Building and Construction Authority

Prefabricated Prefinished Volumetric Construction (PPVC)

Information Kit

Revision 1.0 – Nov 2019

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1. Introduction

This information kit aims to share the learning points from completed and ongoing PPVC projects, and serves as a guide with the useful information on PPVC.

Different sections of this kit may be more applicable to certain stakeholders. The table below summarises the contents and respective target audience.

Section	Content	Developer	Contractor
2	Design	√	
3	Manufacturing	√	√
4	Construction Management	√	√
5	Logistics		√
6	Regulations		√
7	Maintenance	√	√
8	Useful Resources	√	√

2. Design

Developer

According to the Code of Practice on Buildability, at least 65% of the total super-structural floor area to be constructed using PPVC method. Designers may make use of other methods to construct the remaining 35% of the floor area.

3. Manufacturing

Developer Contractor

3.1 List of Firms

Below are the list of firms with PPVC project references and, firms that have In Principle Acceptance (IPA) for their PPVC systems for use in Singapore projects.

List of firms	Link
Architectural, C&S engineering firms and main-contractors with completed or on-going PPVC projects	Please refer to this link or QR code.
Firms with IPA Certificates	Please refer to this link or QR code.

3.2 Fit-out Works

BCA is planning to roll out Integrated Construction and Prefabrication Hubs (ICPH) with shared facilities for multiple users. The ICPHs may be used for carrying out fit-out works for PBU and PPVC. To find out more about ICPH, please refer to this link or QR code.

3.3 Steel Mould Fabricators

Steel is used to fabricate moulds to withstand the wear and tear from handling and repeated uses, and to achieve high quality precast concrete products. Concrete PPVC modules can be produced using:

(a) 3D mould for volumetric production
Besides the conventional 3D mould, the 3D flexible mould can be re-configured and re-used for multiple number of times for varying PPVC shell dimensions.

Figure 1: Conventional 3D mould	Figure 2: 3D flexible mould
	

(b) 2D mould for panelised PPVC system
2D precast panels are assembled together using mechanical connection to form PPVC modules.

Please refer to the list below for steel mould fabricators supplying to projects in Singapore.

Steel Mould Fabricators	Please refer to this link or QR code.

3.4 Assessments to Ensure Quality Standards

To ensure quality standards of PPVC modules, quality assessments are carried out both in the factory and on site.

S/N	Item	Link
(a)	**Precaster Accreditation Scheme (PAS) / Structural Steel Fabricators' Accreditation Scheme (SSFAS)** For production facilities producing PPVC shell. PAS for concrete shell production and SSFAS for steel shell production.	To find out more about PAS, please refer to this link or QR code. To find out more about SSFAS please refer to this link or QR code.
(b)	**Manufacturer Accreditation Scheme (MAS)** For production facilities carrying out PPVC fitting out works.	To find out more about MAS, please refer to this link or QR code.
(c)	**CONQUAS** Assesses the quality of workmanship in fit-out and on-site works.	To find out more about CONQUAS, please refer to this link or QR code.

(d)	**Quality Mark** Assesses the internal finishes and fit-out works (i.e. floor and wall finishes, wardrobes, electrical switches etc.), and water tightness of newly completed dwelling unit in a project.	To find out more about Quality Mark, please refer to this link or QR code.

4. Construction Management

Developer | Contractor

4.1 Construction Cost Premium

The direct cost premium of concrete PPVC against conventional reinforced concrete construction for private residential non-landed projects is estimated to be less than 8% as of 2019. With the increasing number of suppliers and lead demand, the cost premium is expected to reduce further.

4.2 Payment Arrangement

Payment terms for PPVC projects can be tailored to suit offsite PPVC work processes. Common practices adopted for public and private sector projects are as below:

(a) Public sector PPVC projects

Under the Public Sector Standard Conditions of Contract (PSSCOC), Option Module D provides advance payment of 20% of the total PPVC costs subject to maximum 10% of the total construction contract sum.

(b) Private sector PPVC projects

Advance Payment	Milestone Payment
(a) Advance payment quantum (%) is pegged against total PPVC cost; and (b) Advance payment is released upon receipt of Banker's Guarantee by the contractor.	(a) Fixed instalment based on milestones completed; and (b) For payment of offsite works, the contractor will provide a performance bond to the developer. Private residential PPVC projects have adopted milestone payment method. The most common schedule for milestone payment is:

Completion Milestones	% of Payment
PPVC shell offsite	30
PPVC finishes offsite	30
Onsite installation	40

4.3 Suppliers of High Capacity Cranes

As PPVC modules are heavy (about 25 to 40 ton), generally, high capacity tower cranes (HCTC) are used for PPVC projects. HCTC generally refers to tower crane with lifting capacity of at least 30 ton at 30 metres.

Please refer to the list below for HCTC suppliers in Singapore.

HCTC suppliers	Please refer to this link or QR code.

4.4 Protection of Modules

Protection is provided to prevent potential damages to modules and installed internal finishes and fittings during delivery, storage and lifting activities.

			
Canvas sheet for module exterior	Bubble wrap for interior fittings (i.e. wash basin)	Self-adhesive plastic wraps for internal finishes (i.e. tiles)	Spray-on protective film for interior finishes

5. Logistics

Contractor

PPVC shells are mostly fabricated overseas. Besides using land route, contractors could consider sea route as an alternative way to import PPVC shells. Contractors can work with Jurong Port to provide staging facilities within Jurong Port for modules imported via sea. For enquiries on Jurong Port facilities, please contact the following Jurong Port representatives.

Name	Email
Doraisingam Sivakumar	sivakumar@jp.com.sg
Vivian Tan Li Vern	viviantan@jp.com.sg

6. Regulations

Contractor

6.1 Offsite Supervision

For production in a factory either in Singapore or overseas, a single site supervisor (RE/RTO) is allow to supervise a few projects where the precast components are produced in the same factory. To find out more about offsite supervision, please refer to this link or QR code.

6.2 Oversized Vehicle Movement (OVM)

LTA's traffic regulatory requirements are applicable to oversized vehicles transporting all types of goods.

Oversized Vehicle Movement (OVM) Regime	Parameters
Travel with permit and Auxiliary Police Force (APF) escort	(a) Width more than 3.4 m; or (b) Height more than 4.5 m; or (c) Weight more than 80 ton

Permitted travel time for OVM without APF	Permitted travel time for OVM with APF
(a) 9.30 a.m. to 5.00 p.m.; and (b) 7.00 p.m. to 7.30 a.m.	(a) 7.00 p.m. to 5.00 a.m. on all roads except expressway; and (b) 11.00 p.m. to 5.00 a.m. on expressways

Please refer to LTA PROMPT website for the latest requirements on OVM.

7. Maintenance

Developer | Contractor

It is a good practice for developers and contractors to provide a homeowner user manual upon completion of project. Homeowners shall inform the MCST of the works to be carried out during renovation. If the renovation works involve hacking, similar to conventional building design, due diligence should be carried out to ensure that key structural elements are not damaged. Homeowners should engage a qualified person to ensure compliance with the building control requirements.

As per URA Controller of Housing requirements, the developer should inform the purchasers about the use of PPVC, in the Option-To-Purchase form, Sale and Purchase Agreement form, sales brochures and any other marketing materials.

8. Useful Resources

Developer | Contractor

(a) PPVC Guidebook

(b) BCA Contact Person

Group	Name	Email
Construction Productivity and Quality	Mika Feng	Mika_FENG@bca.gov.sg
	Albert Tang	Albert_TANG@bca.gov.sg