



PREFABRICATED BATHROOM UNIT (PBU)

GOOD INDUSTRY PRACTICES

FOREWORD

The Building and Construction Authority's (BCA) Construction Quality Assessment System (CONQUAS) has been widely adopted as the de facto national yardstick for measuring the workmanship quality of building projects. To meet the rising expectations of homeowners, the Quality Mark (QM) Scheme was launched in 2002 to promote a higher consistency in workmanship standards for private residential developments. To help projects achieve the standards in CONQUAS and QM, BCA has developed a series of publications on Good Industry Practices for different trades.

This "Good Industry Practices – Prefabricated Bathroom Unit (PBU)" is part of the CONQUAS Enhancement Series to promote good practices. The PBU has been identified as a technology that can achieve consistent high quality workmanship and productivity, provided it is done correctly with proper planning, design and execution. PBUs are pre-assembled off site complete with services and fittings. Much of the labour intensive trade activities are now carried out in a controlled factory type environment shielded from the elements. The PBUs can be produced in parallel with other critical construction site of activities, thus shortening the construction period. Recognising these benefits in high quality and productivity, the use of PBUs will be mandated for all residential government land sales (GLS) sites in later part of 2014.

The use of PBUs is also encouraged and recognised under CONQUAS 8th edition. Higher buildable design scores can also be achieved by projects that include PBUs in their designs. This guide shares some of the good practices adopted by practitioners and contractors who consistently deliver high quality work in PBU construction. It provides simple and practical illustrations on how good quality work can be achieved with higher productivity. Quality checks and critical inspections for PBUs are highlighted. This edition focuses on the Precast Concrete Volumetric System PBU, while other types of PBUs will be covered in subsequent publications.

This guide is not meant to be a definitive publication on or dictate how PBUs must be designed and installed. As there will always be new materials and construction methods, it will evolve with time and changing technology. To obtain more comprehensive information and guidance, readers should seek professional advice from designers and suppliers of PBUs. We gratefully acknowledge the contributions of practitioners in the production of this guide and trust that the industry will find this publication useful. We welcome any contributions from readers to further improve this and subsequent editions of this guide.



Lam Siew Wah

Deputy Chief Executive Officer
Industry Development
Building and Construction Authority

ACKNOWLEDGEMENT

This “Good Industry Practices – Prefabricated Bathroom Unit (PBU)” was developed with inputs from Architects, Developers, Builders, Specialist Contractors and members from various industry associations and organisations.

A Technical Committee was formed to review the contents and good practices identified. We wish to thank the members of the Technical Committee for their valuable contributions.

Technical Committee:

Chairman	Mr Ding Hock Hui	Building and Construction Authority
Dy Chairman	Mr Tan Boon Kee	Building and Construction Authority
Working Committee	Mr Rajendran Ramamoorthy	Building and Construction Authority
	Mr Ng Kam Leong	Building and Construction Authority
	Mr Gary Chua Chei Seong	Building and Construction Authority
	Ms Jacelyn Yeo Hui Ping	Building and Construction Authority
	Mr Stephen Chan Keng Huat	Building and Construction Authority
	Mr Kelven Yee Weng Cheong	Building and Construction Authority
Members	Mr Ng Thiam Min	Housing and Development Board
	Mr Richard Lai	Singapore Institute of Architects
	Mr Lim Thiam Kooi	Singapore Contractors Association Ltd
	Mr Ryan Lim	Singapore Contractors Association Ltd
	Mr Keith Ooi	Real Estate Development Association of Singapore
	Mr Lim Song King	City Developments Ltd
	Mr Kelvin Lo	CapitaLand Ltd
	Mr Eddie Lam	Woh Hup (Pte) Ltd
	Mr Thierry Brezac	Dragages Singapore Pte Ltd
	Mr Chiang Kian Hong	Tiong Seng Contractors Pte Ltd
	Mr Ichiro Okamoto	Shimizu Corporation (Singapore Office)
	Mr Yong Chiang Boon	Eastern Pretech Pte Ltd
	Mr Tan Bian Tiong	Excel Precast Pte Ltd
	Mr Dennis Chew	Excel Precast Pte Ltd
	Mr William Ling	Sembcorp EOSM Pte Ltd
	Mr Wong Lok Toon	Squire Mech Pte Ltd
Mr Teo Wee Hwee	USGBORAL	
Mr Billy Cho	USGBORAL	

We would like to thank the following organizations for their valuable feedback in the review of this guide:

Building and Construction Authority

Er Rose Nguan Construction Productivity Centre (CPC)
Er Tan Chong Lin Building Engineering (BE)
Deva Lutchia Building Plan & Management (BPM)

Building and Construction Authority Academy

Mr Qin Hao Centre For Construction IT

Agencies and Associations

Housing and Development Board (HDB)
Singapore Institute of Architects (SIA)
Institution of Engineers, Singapore (IES)
Real Estate Development Association of Singapore (REDAS)
Association of Consulting Engineers Singapore (ACES)

Developers

CapitaLand Residential Singapore Pte Ltd
City Developments Ltd
Keppel Land International Limited
Bukit Sembawang Estates Ltd

Contractors

Dragages Singapore Pte Ltd
Straits Construction Singapore Pte Ltd
Tiong Seng Contractors Pte Ltd
Woh Hup Pte Ltd
Shimizu Corporation
Hexacon Construction Pte Ltd
Lum Chang Building Contractors Pte Ltd

Architects / Consultants

DP Architects Pte Ltd
DCA Architects Pte Ltd

PBU Manufacturers

Excel Precast Pte Ltd
Eastern Pretech Pte Ltd

Others

Hansgrohe Pte Ltd
Gerberit South East Asia Pte Ltd



Tan Tian Chong

Group Director
Technology Development Division
Building and Construction Authority

CONTENTS

1. INTRODUCTION	1
2. TYPES OF PBU	2
3. PRECAST CONCRETE VOLUMETRIC SYSTEM PBU	4
3.1 DESIGN CONSIDERATIONS	5
3.2 BATHROOM PRODUCTION	11
3.3 PROTECTION, TRANSPORTATION AND LIFTING	17
3.4 INSTALLATION	18
3.5 M&E CONNECTIONS AND FINAL FIXINGS	20
3.6 MAINTENANCE, REPLACEMENT AND RENOVATION	28
4. GOOD PRACTICES IN INSTALLATION, ARCHITECTURAL FINISHES, M&E SERVICES AND RENOVATION	34
4.1 INSTALLATION	34
4.2 ARCHITECTURAL FINISHES	37
4.3 M & E SERVICES	39
4.4 RENOVATION	42
5. CRITICAL INSPECTIONS AND QUALITY CHECKS	44
5.1 CRITICAL FUNCTIONALITY INSPECTION AND TESTS	44
5.2 QUALITY CHECKS	48
APPENDIX	52
APPENDIX A: SAMPLE OF INSPECTION AND TEST PLAN	
PRECAST CONCRETE SHELL	52
PRECAST BATHROOM AT MANUFACTURER'S FACTORY	56
PRECAST BATHROOM (SITE INSTALLATION)	58
APPENDIX B: REQUEST FOR INSPECTION FORM	
PRECAST FORMWORK	60
PRECAST CONCRETING	61
ARCHITECTURAL FLOOR / WALL	63
REFERENCES	64

1. INTRODUCTION

The bathroom is an indispensable component in all buildings. The conventional method of constructing a bathroom on site involves many labour intensive building trades such as brick or block work, waterproofing, finishes, plumbing, sanitary, electrical works and accessories installation. This requires extensive manpower, time and co-ordination among trades within a restricted site environment.

A prefabricated bathroom unit (PBU) refers to a bathroom unit preassembled off-site complete with finishes, sanitary wares, concealed pipes, conduits, ceiling and bathroom cabinets before installing into position. A PBU which integrates various trades and constructed in an off-site factory environment can achieve consistent and high quality workmanship and improved site productivity.

The introduction of PBU can address the extensive on-site manpower, time, and coordination issues. Off-site fabrication can run parallel to other construction site activities, thereby shortening the construction cycle. The effects of inclement weather downtime are also minimized. Other benefits of PBU include better control of materials, streamlined factory fabrication and production processes, less co-ordination with multiple trades/parties, less abortive work for construction sites, etc.

PBUs have been widely used around the world including Japan, USA, UK, Italy and many other countries. There are many types and variants of PBU in the market. In Singapore, both HDB and private developers have used PBUs in some projects since the mid-90s.

This edition focuses on Precast Concrete Volumetric System PBU i.e. PBU with concrete floor and walls, for residential developments. The other types of PBUs will be covered in subsequent publications.



2. TYPES OF PBU



2.1 There are many types of PBU and it is essential to understand the characteristics of each type before its selection for use. The above pictures show 2 main types viz. PBU formed with concrete base and walls of concrete or other materials e.g. drywall, steel panel, etc. and PBU with fibre reinforced walls and floor panels. Each type has its own characteristics. Developers, consultants and builders should evaluate and select the type that meets their project requirements and this should be incorporated into their project planning and design.

