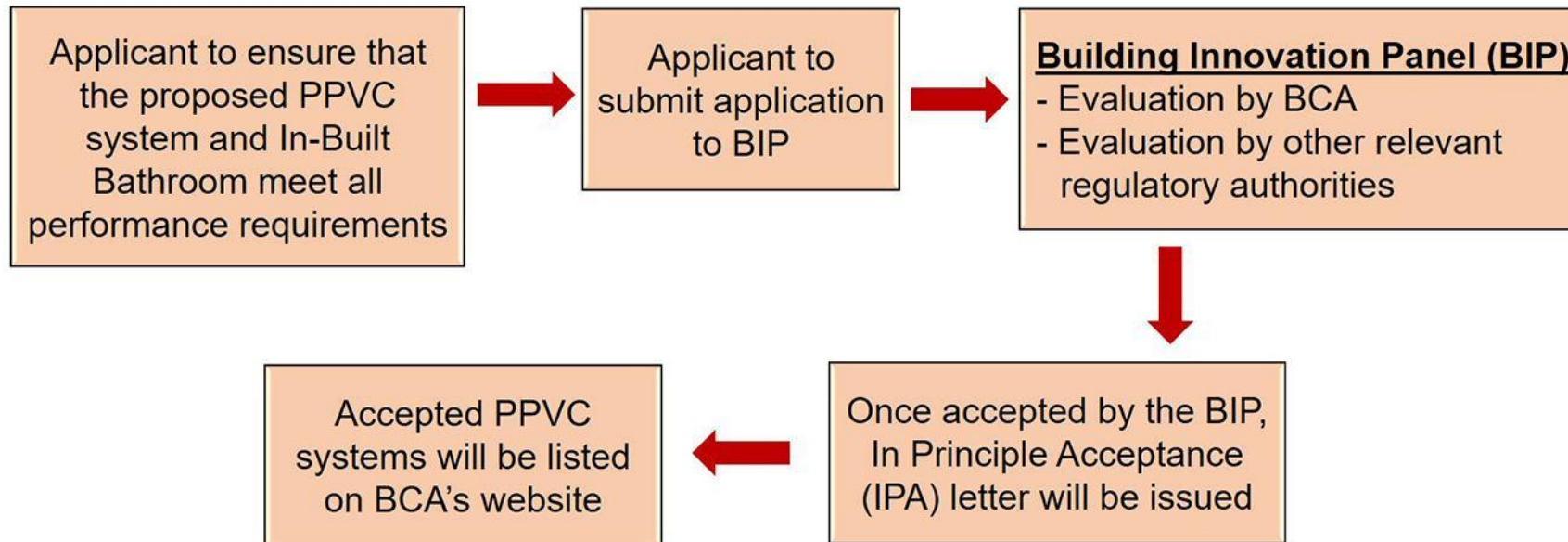
- ❖ Minimum Level of Use of PPVC – **65%** of total super-structural floor area
- ❖ Minimum Level of Finishing & Fittings to be Completed Off-Site

Element	Minimum Level of Completion Off-Site
Floor finishes	80%
Wall finishes	100%
Painting	100% base coat, only final coat is allowed on-site
Window frame and Glazing	100%
Doors	100%, only door leaves allowed for on-site installation
Wardrobe/ Cabinet	100%, only door allowed for on-site installation
M&E (includg pipes, conduits & ducting)	100%, only equipment allowed for on-site installation
Electrical sockets & light switches	100%, only light fittings allowed for on-site installation

BCA's Guideline (2) - PPVC Acceptance Framework

The PPVC acceptance framework consists of **2 parts**:

- ❖ Acceptance by Building Innovation Panel (BIP)
- ❖ Accreditation by PPVC Manufacturer Accreditation Scheme (MAS)



BCA's Guideline (3) – Firm with PPVC projects / met PPVC Performance Requirements

NO OF FIRM WITH PPVC PROJECTS

- ❖ Architectural Firms : 16 nos
- ❖ C&S Firms : 17 nos
- ❖ Builders/ Contractors : 25 nos

NO OF SUPPLIER/ MANUFACTURER MET THE PPVC PERFORMANCE REQUIREMENTS

- ❖ Concrete PPVC System : 33 nos
- ❖ Steel PPVC System : 17 nos

Integrated Construction and Prefabrication Hubs (ICPH)

- ❖ Master plan of the development of ICPH with a **30-year lease term**
- ❖ A multi-storey **automated and high degree mechanized** manufacturing facilities producing prefabricated components including PPVC
- ❖ **5 nos** of ICPH
 - ✓ Soil-Build (Pte) Ltd



PAQS YQSG Day 2 Program: ICPH Visit on 10 Sep 2022



Progress of PPVC so far...