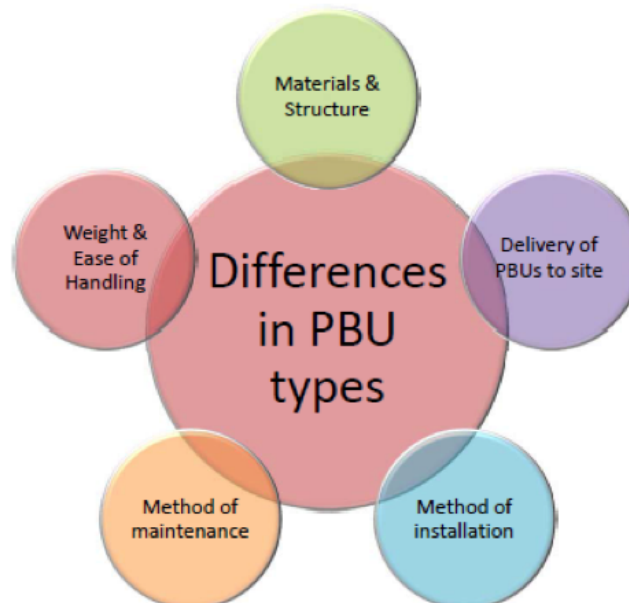
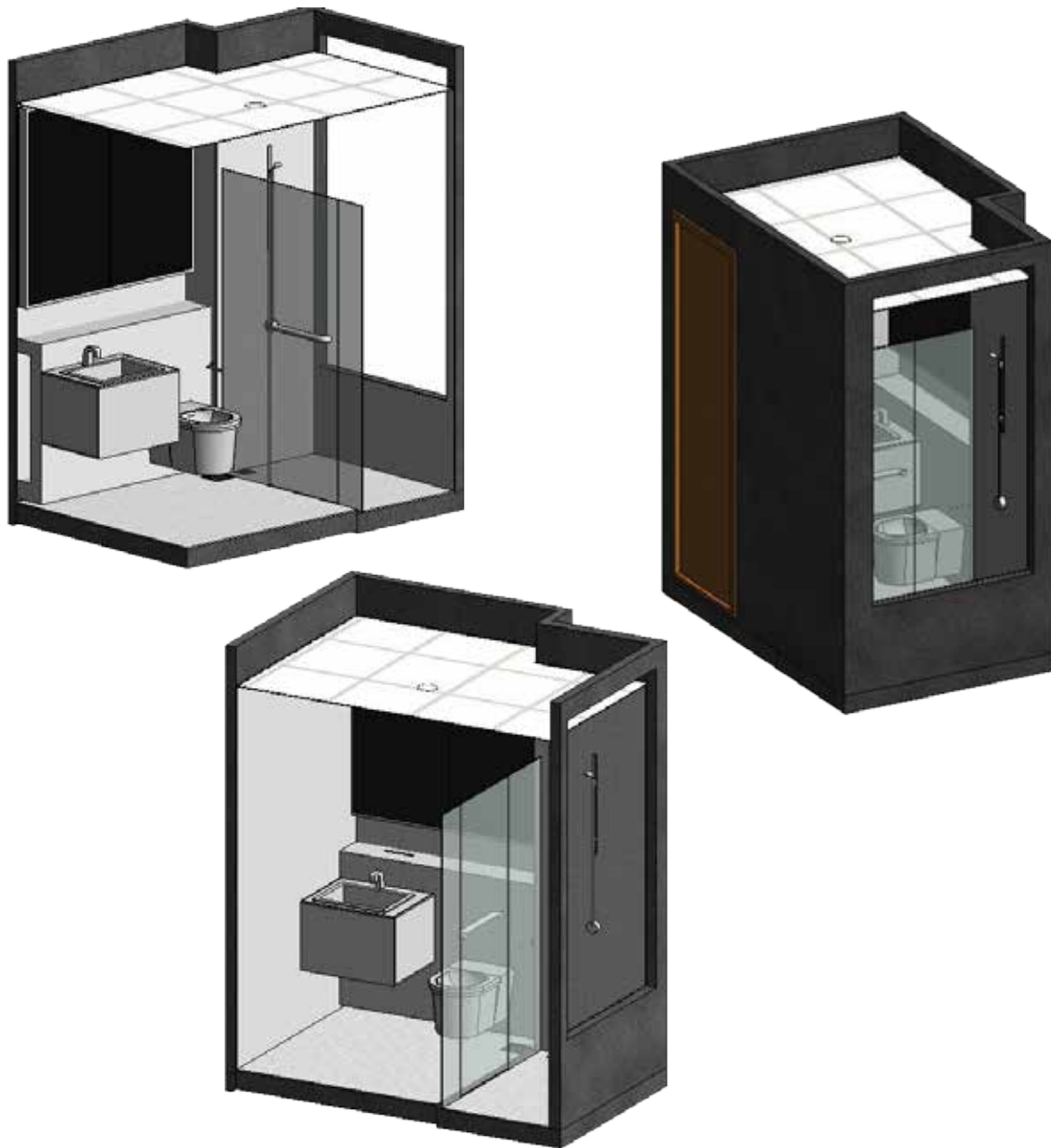


Table 2.1 Comparison of Different Types of PBU

	Precast Concrete Volumetric PBU (Monolithic)	Lightweight Concrete PBU	Steel Wall Panel PBU	Drywall PBU	FRP PBU
Weight	~3.4 to 9 tonnes (with finishes)	~3.5 tonnes (with finishes)	~2.5 to 5 tonnes (with finishes)	~2 tonnes (with finishes)	< 2 tonnes (with finishes)
Handling and transportation	No additional temporary stiffening required	No additional temporary stiffening required	May requires additional temporary stiffening	May requires additional temporary stiffening	May requires additional temporary stiffening, if preassembled off site
Installation Method	Usually by critical path (top down) method	Critical or non-critical path method	Critical or non-critical path installation	Critical or non-critical path installation	Designed for on-site installation
Hoisting Machinery	Needs hoisting by crane	Needs hoisting by crane	Needs hoisting by crane	Needs hoisting by crane	Needs hoisting by crane crane, if preassembled off-site
Familiar to renovators in maintenance, replacement / renovation works	Similar to conventional bathroom	Similar to conventional bathroom	Cannot use conventional method of chisel and hammer; Heating is required to remove tiles installed by glue	May use conventional method of chisel and hammer to remove tiles and cutter to create openings in board to replace piping; Easy to patch opening	Affected panel can be removed; Alternatively, entire PBU can be changed
Provision for Barrier-Free Accessibility Requirements	Similar to conventional bathroom	Similar to conventional bathroom	Need to specify locations of supports in Homeowner User Manual	Need to specify locations of supports in Homeowner User Manual	Need to specify locations of supports in Homeowner User Manual

3. PRECAST CONCRETE VOLUMETRIC SYSTEM PBU

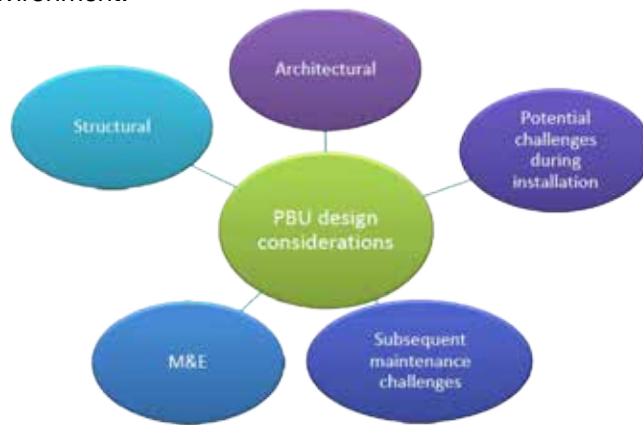


Precast concrete volumetric prefabricated bathroom unit (PBU) is one of the most commonly used PBU systems in Singapore. Its main advantage is its robustness and readiness to accommodate repair and maintenance, which far outweighs the disadvantages posed by its heavier weight and the top down installation method (critical path).

This chapter outlines the considerations in design, production, installation and maintenance of precast concrete volumetric PBU including architectural and M&E work sequence, transportation, lifting and protection, installation and replacement.

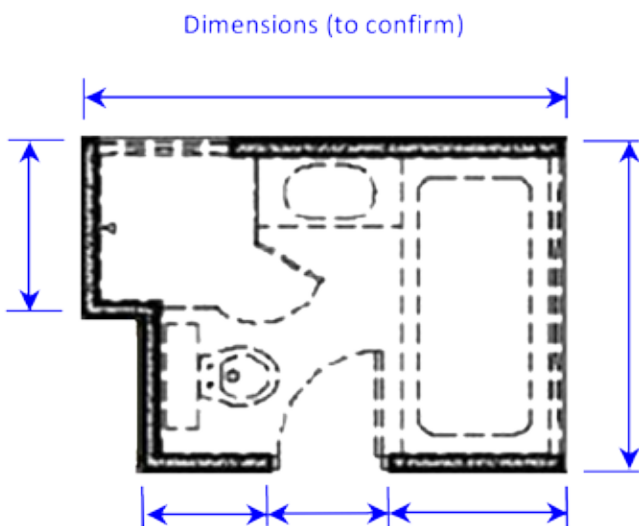
3.1 Design Considerations

Design parameters are critical for any construction work. In the case of PBU, design parameters such as structural, architectural, M&E works, installation, and subsequent maintenance challenges must be determined early to ensure that the PBU system is integrated and can be incorporated in the overall building design. A good PBU design should provide practical solutions to address potential issues arising in different stages of PBU's life cycle including future renovation. It is also important the design meets the requirements in the Code on Accessibility in the Built Environment.



3.1.1 Architectural Design Considerations

a. Dimension



An efficient volumetric system requires careful consideration and confirmation of the overall dimensions. The overall dimensions and design should take into consideration space/floor area taken up by the double wall/floor systems, structural drop slab and storage heater (if any) to ensure effective use of space. The types of bathrooms should be standardized to achieve economy of scale production while providing sufficient design variation.

b. Location of Service Ducts and Access for Maintenance



Gap between PBU and structural slab above can be covered by drywall board.

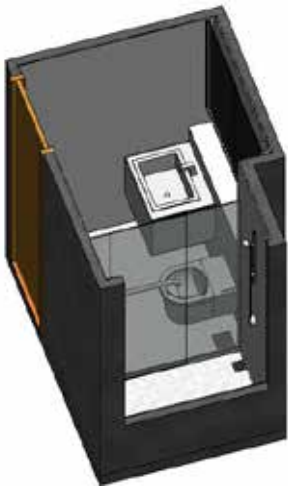
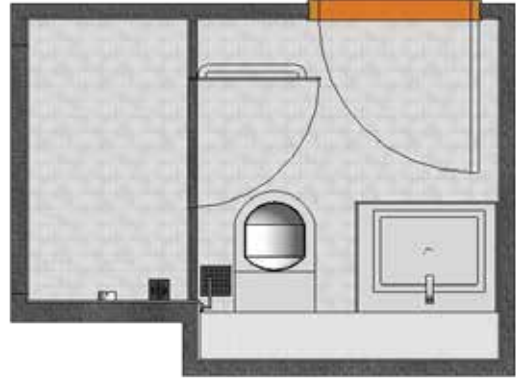
It is a good practice to locate services near to the edge of PBU for ease of future maintenance.

Example of vertical soil stack accessible from within dwelling unit

The routing and connection of services should be predetermined and coordinated with the PBU manufacturer during the design stage.

c. Layout

The locations of door and window openings and layout of fixtures and M&E services should be functional and practical. The formwork mould for volumetric PBU production is dependent on the locations of these openings. It is recommended that the general layout of the prefabricated bathroom unit be provided in the homeowner user manual.