36 PPVC projects as of end 2019

Key Projects:



NTU North Hill
Hostel
(PPVC)

2015



10-Storey Crowne Plaza
Hotel Extension (PPVC)

2016



9-Storey Dormitory at
JTC Space @ Tuas (PPVC)

2017



10-Storey Brownstone
Executive Condominium (PPVC)



36-Storey Parc Riviera
Condominium (PPVC)

2018 and onwards



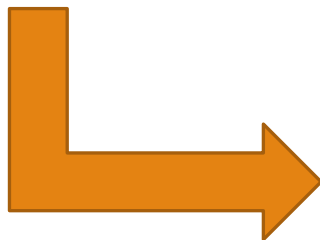
40-Storey
Clement Canopy
Condominium (PPVC)

TARGET TO CREATE **39** MORE PPVC PROJECTS IN 2020 & 2021...

Construction Constraints – Offsite Factory & Onsite Installation



Structural Carcass at Factory
(offsite)



Architectural Fit Out at Factory
(offsite)



Installation (onsite)



Offsite Factory & Onsite Installation



Module Design Constraints – Transportation



Height < 4.5 m (inclusive of truck height)

Width <= 3.4m

Weight < 80 tons

**Note: [Auxiliary Police Force \(APF\) Escort](#) is required if exceeding LTA's traffic regulatory requirements.*

Module Design Constraints – Hoisting Machine

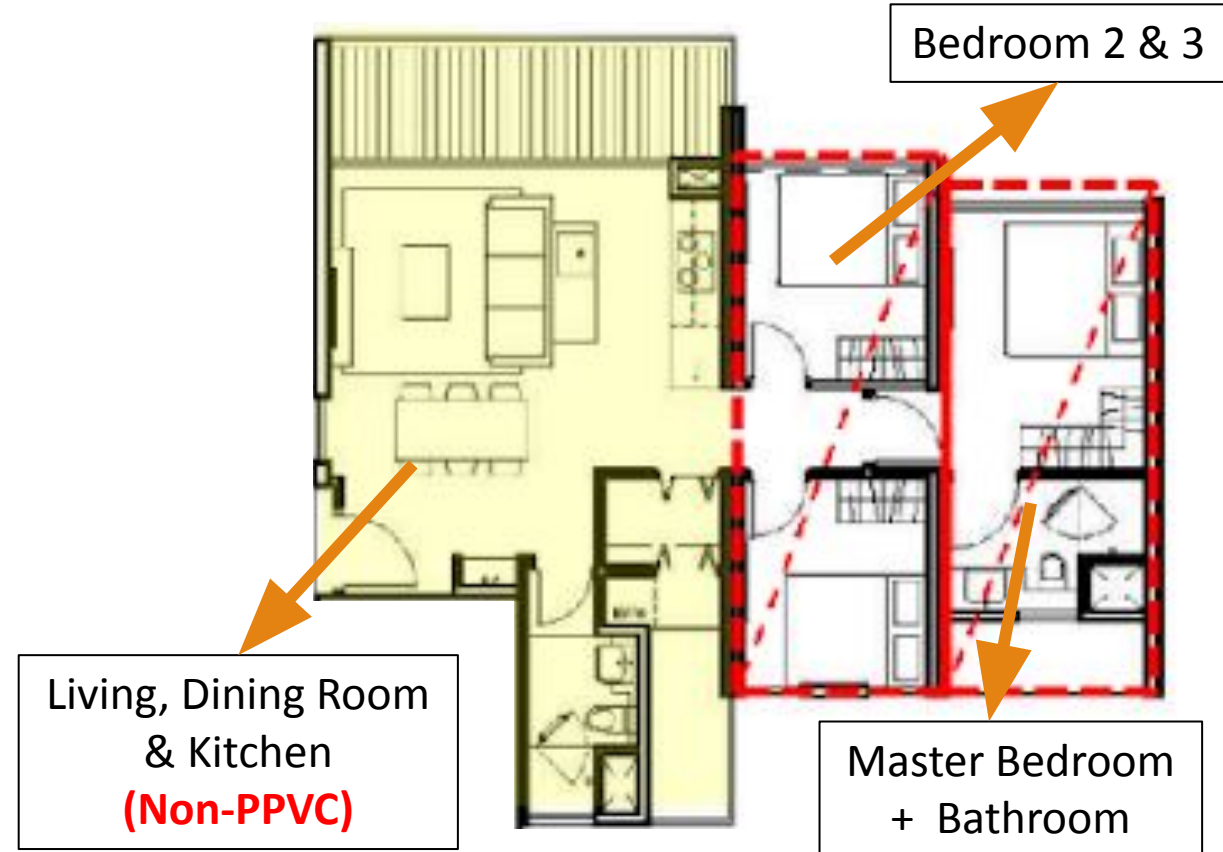


Characteristic of Crane	Tower crane	Mobile crane	Crawler crane
Crane Capacity	50 tons	700 tons	500 tons
Lifting Capacity	25 tons – 40 tons	25 tons – 40 tons	25 tons – 40 tons
Height of Equipment	120m	40m	80m
Radius of work	40m	40m	40m