Door



Window



Sanitary Wares

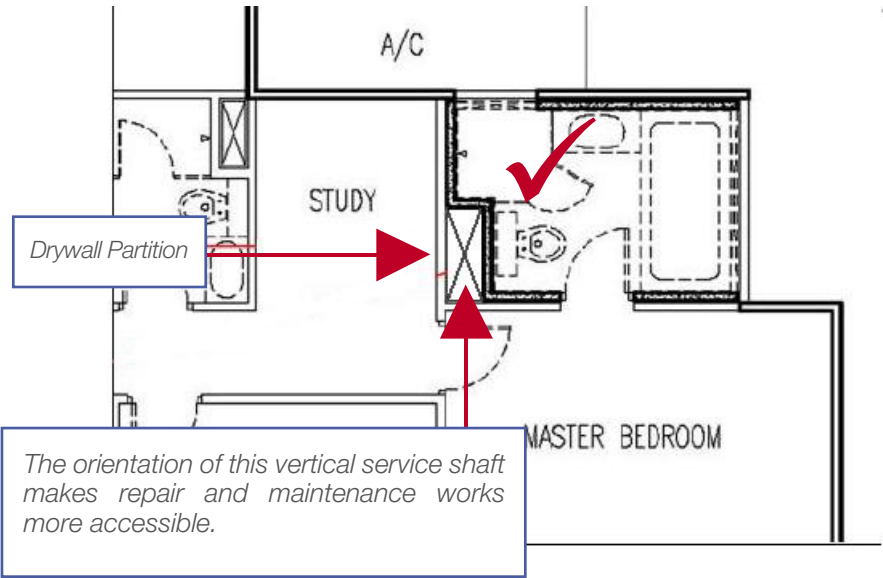
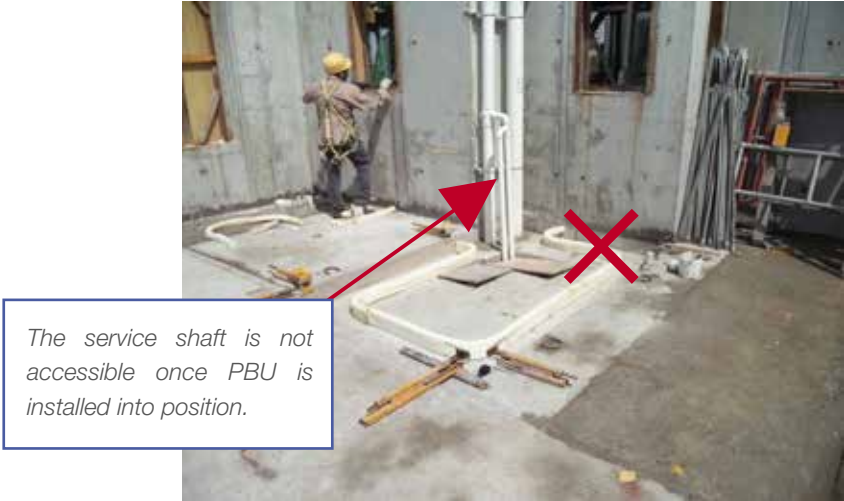


Architectural Fixtures



M&E Services

The location of the service shaft is critical to the maintenance of the precast concrete PBU.

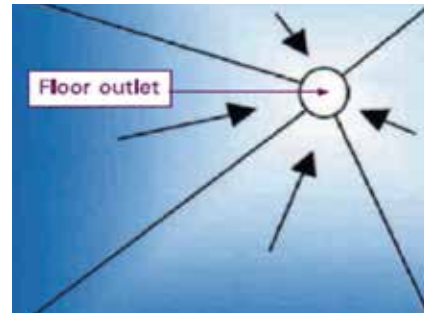


It is important to make the vertical service shaft accessible for future repair and maintenance works of the PBU.

3.1.2 Structural Design Considerations

As precast concrete PUB typically weighs up to 9 tons, it is necessary to ensure that the structural strength of different types of receiving platforms are adequately designed. Use of different types of concrete, such as lightweight concrete or high strength concrete can reduce the overall weight of PBU. The design of the hoisting and lifting devices placed within the precast elements is also crucial to facilitate the installation process. The choice of structural system may have an impact on the buildability score of the project.

a. Double Slab System



Structural design of the secondary slab has to incorporate a gradient to an outlet at the lowest point for drainage.

b. Single Slab System



Perimeter beams for seating PBU



Corbels for seating PBU

c. Lifting and Hoisting Devices



Different types of lifting and hoisting devices

3.1.3 M & E Design Considerations

The design considerations for M&E services will determine the placement and routing methods of these services.



Embedded services within PBU



Recesses/block-outs provided for services



Shallow floor trap



Conventional S or P trap



Cast-in air-con drain pipe



Air-con drain pipe connecting direct to stack

Different ways of routing the air-con drain pipe

3.2 Bathroom Production

3.2.1 Precast Unit Production

A good design and specification of the formwork mould is crucial for producing high quality precast concrete PBU. The steel plate thickness for the precast concrete mould must be sufficiently designed to withstand the concreting pressure. The use of checker plate formwork (for concrete surface receiving finishes) improves bonding between the finished concrete and the adhesive. Proper propping supports should also be provided during the concreting process.



Use of checker plate formwork



Props to formwork

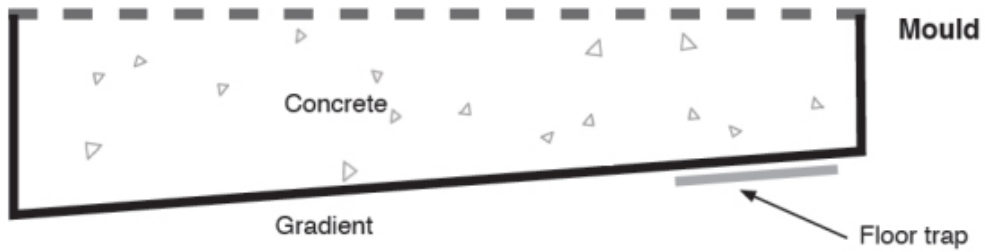


Damage after stripping formwork



Demoulding defects

To improve productivity in the manufacturing process, it is advisable to cast the base slab to the required water gradient (as indicated below) to cut down the screeding process.



If the slab is cast without gradient, it is important to control the thickness of the screed to achieve the required gradient for water flow.

Please refer to Appendix A - Sample of Inspection and Test Plan

Please refer to Appendix B - Request for Inspection Form



Install reinforcement bars



Install M&E embedded services



Concreting



Secure block-outs



Use of vibrating system to achieve concrete uniformity



Demoulding & curing

*Please refer to Appendix A - Sample of Inspection and Test Plan
Please refer to Appendix B - Request for Inspection Form*

3.2.2 Architectural and M&E Works Sequence

After the completion of precast concrete shell fabrication, the next construction process will be the architectural and M&E works. The application of waterproofing as well as water-ponding test is always an important process towards achieving primary functionality of the PBU. Other key architectural works include fixing of door and window frames, followed by tiling works and installation of sanitary wares and components. Adequate allowance for movement joints should be made for PBU and window and door joints openings.

It is recommended the relevant good industry practices for various trades as in the CONQUAS Enhancement Series http://www.bca.gov.sg/Publications/EnhancementSeries/enhancement_series.html be followed.



Waterproofing system must be tested before receiving architectural works



Door and window frame installation



Tiling works installation



Basin and cabinet



Water closet



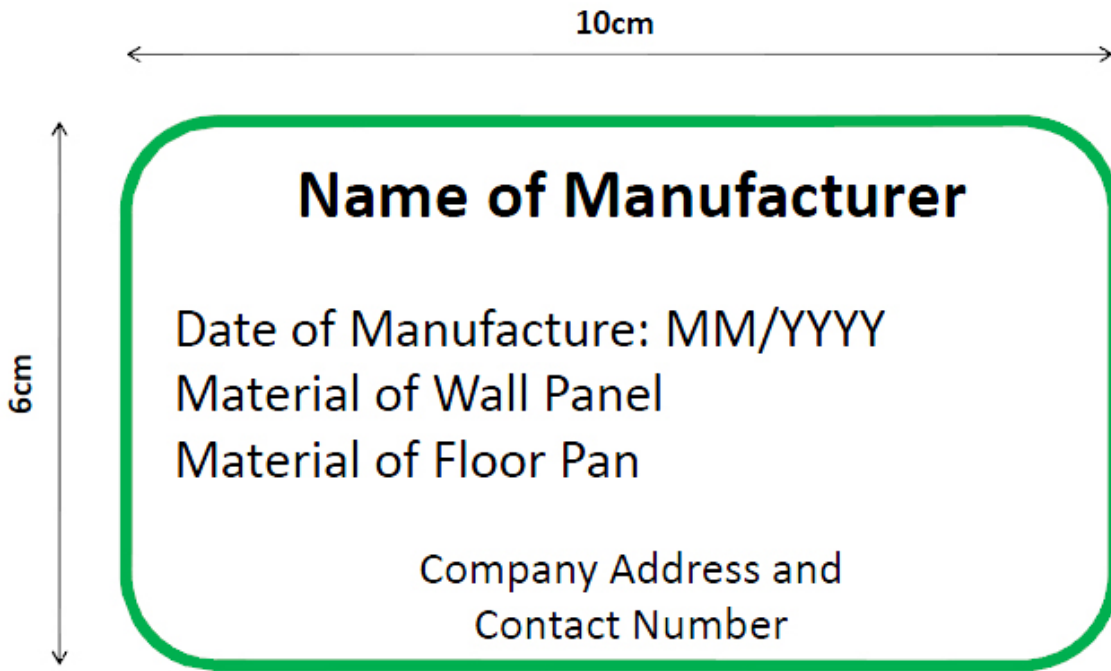
Shower screen



Mirrors

All fragile fixtures can be installed at the last stage of fabrication to minimise possible damage. The architectural internal finishing works should be properly protected before delivery of the precast concrete PBU to site.

3.2.3 Manufacturer's Label



The manufacturer's label should be incorporated in the completed PBU before delivery. This label must be visible to users and should be used as a reference for any repair, replacement and renovation work. It is recommended that the location of the manufacturer's label be provided in the homeowner user manual.

3.3 Protection, Transportation and Lifting

A well-planned transportation, lifting, protection and storage system for the PBU is important to ensure minimal damage to the finished product before and after the PBU is installed at the site.



Sheltered storage facilities eliminate the adverse effects of weather



Delivery of PBU



Protection (to remain) during hoisting



Installation upon delivery

Proper coordination and planning of delivery of PBU can help to resolve the logistical hassle of insufficient storage space, double handling and control of access to the PBU.

3.4 Installation

The readiness of the construction site to receive the PBU is critical to the successful installation of the PBU. It is also important to understand the different structural systems that are designed to receive the PBU at site, viz:

- Double Slab System
- Precast Beam System
- Corbel System



Hoisting of PBU



Positioning PBU (double slab system)



Double slab system



Grouting (double slab system)

The key feature of the double slab system is the fixed dimension of the secondary slab to receive the PBU. It is recommended that the gap between the two slabs be grouted to eliminate any possible water stagnation issues.



Corbel system



Precast beam system for PBU

For precast beam system, the PBU is directly supported on the perimeter beams and hence the positions and dimensions of these beams must be constructed precisely.

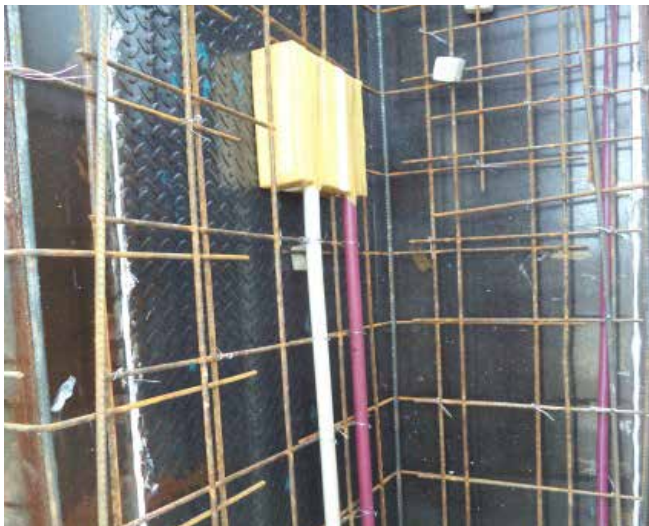
3.5 M&E Connections and Final Fixings

The installation of M&E services and fittings is probably the most critical work process in the entire PBU fabrication as it affects the functionality and serviceability of the PBU. Design for the M&E pipes and duct works shall take into consideration their connectivity to power supply, water supply and sanitary drainage.

3.5.1 Provision for M&E Services

Generally, there are two methods of laying the M&E services in precast concrete PBU. The M&E pipes and conduits can either be cast together with the precast concrete shell or laid via block-outs or recess, which are provided for on the external or internal surfaces of the precast concrete volumetric shell.

For embedded M&E conduits, their positions must be precise and care should be taken to ensure they are properly bent and securely fastened for long-term durability.



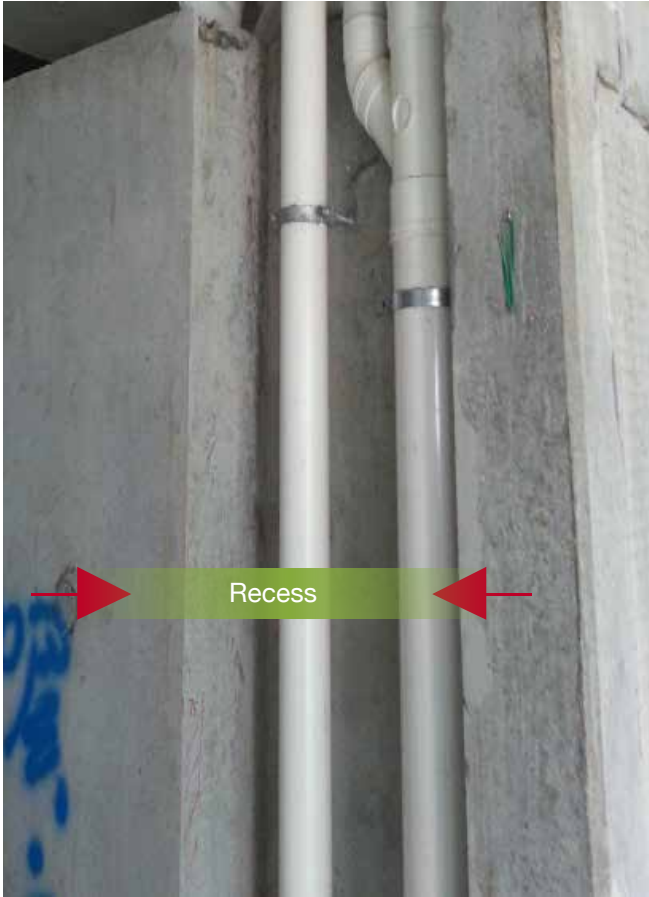
Cast-in M&E services on walls



Embedded M&E services on slab

The selection and installation of the embedded electrical conduits should comply with the relevant Code of Practice (CP5 & CP88).

Block-outs and recesses should be sufficiently provided for in accordance to the layout of M&E services for ease of connection to the M&E fittings.



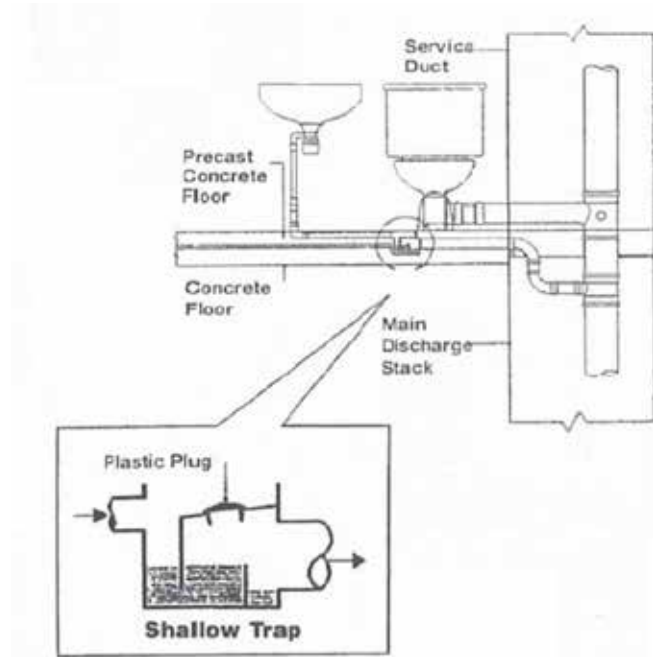
Recess for drainage system



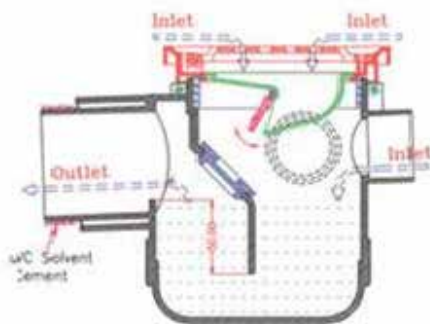
Block-outs for M&E services

3.5.2 Use of Shallow Floor Trap

It is common to utilize a shallow floor trap for PBU with double slab system or when there is constraint in floor height. Unlike the conventional floor trap system where pipes are exposed at the slab soffit, the shallow floor trap and its connecting sanitary pipes are fully concealed in the slab and connected to the main discharge stack directly.



Section drawing of shallow floor trap design

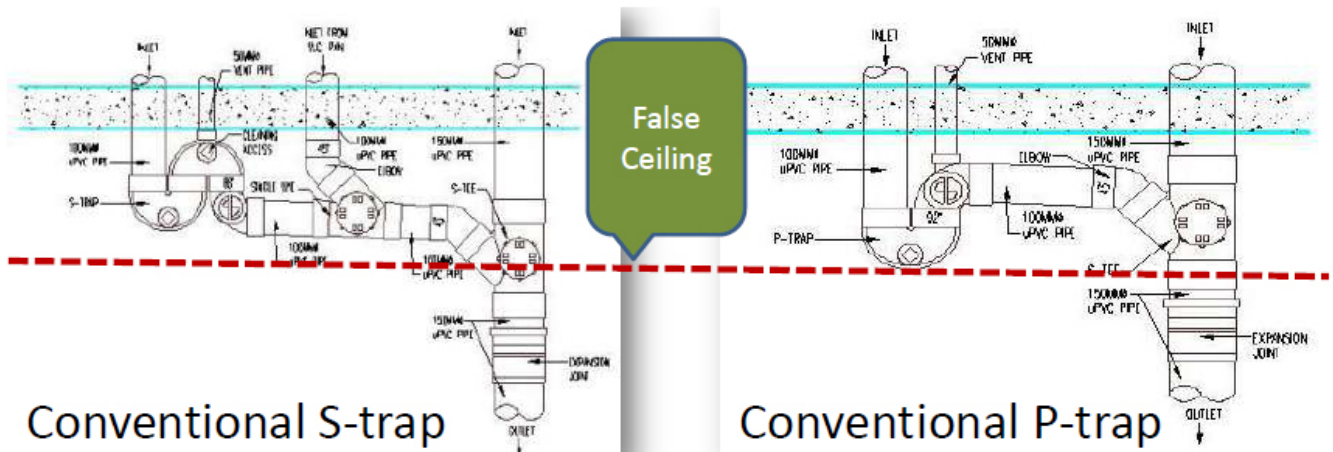


Examples of approved shallow floor traps

In Singapore, the use of shallow floor trap is approved by Public Utilities Board (PUB) if the shallow floor trap is in compliance with EN 1253, which comprises the following 8 tests:

- Anti-blockage test
- Water tightness test
- Flow rate test
- Odour tightness test
- Resistance of water seal to pressure
- Depth of water seal
- Access for cleaning
- Side inlet

3.5.3 Use of Conventional Floor Trap



There is no special maintenance consideration for the use of conventional floor trap in the precast concrete PBU, except for the space required to accommodate the services with the provision of sufficient floor height.

3.5.4 Connection to M&E Fixtures

a. Wash Basin

The water and discharge works for the wash basin in the precast concrete PBU should follow the approved method statements and comply with the relevant Code of Practice for plumbing and sanitary works. Accuracy of the penetration joints from the precast concrete PBU to the connecting accessories (i.e. hoses, taps) of the wash basin is important for its functionality and overall alignment of the wash basin.



Connection and installation of wash basin

Positions and routes of the embedded M&E services should be clearly identified to prevent accidental damage caused by the drilling of anchors and supports for the wash basin.

b. WC Pedestal

Depending on the type of water closet (WC) pedestal used, the plumbing and sanitary connections of the WC may run horizontally through the wall or vertically to the floor slab of the precast concrete PBU. Accuracy of the penetration joints and sleeves from the precast concrete PBU to the accessories of the WC pedestal is important for its functionality and overall alignment. For better aesthetics, the jointing at any pipe penetration should be concealed or covered up neatly.