Configuration of PPVC Modules – Plan

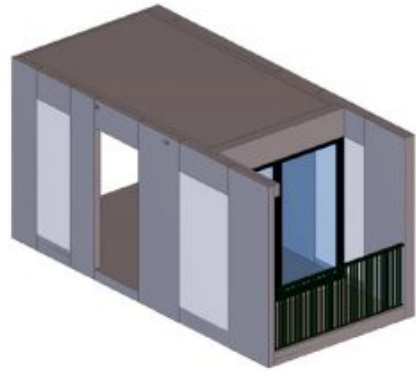


2-Bedroom Unit Modules

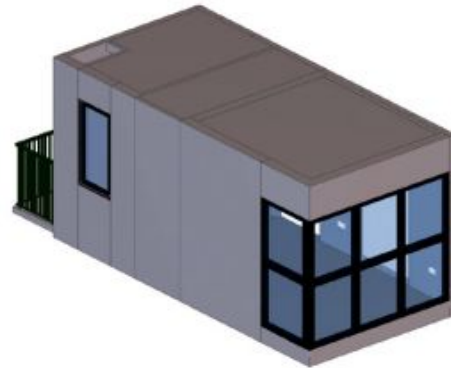


3-Bedroom Unit Modules

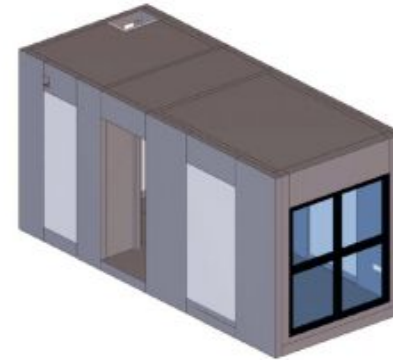
Configuration of PPVC Modules – 3D



**MODULE A:
LRDIN**
Living and