Horizontal connection to WC pedestal



Vertical connection to WC pedestal

c. Shower Mixer Tap

When there is provision for a shower mixer tap, separate water pipes for hot and cold water should be catered for in the design and fabrication of the precast concrete PBU shell. The routing of the different water pipes could be demarcated by coloured tapes on the finished wall surfaces for clear identification of these pipes.



Connection of shower mixer tap on wall



Demarcation of hot and cold water supply by coloured tapes

3.5.5 Routing of Air-conditioning Drain Pipes

Air-conditioning drain pipes are normally laid through the wall and floor slab at a gradient to discharge condensate water to the PBU floor trap. The air-conditioning drain pipes could be designed to run embedded in the precast concrete PBU floor slab connecting to the floor trap. An alternative is to run the insulated drain pipes through the false ceiling (if available) and connect directly to the discharge stack.



Cast in air-con drain pipe



Running insulated air-con drain pipes at ceiling and connect to a separate stack pipe

3.6 Maintenance, Replacement and Renovation

There are differences in the maintenance, replacement and renovation of precast concrete volumetric PBU as compared to conventional toilet. Therefore, it is important for developers and builders to provide a homeowner user manual upon completion of project for instructions and advice on how to maintain, replace and renovate the PBU.



Use of breaker to hack tiles during renovation



Hammer and chisel method used for replacement and maintenance work

As the wall and floor of precast concrete PBU may not be as thick as conventional toilet, the selection of appropriate tools and use of recommended methods of work execution can prevent damage to the precast concrete PBU. The types of tools and execution methods must be covered in the homeowner user manual.

3.6.1 M&E Concealed Services



M&E embedded services (cast-in)



M&E concealed services routing through precast block-out

For M&E services that are cast-in with concrete, both the tiles and concrete need to be hacked during repair works. For M&E services that are laid through block-outs, removal of tiles or surface finishes should suffice.

Hence, it is essential to provide the M&E concealed services locations through drawings and demarcation of route in the homeowner user manual. This can help homeowners and renovation contractors minimize damage during repair and replacement of M&E concealed services.

3.6.4 Ceiling Access Panel



Ceiling Access Panel Location

The ceiling access panel is a common provision for toilets with false ceiling. The function of the access panel within the precast concrete PBU is to access and maintain all M&E works above the false ceiling, similar to that for conventional toilet.

3.6.5 Replacement of Other Items



Replacement of sanitary ware



Replacement of shower screen



Replacement of bathroom cabinet



Replacement of M&E piping



Replacement of shower mixer tap

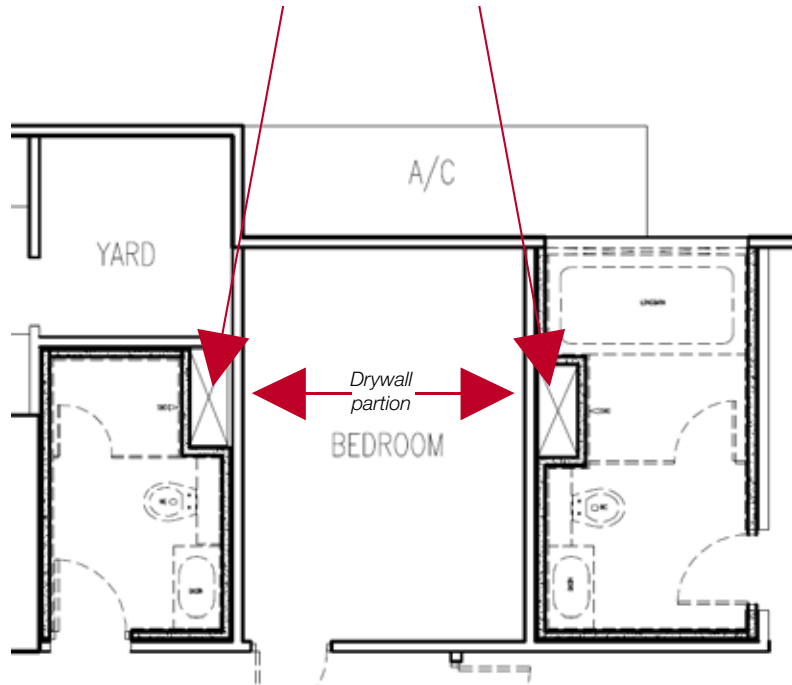


Replacement of shower bar

The replacement of sanitary items and components within the PBU is similar to that for conventional toilet.

It is recommended that the method of removal and access to the M&E stack shaft be covered in the homeowner user manual. PBU designers should also explore other possible options to access the stack shaft.

Stack pipe shaft is accessible for maintenance on side of drywall partition



Example of service duct access to stack pipe shaft



Example of an accessible stack pipe shaft

4. GOOD PRACTICES IN INSTALLATION, ARCHITECTURAL FINISHES, M&E SERVICES AND RENOVATION



While it is possible to achieve high quality PBU by following closely approved work procedures, adopting good practices in installation, M & E services and renovation of PBU can often lead to greater productivity and better user experience. This may require the employment of professionals and more skilled workers to achieve higher quality standards. However, as every project's objective may be different, it may be necessary to be selective or customize the suggested good practices mentioned herein to suit each project.

4.1 Installation

The precast concrete PBU is the sturdiest and heaviest PBU available. Therefore the design of the receiving platform and installation is critical to the success of the PBU installation. As the precast concrete PBU typically weighs up to 9 tons, the slot-in (non-critical path) method may not be suitable and hence, the top down (critical path) installation is often used. For top down approach, coordination is critical and protection of finishes can be challenging.



Top down installation method (critical path)

It is necessary to ensure that the structure of the receiving platform is adequately designed. The selection of single slab or double slab types for receiving platforms is often determined by the floor to floor height and other considerations e.g. ease of tracing seepage or leakage, etc.

4.1.1 Double Slab Approach



Pros

- Base slab facilitates ease of installation of PBU

Concerns

- A challenge to trace leak
- Reduces headroom

Edges at gap between slabs should be sealed to prevent water ingress during construction

Pros

- Easier to trace water leakage

Concern

- Need more precise co-ordination during installation

Pros

- Easier to trace water leakage
- Able to install complete finishes with fittings

Concern

- Need more precise co-ordination during installation

4.1.2 Single Slab Approach



Beam

PBU resting on precast beam edge

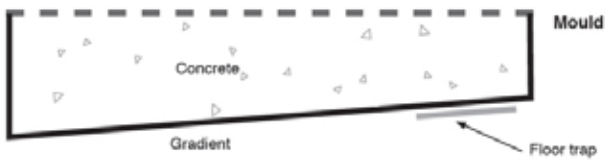


Corbel

PBU resting on corbel

4.2 Architectural Finishes

It is recommended to cast the floor slab of the precast concrete PBU with a gradient to reduce some work processes such as screeding works.



Floor slab gradient

- Gradient to fall in both directions
- For slab without gradient, need to control thickness and quality of the screed

Waterproofing works

- Water proofing works to commence after structural ponding test

Tiling works

- Tiling work is done over render and screed

Other works

- Other works such as cabinets can follow



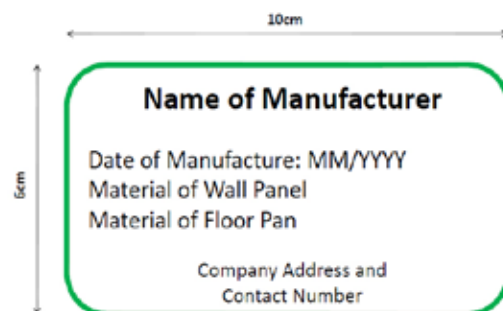
Long Bath

- Use metal frame for long bath installation instead of bricks or blocks



Manufacturer's Label

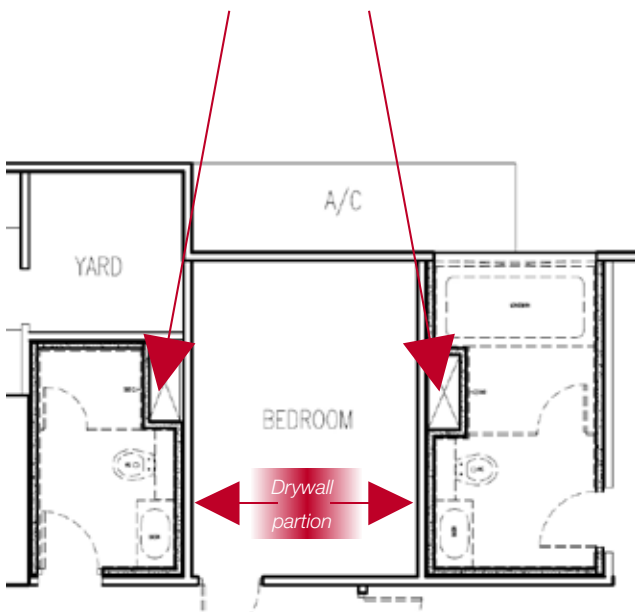
- Incorporate manufacturer's label in the completed PBU
- Visible to homeowners
- Reference for repair, replacement and renovation work.



4.3 M & E Services

The choice of M & E services must take into consideration conduct of tests and future maintenance.

Stack pipe shaft is accessible for maintenance on side of drywall partition



Location of Stack Pipes

- Location of stack pipes and orientation of shaft within unit is important for future maintenance, repair and renovation
- Locating pipes at or facing external wall will pose greater challenge for replacement and repair

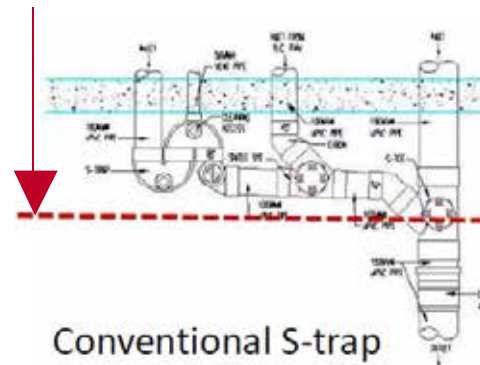
Concealed Services

- Cast in concealed piping
- Block-out within PBU make replacement easier

Conventional Floor Trap

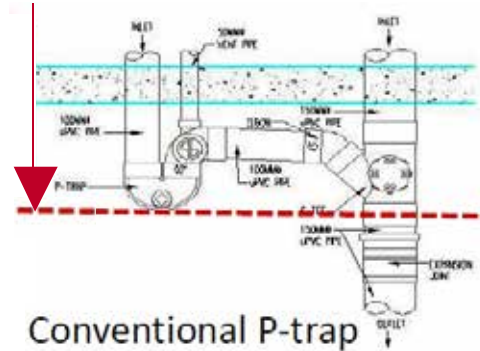
- Maintenance and repair similar to conventional bathroom
- It is important to have sufficient floor height

False Ceiling



Conventional S-trap

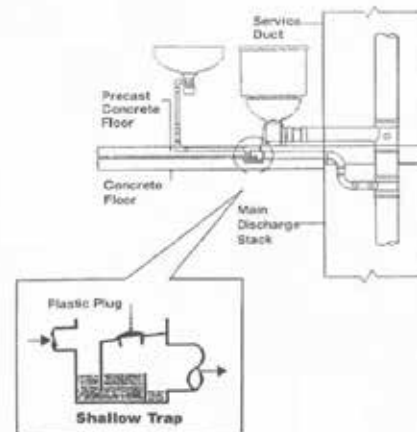
False Ceiling



Conventional P-trap

Shallow Floor Trap

- Select brands approved by PUB
- To comply to BSEN 1253 standard
- Test certificates required
 - Anti-blockage test
 - Water tightness test
 - Flow rate test
 - Odour tightness test
 - Resistance of Water Seal to Pressure
 - Depth of Water Seal
 - Access for Cleaning
 - Side inlet





Routing of Pipes Above PBU

- route pipes near the edge of PBU (reachable from outside) or accessible via ceiling access panel



Air-conditioning drain pipe (Concealed)

Pros

- Connect to floor trap and cast in, do not require false ceiling

Concern

- Unable to achieve sufficient gradient within slab thickness



Air-conditioning drain pipe (through slab)

Pros

- Can achieve sufficient gradient

Concern

- Need false ceiling and sufficient headroom

Renovation

- Renovator should be trained
- It is important to use appropriate tools for renovation works
- Exercise care when renovating and replacing tiles by referring to the homeowner user manual

4.4 Renovation

Although precast concrete PBU is similar to conventional bathroom, it is essential to exercise care during renovation to prevent damage to the PBU. A trained renovator should be engaged who should use appropriate tools and follow the instructions in the homeowner user manual.



4.4.1 Homeowner User Manual

Besides engaging renovation contractors who are trained, homeowners should have a ready reference of the PBU system used in the unit. It is good practice for developers/builders to provide a homeowner user manual of the PBU upon completion of the project. The homeowner and subsequent buyers of the unit should obtain a copy of the homeowner user manual after taking over the unit and follow the recommendations on PBU renovation provided in the manual.

The information in the homeowner user manual could include (but not limited to) the following:

(a) General information on PBU

- (i) Introduction to the PBU installed
- (ii) Safety notices
- (iii) Instructions for use

(b) Structure of the PBU

- (i) Floor
- (ii) Wall
- (iii) Ceiling
- (iv) Water piping
- (v) Sanitary discharge pipe/vertical soil stack
- (vi) Electrical conduits

(c) Layout of the PBU

- (i) General layout
- (ii) Waterproofing layout
- (iii) Locations of concealed services
- (iv) Location of access panel
- (v) Location of the manufacturer's label

(d) Cleaning and maintenance advice

- (i) Internal fittings, tiles and accessories
- (ii) Floor trap
- (iii) Ceiling access panels

(e) Alteration, repair and replacement works

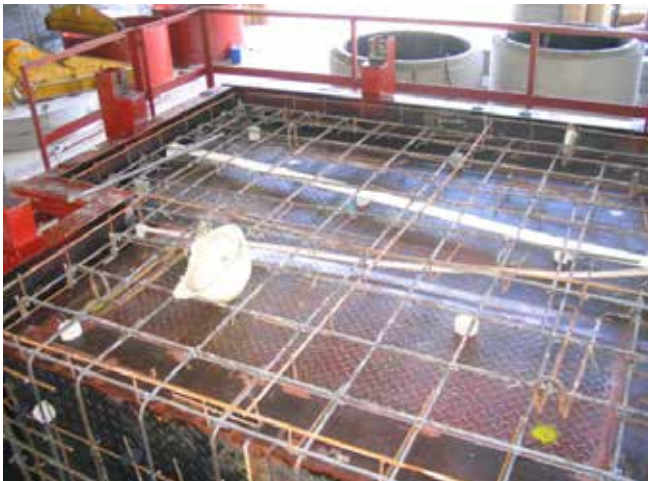
- (i) Replacement of accessories/installation of additional fittings
- (ii) Availability and supply of spare parts
- (iii) Instructions for drilling and fixing
- (iv) Instructions for tile replacement
- (v) Instructions for grab bars installation

5. CRITICAL INSPECTIONS AND QUALITY CHECKS

5.1 Critical Functionality Inspection and Tests

Every construction process requires inspection or testing to ensure its functionality. The functionality of PBU is critical and needs to be inspected or tested from fabrication to installation either at the precast yard or construction site.

5.1.1 M&E Provision



M&E cast-in-items



M&E block-outs

It is important to ensure all the M&E cast-in-items/block-outs are provided in the correct position and properly secured during fabrication. M&E services functionality depends on the proper securing of these block-outs during concreting. All works should follow the M&E, sanitary and plumbing approved method statements and construction drawings.

5.1.2 Waterproofing Works



Water-ponding tests

Water tightness is one of the primary functionality of PBU. To achieve quality waterproofing works, an effective waterproofing method should be developed. The BCA's Good Industry Practices "Waterproofing for Internal Wet Areas" under CONQUAS Enhancement Series is a good reference for development of the approved method statement. The waterproofing in-process installation, inspection and testing should then be conducted in accordance to the approved method statement.

5.1.3 Shallow Floor Trap Tests



Shallow floor trap

The floor trap is crucial towards the functionality of a bathroom. Manufacturers can choose among the conventional P, S or shallow floor trap. When using shallow floor trap, it is essential to ensure that it has been tested and meet the following requirements:

- Anti – blockage test
- Water tightness test
- Flow rate test
- Odour tightness test
- Resistance of water seal to pressure
- Depth of water seal
- Access for cleaning
- Side inlet

5.1.4 Pipe Pressure Test



Pipe pressure test

Pipe pressure test will determine the ability of the pipe and its connection to take the stipulated pressure. The test should be conducted in accordance to the approved method statement. All pipes in PBU should be pressure tested.

5.1.5 Tiling and Tile Pull-Off Test



Tiling pull-off test

To achieve quality flooring and wall finishing works, it is recommended to conduct in-process tiling installation inspection and, if applicable, wall tiles pull-off test to an approved method statement as in BCA Good Industry Practices Guides on “Ceramic Tiling” or “Marble and Granite Finishes”.

5.1.6 Grouting



Grouting to gap between slabs (for double slab system)

It is important to seal up the gaps between slabs for double slab system, by grouting. It is recommended to follow the grouting procedure according to the approved method statement.

5.2 Quality Checks

Process checks during every stage of the bathroom unit production are important to ensure a high quality final product is achieved.

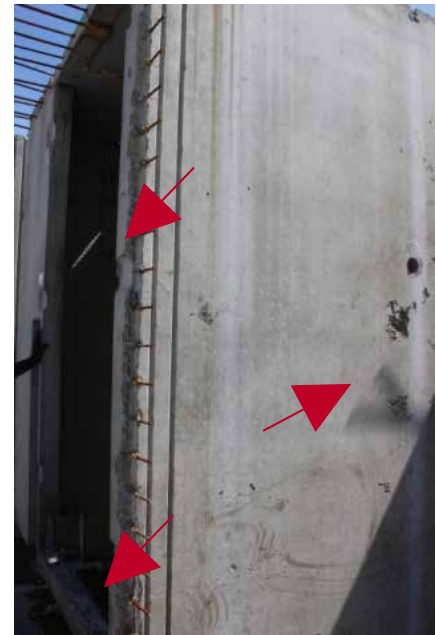
5.2.1 Structural Works



Formwork check

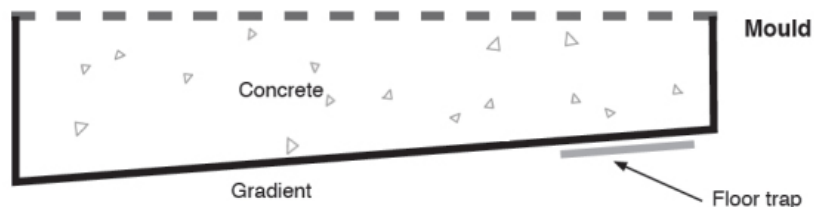


Reinforcement check



Concreting defects check

Checks on formwork, reinforcement and concreting defects should be made progressively in accordance to the specified requirements.



Base slab gradient checks

It is recommended that the PBU base slab is concreted to the desired gradient to receive the tiles. This method is highly productive and it reduces defects by removing the need for thick screed for floor tiling works.

5.2.2 Architectural Works

Upon completing PBU fabrication, it is important to conduct quality checks to approved architectural internal finish standards before delivery.



Floor



Wall



Ceiling

Floor, wall and ceiling should be checked on finishing, alignment and evenness, crack and damages, roughness, and jointing.



Door



Window



Component



Floor Trap

Door, window, component and M&E works should be checked on joints and gap, alignment and evenness, material and damages, functionality, and accessories defects.



Protection checks

The final check before the PBU is delivered to site will be the protection work, internally and externally. It is important to protect the completed PBU before delivery. The protection of the PBU should not be removed unless necessary until after installation and access to the PBU must be controlled after removing the protection.

It is recommended to have another round of checks once the protection is removed to ensure the PBU meets the design and specified requirements.