Dining Room



**MODULE B:
B2-IBB**
Bedroom 2
with In-built
Bathroom



**MODULE C:
MB-IBB**
Master
Bedroom
with In-built
Bathroom

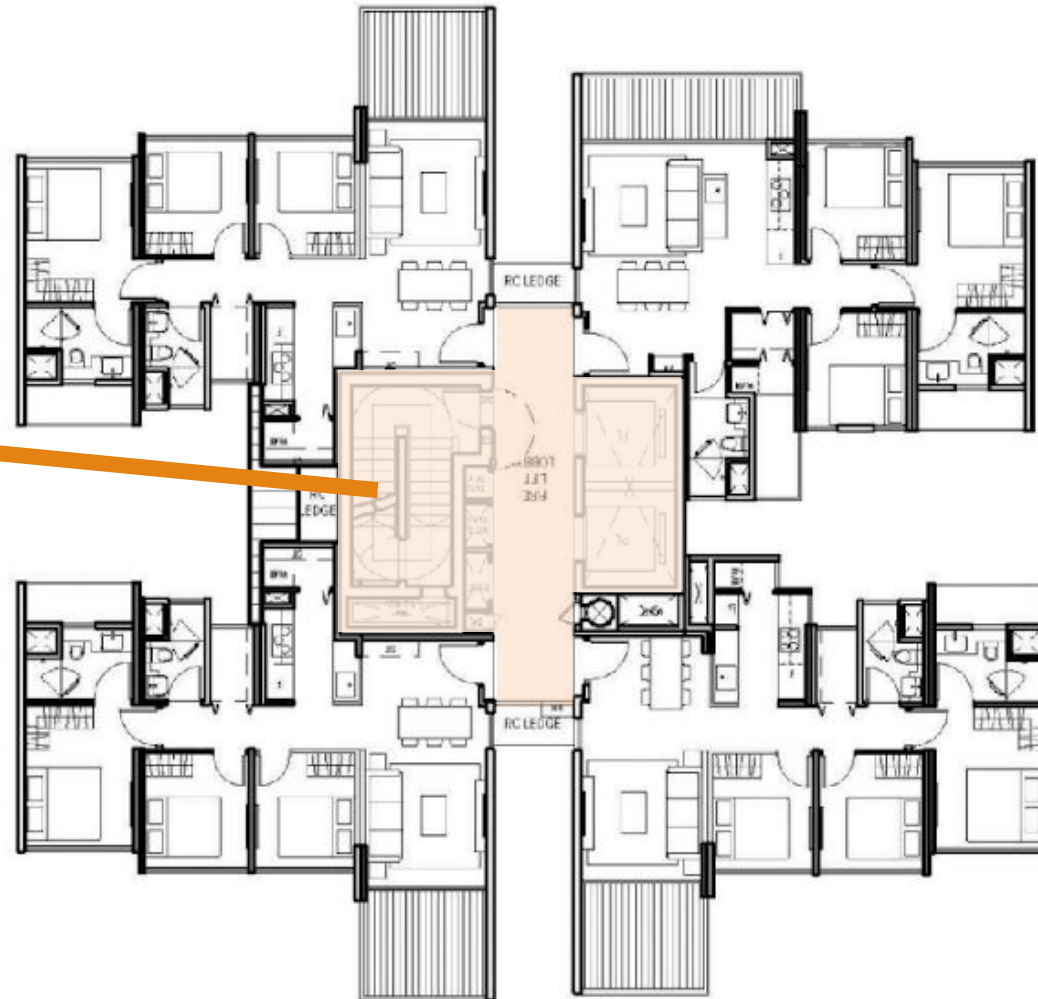


**MODULE D:
KIT**
Kitchen

Configuration of PPVC Modules

Common Area (Corridor & Stair/ Lift Core)