Sample of Inspection and Test Plan

APPENDIX A

Project:

Scope of Work: Precast Concrete Shell

S/No	Activity	People-In-Charge	Inspection Method	Requirement Reference	Frequency	Acceptance Criteria	Stages	Records
1	Submission (Shop Drawing / Method Statement)							
1.1	Shop Drawings	BR / ARCH / C&S / M&E	Review	Approved Shop Drawings	Initially / Amendment	Conform to Project Specification & Construction Drawings	Prior to Start Work	Approved Submission
1.2	(Architectural, Structural and M&E services)	BR / C&S / M&E	Review	Approved Method Statement	Initially / Amendment	Conform to Project Specification	Prior to Start Work	Approved Submission
1.3	Structural and M&E Method Statement	BR / C&S / M&E	Review	Approved Design	Initially / Amendment	Conform to Regulation & Project Specification	Prior to Start Work	Approved Submission
1.4	PE Calculation (wherever applicable)	BR / C&S	Review	Approved Design Mix	Initially / Amendment	Trial Mix & Cube test result	Prior to Start Work	Approved Submission
1.5	Concrete Design Mix & Test Result	BR / ARCH / M&E	Review	Approved Material	Initially / Amendment	Conform to Project Specification	Prior to Start Work	Approved Submission
1.6	Structural and M&E Material Submission	BR / ARCH / M&E	Review	Approved Sample	Initially / Amendment	Conform to Project Specification	Prior to Start Work	Approved Submission
Prepared By:		M&E Sample Submission		Approved By:				
Date:		Date:						
Legend		ARCH – Architect ARTO – Architectural RTO		C&S – C&S Engineer RETO – Resident Engineer / C&S RTO		M&E – M&E Engineer MRTO – M&E RTO		

This form serves as a guide only.

Sample of Inspection and Test Plan

APPENDIX A

Project:

Scope of Work: Precast Concrete Shell

S/No	Activity	People-In-Charge	Inspection Method	Requirement Reference	Frequency	Acceptance Criteria	Stages	Records
2	Incoming Inspection							
2.1	Concrete	BR / RE	Specifications / Testing	Approved Design Mixed	Each Delivery	Conform to Project Specification	During casting	Test Results
2.2	Rebar / Welded Mesh	BR / RE	Specifications / Testing	Approved Submission	Based on Tonnage / test	Mill Certificate & Test report	Prior to Start Work	Test Results
2.3	M&E Embedded	BR / MRTO	Visual / Testing	Approved Submission	Based on Batch Delivered	Conform to Project Specification & Test report	Prior to Start Work	Test Results
2.4	Architectural Materials	BR/ARTO	Visual / Testing	Approved Submission	Based on Batch Delivered	Conform to Project Specification & Test report	Prior to Start Work	Test Results
2.5	M&E Items and Accessories	BR / MRTO	Visual / Testing	Approved Submission	Based on Batch Delivered	Conform to Project Specification & Test report	Prior to Start Work	Test Results
Prepared By:				M&E Sample Submission		Approved By:		
Date:				Date:		Date:		
Legend	BR – Builder Rep.	ARCH – Architect ARTO – Architectural RTO	C&S – C&S Engineer RETO – Resident Engineer / C&S RTO	M&E – M&E Engineer MRTO – M&E RTO				

This form serves as a guide only.

Sample of Inspection and Test Plan

Project:

Scope of Work: Precast Concrete Shell

APPENDIX A

S/No	Activity	People-In-Charge	Inspection Method	Requirement Reference	Frequency	Acceptance Criteria	Stages	Records
3	In-Process Fabrication (Precast Type)							
3.1	Fabrication of formwork and Transportation to precast yard	PR	Visual / Specifications	Approved Submission	Each Location	Conform to Project Specification & Construction Drawings	Prior to Start Work	Approved Submission
3.2	Installation of Rebar, M&E services & lifting hooks	PR	Visual / Measurement	Approved Submission	Each Location	Conform to Project Specification	Prior to Start Work	Inspection Forms
3.3	Inspection prior to closing formwork	PR / BR / RETO	Visual / Measurement	Approved Submission	Each PBU	Conform to Regulation & Project Specification	Prior to Concrete Work	Inspection Forms
3.4	Formwork closure and Plumb	PR / BR / RETO	Visual / Measurement	Approved Submission	Each PBU	Trial Mix & Cube test result	Prior to Concrete Work	Inspection Forms
3.5	Casting of Bathroom Unit	PR / BR / RETO	Visual	See Section in Write-up	Each PBU	Conform to Project Specification	Precast Concrete Work	Inspection Forms
Prepared By:			M&E Sample Submission			Approved By:		
Date:			Date:			Date:		
Legend	BR – Builder Rep.	ARCH – Architect ARTO – Architectural RTO	C&S – C&S Engineer RETO – Resident Engineer / C&S RTO	M&E – M&E Engineer MRTO – M&E RTO				

This form serves as a guide only.

Sample of Inspection and Test Plan

Project:

Scope of Work: Precast Concrete Shell

APPENDIX A

S/No	Activity	People-In-Charge	Inspection Method	Requirement Reference	Frequency	Acceptance Criteria	Stages	Records
3	In-Process Fabrication (Precast Type) – Continued							
3.6	De-moulding of formwork	PR / BR / RETO	Visual	See Section in Write-up	Each PBU	Conform to Specification	Precast Concrete Work	Inspection Forms
3.7	Curing	PR / BR / RETO	Visual	See Section in Write-up	Each PBU	Conform to Specification	Precast Concrete Work	Inspection Forms
3.8	Rectification works	PR / BR / RETO	Visual	See Section in Write-up	Each PBU	Conform to Specification	Precast Concrete Work	Inspection Forms
3.9	Structure Ponding Test	PR / BR / RETO	Visual / Testing	See Section in Write-up	Each PBU	Conform to Specification	Precast Concrete Work	Inspection Forms
Prepared By:				M&E Sample Submission		Approved By:		
Date:				Date:		Date:		
Legend	BR – Builder Rep.	ARCH – Architect ARTO – Architectural RTO	C&S – C&S Engineer RETO – Resident Engineer / C&S RTO	M&E – M&E Engineer MRTO – M&E RTO				

This form serves as a guide only.

Sample of Inspection and Test Plan

APPENDIX A

Project:

Scope of Work: Precast Bathroom at Manufacturer's Factory

S/No	Activity	People-In-Charge	Inspection Method	Requirement Reference	Frequency	Acceptance Criteria	Stages	Records
1	Submission (Shop Drawing / Method Statement)							
1.1	Shop Drawings (Architectural and M&E services)	BR / ARCH / M&E	Review	Approved Shop Drawings	Initially / Amendment	Conform to Project Specification & Construction Drawings	Prior to Start Work	Approved Submission
1.2	Architectural and M&E Method Statement	BR / ARCH / M&E	Review	Approved Method Statement	Initially / Amendment	Conform to Project Specification	Prior to Start Work	Approved Submission
1.3	Architectural Material Submission	BR / ARCH	Review	Approved Design	Initially / Amendment	Conform to Project Specification	Prior to Start Work	Approved Submission
1.4	Architectural Sample Submission	BR / ARCH	Review	Approved Design Mix	Initially / Amendment	Conform to Project Specification	Prior to Start Work	Approved Submission
1.5	M&E Material Submission	BR / M&E	Review	Approved Material	Initially / Amendment	Conform to Project Specification	Prior to Start Work	Approved Submission
1.6	M&E Sample Submission	BR / M&E	Review	Approved Sample	Initially / Amendment	Conform to Project Specification	Prior to Start Work	Approved Submission
Prepared By:			Verified By:		Approved By:			
Date:			Date:		Date:			
Legend		BR – Builder Rep.	ARCH – Architect ARTO – Architectural RTO	C&S – C&S Engineer RETO – Resident Engineer / C&S RTO	M&E – M&E Engineer MRTO – M&E RTO			

This form serves as a guide only.

Sample of Inspection and Test Plan

APPENDIX A

Project:

Scope of Work: Precast Bathroom at Manufacturer's Factory

S/No	Activity	People-In-Charge	Inspection Method	Requirement Reference	Frequency	Acceptance Criteria	Stages	Records
2	Submission (Shop Drawing / Method Statement)							
2.1	Waterproofing works	BR / ARTO	Specifications / Testing	Approved Submission	Each PBU	Conform to Approved Drawings	Architectural Works	Approved Submission
2.2	Water Ponding Test(On rendered surface)	BR / ARTO	Specifications / Testing	Approved Submission	Each PBU	Conform to Project Specification	Architectural Works	Test Results
2.3	Install Door and Window Frames	BR / ARTO	Specifications / Testing	Approved Submission	Each PBU	Conform to Approved Drawings & Project Specification	Architectural Works	Approved Submission
2.4	Tiling Works	BR / ARTO	Specifications / Testing	Approved Submission	Each PBU	Conform to Approved Drawings & Project Specification	Architectural Works	Approved Submission
2.5	Pipe Pressure Test	BR / MRTO	Specifications / Testing	Approved Submission	Each Embedded Pipe Location	Conform to Approved Drawings & Project Specification	Architectural Works	Test Results
2.6	Install Sanitary and Other Fixtures	BR / MRTO	Specifications	Approved Submission	Each PBU	Conform to Approved Drawings & Project Specification	Architectural Works	Approved Submission
2.7	Protection	BR	Specifications	Approved Submission	Each PBU	Conform to Project Specification	Architectural Works	Approved Submission
				Verified By:	Approved By:			
Date:			Date:	Date:				
Legend	BR – Builder Rep.	ARCH – Architect ARTO – Architectural RTO	C&S – C&S Engineer RETO – Resident Engineer / C&S RTO	M&E – M&E Engineer MRTO – M&E RTO				

This form serves as a guide only.

Sample of Inspection and Test Plan

APPENDIX A

Project:
Scope of Work: Precast Bathroom (Site Installation)

S/No	Activity	People-In-Charge	Inspection Method	Requirement Reference	Frequency	Acceptance Criteria	Stages	Records
1.1	Submission (Shop Drawing / Method Statement)							
1.2	PE Calculation (Hoisting Equipment)	BR / C&S / M&E	Review	Approved Design	Initially / Amendment	Conform to Regulation & Specification	Prior to Start Work	Approved Submission
1.3	Installation Method Statement	BR / Arch / C&S / M&E	Review	Approved Method Statement	Initially / Amendment	Conform to Specification	Prior to Start Work	Approved Submission
1.4	M&E Connection Method Statement	BR / Arch / C&S / M&E	Review	Approved Method Statement	Initially / Amendment	Conform to Specification	Prior to Start Work	Approved Submission
1.5	Lifting Plan	BR (Safety)	Review	Approved Method Statement	Initially / Amendment	Conform to Specification	Prior to Start Work	Approved Submission
Prepared By:					Approved By:			
Date:			Date:			Date:		
Legend	BR – Builder Rep.	ARCH – Architect ARTO – Architectural RTO	C&S – C&S Engineer RETO – Resident Engineer / C&S RTO	M&E – M&E Engineer MRTO – M&E RTO				

This form serves as a guide only.