Non-PPVC

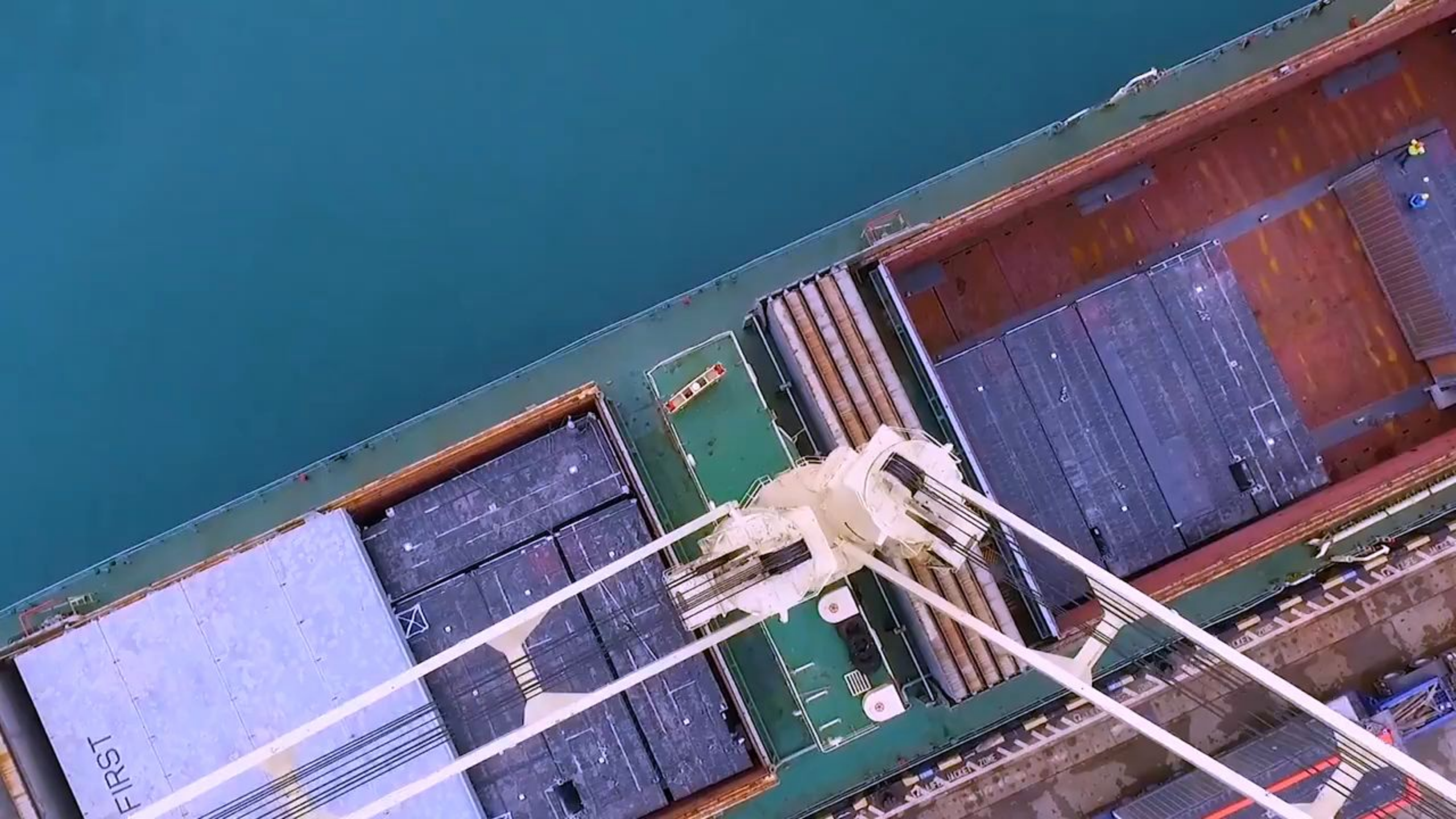




Case Study – Crown Plaza Hotel Extension

Project Profile

- ❖ Singapore's first private PPVC building
- ❖ Year Completed: 2016
- ❖ Hotel
- ❖ 1 block, 10 storeys
- ❖ 243 guest rooms
- ❖ 252 modules
- ❖ Hybrid of Steel and Concrete
(Steel frame with concrete floor base)
- ❖ Installation Period: 26 days
- ❖ Estimated Time Savings: 17%
- ❖ Estimated Cost Premium: 10 - 15%



FIRST

KEY POS

MICKEL ZONE

Case Study – Clement Canopy

Project Profile

- ❖ The World's Tallest Concrete PPVC Building
- ❖ Year Completed: 2019
- ❖ Condominium
- ❖ 2 blocks, 40 storeys
- ❖ 505 dwelling units
- ❖ 1,866 modules
- ❖ Concrete PPVC modules
- ❖ Weight of the modules: 26 to 31 tons
- ❖ Installation: 10 to 12 modules per day
(i.e. 7 days for a floor)
- ❖ Tower Cranes: 2 nos of 48-ton



Cost Implications

Estimated cost premium of PPVC: ~8% (as of Feb 2020)

Cost Drivers:

1. [Precast Mould](#) – different module requires different mould
2. [Transportation](#) – LTA Permit and Auxiliary Police Force (APF) Escort
3. Hoisting Crane
4. Offsite Yard
5. Additional Temporary Occupation Licence (TOL)
6. Additional Supervision – off-site/ overseas

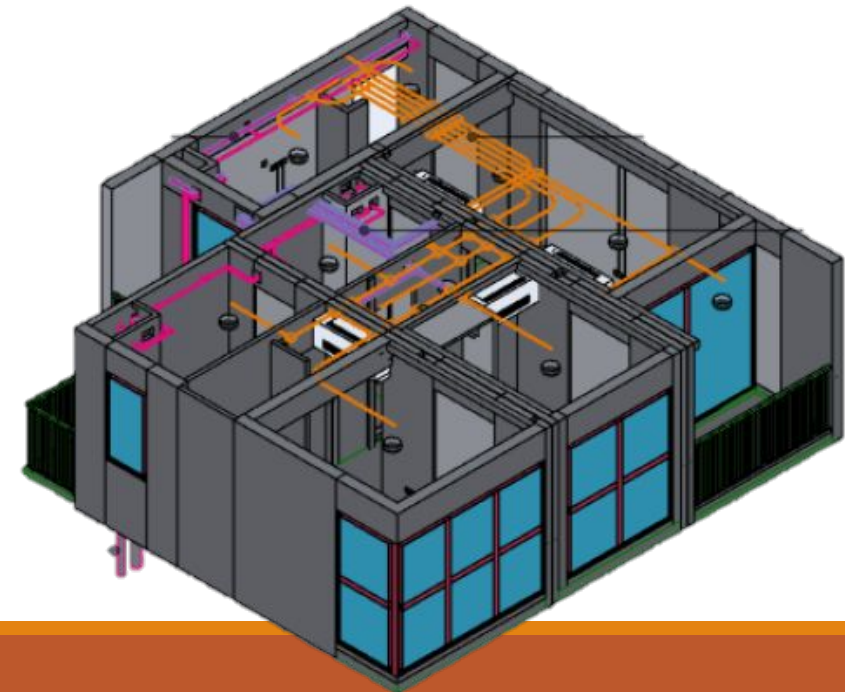
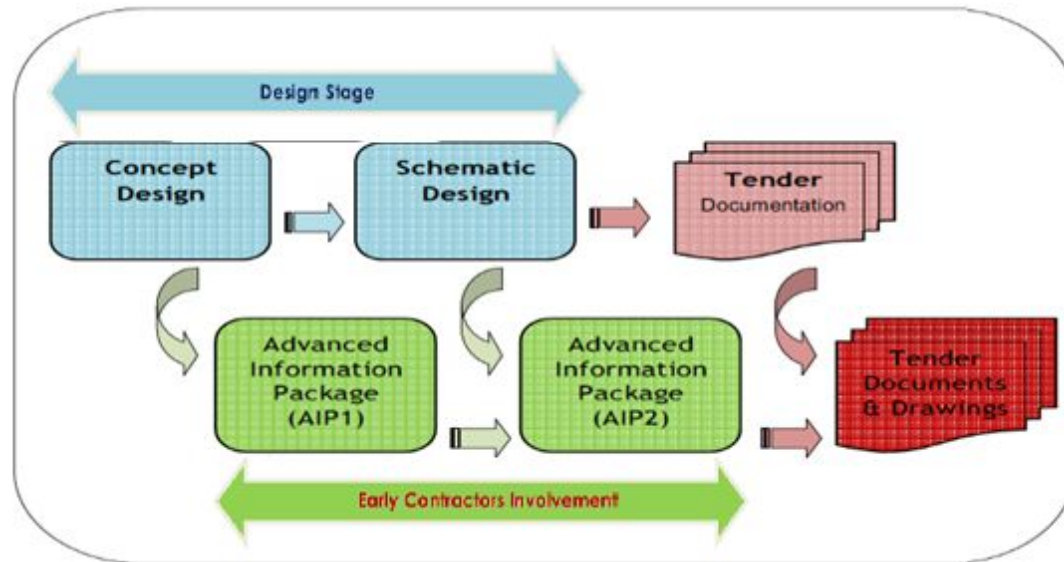


Contractual Frameworks

Procurement Method

Early Involvement of Contractors (ECI)

- ❖ Due to the **complexity of the PPVC module** and **own proprietary system**, it is highly encouraged to engage the PPVC Manufacturers and builders early during the design stage to facilitate integration of design and construction process, and better and more effective technical solution.