Sample of Inspection and Test Plan

APPENDIX A

Project: Scope of Work: Precast Bathroom (Site Installation)

S/No	Activity	People-In-Charge	Inspection Method	Requirement Reference	Frequency	Acceptance Criteria	Stages	Records
2	Installation							
2.1	Setting Out	BR / ARTO / RETO	Approved Shop Drawings	Section 3	Each PBU	Conform to Specification	Installation	Approved Submission
2.2		BR / ARTO / RETO	Approved Shop Drawings	Section 3	Each PBU	Conform to Specification	Installation	Approved Submission
2.3	Installation	BR / MRTO	Approved Shop Drawings	Section 3	Each PBU	Conform to Specification	Installation	Approved Submission
2.4	Pipe Installation at Vertical Shaft	BR / ARTO / RETO	Approved Shop Drawings	Section 3	Each PBU	Conform to Specification	Installation	Approved Submission
2.5	Securing PBU In Position	BR / ARTO / RETO	Approved Method Statement	Section 3	Each PBU	Conform to Specification	Installation	Approved Submission
2.6	Grouting	BR / ARTO	Approved Method Statement	Section 3	Each PBU	Conform to Specification	Installation	Approved Submission
2.7	Final Fixture	BR / MRTO	Approved Shop Drawings	Section 3	Each Connection	Conform to Specification	Installation	Approved Submission
2.8	M&E Pipe connection	BR / MRTO	Visual / Testing	Section 3	Each Connection	Conform to Specification	Installation	Inspection Forms
2.9	Final Waterponding Test (On Finished Tiled Surface)	BR / ARTO / RETO	Visual / Testing	Section 3	Each PBU	Conform to Specification	Installation	Inspection Forms
Prepared By:			Verified By:			Approved By:		
Date:			Date:			Date:		
Legend		BR – Builder Rep.	ARCH – Architect ARTO – Architectural RTO	C&S – C&S Engineer RETO – Resident Engineer / C&S RTO	M&E – M&E Engineer MRTO – M&E RTO			

This form serves as a Guide only.

APPENDIX B

Request for Inspection Form (Precast Formwork)

Project Title: XY Condominium		Supplier: 123 Formwork Pte Ltd	
Work Trade: Precast Formwork		Main Contractor: AB Contractor Pte Ltd	
Type of PBU Mould: Type A-1		Inspection No: XY/123/ABC/4474/01	
Supplier Rep.:	Builder Rep.:	ITP Reference No: 3 (In-Process Fabrication)	
.....	Drawing No: XY/123/ABC/A-1/001	
Name	Name		

Note: Use Approved drawing of the unit to be inspected. Mark defect on the formwork.

S/N	Inspection Criteria	Acceptance Criteria	Accepted		Remarks / Comments
			Yes	No	
1	Thickness of Mould	As Per Approved Submission			
2	Welding	As Per Approved Submission			
3	Supports / Props	As Per Approved Submission			
4	Dimension (L x B x H)	As Per Approved Submission			
5	Plumb	+/- 3mm/m			
6	Alignment	+/- 3mm per 1.2m			
7	Evenness	Even, Not Wavy			
8	Squareness	+/- 4mm along 300mm square			
9	Appearance	Smooth / Checker (As Approved), no crack, no dent, no bulging, no holes & visible gap at joints, no weld spatter			
10	Door / Window Openings (Size)	As Per Approved Submission			
11	Door / Window Openings (Position)	As Per Approved Submission			
12	Door / Window Openings (Alignment & Squareness)	No Tolerance			
13	Finishing	Opaque and Clear Painting			
14	Others(Specify)				

Note: Use Approved Drawings of the unit to be inspected. Mark defects on the floor & wall.

S/N	Date of Inspection	Signature (Supplier Rep.)	Signature (Builder Rep.)	Remarks / Comments
1				
2				
3				

APPENDIX B

Request for Inspection Form (Precast Concreting)

Project Title: XY Condominium			Work Trade: Precast PBU Concreting		
Supplier: 123 Interior Pte Ltd			Main Contractor: AB Contractor Pte Ltd		
Type of PBU: Type B-2		Inspection No. for Same PBU: 40	Inspection Record No: XY/123/ABC/4483/202		
Supplier Rep.:	Builder Rep.:	RE / RTO:	ITP Reference No: 3 (In-Process Fabrication)		
.....	Drawing No: XY/123/ABC/B-2/002		
Name	Name	Name			
S/N	Inspection Criteria	Acceptance Criteria	Accepted		Remarks / Comments
			Yes	No	
Note: Use Approved drawing of the unit to be inspected. Mark defect on the Formwork or Finished Concrete.					
Stage 1 – Preparation for Concreting					
1	Reinforcement Bars	Rebar size & spacing as per Approved Drawings. Rebar Condition.			
2	Formwork	Evenness, Cleanliness, Any Damage.			
3	Internal Dimension	As Per Approved Drawing.			
4	Door / Window Openings	Size, Position, Alignment.			
5	Cover	As Per Approved Drawings.			
6	M&E Embedded	Numbers, Position, Properly Secured, No Damage.			
7	Lifting Anchors	Position, Properly Secured, No Damage.			
17	Others (Specify):				
Note: Use Approved Drawings of the unit to be inspected. Mark defects on the floor & wall.					
Inspection No	Date & Time of Inspection	Signature (Supplier Rep.)	Signature (Builder Rep.)	Signature	Remarks / Comments
1					
2					
Stage 2 – After Formwork Closing					
8	External Dimension	As Per Approved Drawings.			
9	Thickness of Wall	As Per Approved Drawings.			
10	Verticality	+/- 1mm			
Inspection No	Date & Time of Inspection	Signature (Supplier Rep.)	Signature (Builder Rep.)	Signature	Remarks / Comments
1					
2					

Stage 3 – After Stripping Formwork						
11	Verticality	+/- 1mm				
12	Alignment / Evenness	+/- 3mm per 1.2m				
13	Size of Openings	As per Approved Drawings				
14	Dimension	As per Approved Drawings.				
15	Square-ness	+/- 4mm along 300mm square.				
16	Fall	As Per Approved Drawings.				
17	Finished Concrete Surface	No Damage, No Honeycomb, No Lost of Grout.				
18	M&E Provision	No Damage, No Blockage				
Inspection No	Date & Time of Inspection	Signature (Supplier Rep.)	Signature (Builder Rep.)	Signature		Remarks / Comments
1						
2						
S/N	Inspection Criteria	Acceptance Criteria	Accepted		Remarks / Comments	
			Yes	No		
Stage 4 – Defect Rectification						
1	Cracks	As Approved Method Statement.				
2	Honeycomb / Loss of Grout	As Approved Method Statement.				
3	Damaged M&E	As Approved Method Statement.				
Inspection No	Date & Time of Inspection	Signature (Supplier Rep.)	Signature (Builder Rep.)	Signature		Remarks / Comments
1						
2						
Stage 5 – Structural Ponding Test						
4	Structural Ponding Test	As Per Approved Drawings.				
Inspection No	Date & Time of Inspection	Signature (Supplier Rep.)	Signature (Builder Rep.)	Signature		Remarks / Comments
1						
2						

APPENDIX B

Request for Inspection Form (Architectural Floor / Wall)

Project Title: XY Condominium			Work Trade: Tiling/Marble/Stone Laying			
Supplier: 123 Interior Pte Ltd			Main Contractor: AB Contractor Pte Ltd			
Type of PBU: Type C-3		PBU No: 45	Inspection Record No: XY/123/ABC/Floor/303			
ITP Reference No: 2 (In-Process Inspection)				Drawing No: XY/123/ABC/C-3/003		
S/N		Inspection Criteria	Acceptance Criteria	Accepted		Remarks / Comments
				Yes	No	
1	Dimension	Layout and Orientation	As Per Approved Drawings.			
2		Size of tile / marble / stone	As Per Approved Submission			
3	Finishing	Dry Lay (Tonality)	Within approved range and colour evenly matched			
4		Stains/Marks	No Stains or Marks			
5	Alignment	Surface Evenness	< 3mm per 1.2m			
6		Lippage	No Tolerance			
7		Squareness	< 4mm per 300mm square			
8		Fall to Floor Trap	Test result			
9	Damage	Chip / Dent / Crack / Scratch	No chip, dent, crack or scratch			
10		Sealing of Stone Porosity (only for Stone)	As Per Approved Method Statement			
11	Hollow	Hollowness	No hollowness			
12	Jointing	Grouting of Joints	Properly grouted joints with consistent thickness (<2mm)			
13		Pointing	Neat & Consistent			
14	M&E	Sanitary Ware Installation	As Per Method Statement			
15		Grouting Around Floor Trap	Neatly Finished			
16		Protection	As Per Approved Method Statement			
17		Others (Specify):				
Note: Use Approved Drawings of the unit to be inspected. Mark defects on the floor & wall.						
S/N	Date of Inspection	Name & Signature (Supplier Rep.)	Name & Signature (Builder Rep.)	Name & Signature (RA / RTO)	Remarks / Comments	
1						
2						
3						

REFERENCES

- i. SS CP5: 1998
Code of Practice for Electrical Installations
- ii. SS CP88: 2001 Part 1 – Construction and Building Sites
Code of Practice for Temporary Electrical Installations
- iii. SS 492 : 2001
Specification for Performance Requirements for Strength and Robustness (including methods of test) for Partition Walls
- iv. BS EN 1253-2: 2003
Gullies for buildings. Test methods.
- v. Public Utilities Board
Code of Practice on Sewerage and Sanitary Works (1st Edition)
- vi. BCA
Code on Accessibility in the Built Environment 2013
- vii. BCA
Code of Practice on Buildability 2013 Edition
- viii. BCA Buildability Series
What you need to know about Prefabricated Bathroom Unit (PBU).
- ix. BCA CONQUAS Enhancement Series
Good Industry Practices – Precast Concrete Elements
- x. BCA CONQUAS Enhancement Series
Good Industry Practices – Waterproofing for Internal Wet Areas (2nd Edition)
- xi. BCA CONQUAS Enhancement Series
Good Industry Practices – Ceramic Tiling (2nd Edition)
- xii. BCA CONQUAS Enhancement Series
Good Industry Practices – Marble and Granite Finishes (2nd Edition)