Contractual Frameworks

Payment

	Public Sector	Private Sector
Advance Payment	<ul style="list-style-type: none"> Public Sector Standard Conditions of Contract (PSSCOC), Option Module D 20% of the total PPVC costs subject to max 10% of the total construction sum Advanced Payment Guarantee/ Bond is required 	<ul style="list-style-type: none"> Agreed % of the total PPVC cost Advanced Payment Guarantee/ Bond is required
Milestone Payment	N.A.	<ul style="list-style-type: none"> Agreed % of the fixed instalment based on milestones Advanced Payment Guarantee/ Bond is required

Contractual Frameworks

Payment – Public Sector

OPTION MODULE D

LUMP SUM ADVANCE PAYMENT FOR PREFABRICATED PREFINISHED VOLUMETRIC CONSTRUCTION (PPVC)

(w.e.f. 01/04/15)

D1.0 Definitions and Interpretation

The following words and expressions shall have the meanings assigned to them unless the context otherwise requires:

- (1) “Advance Payment” means the payment of an amount specified in the Appendix to be made in advance by the Employer to the Contractor in respect of design and fabrication works for off-site prefabrication of PPVC Works.
- (2) “Advance Payment Guarantee” means a guarantee for the Advance Payment in the prescribed form issued by:

Contractual Frameworks

Payment – Private Sector (Milestone)



Structural Carcass at Factory
(offsite) **30%**



30%
Architectural Fit Out at Factory
(offsite)



Installation (onsite) **40%**



Contractual Frameworks

Insurance

- ❖ Existing off-site storage and inland transit endorsement in Contractor's All Risks Policy (CAR) is no longer suffice
- ❖ Additional **Property All Risk Policy*** is required to cover off-site fabrication in another country (eg. [Malaysia](#))
- ❖ A proper **Marine Cargo Insurance*** is required to cover shipments or transit of the PPVC modules from another country (eg. Malaysia) to Singapore

*Both insurance policies are to be insured **in the joint names of both the Contractor and Employer**

Contractual Frameworks

Nominated Sub-Contractors (NSCs)

- ❖ Some NSC's product to be delivered to the Contractor's off-site yard instead of construction site, eg.
 - ✓ Sanitary wares and fittings
 - ✓ Windows
 - ✓ Wardrobes and cabinets (excepts doors)
 - ✓ Electrical conduits and switches
- ❖ Back-to-back provisions relating to payment, advance payment bond/ guarantee and insurances shall also be provided in NSC's contract
- ❖ Ensure the NSC's contract sum include the delivery to off-site yard in another country (if any)



Impact of COVID-19 on PPVC Development

Impact of COVID-19

- ◆ **Cost Premium**
15~18% (2015) → 20% (Feb 2020) → **15% (pandemic period)**
- ◆ **Total no of constructed ICPH**
 - ✓ Targeted: 10 nos (as of 2020)
 - ✓ Current: **5 nos**
- ◆ **DfMA adoption rate (in term of GFA)**
 - ✓ Targeted: 40% (by end 2020)
 - ✓ Achieve **44%** as of 2021
 - ✓ On track to achieve 70% by 2025 (*Mr Desmond Lee – Minister of MND*)

Government Support Measure

- ◆ **COVID-19 (Temporary Measures) Act (COTMA) [7 April 2020]**
- ◆ **Waivers** to relax the minimum requirement of PPVC (case-by-case basis)
- ◆ **Temporary Occupational Land (TOL) at Punggol Pulau Timor**
 - ✓ Temporary manufacturing and storage space for Soilbuild's precast components





Conclusion

Conclusion

Singapore government and Singapore's construction industry is **determined** to transform to be an advanced and integrated sector through adoption of new game-changing technologies.

Built Environment Industry Transformation Map





Thank You