

**PRECAST /
PREFABRICATED
BATHROOM UNITS**

CHAPTER 6

The bathroom is usually one of the smallest rooms in a dwelling unit. Nevertheless, it is one of the most labour intensive elements to be co-ordinated. It requires the involvement of almost all building trades such as waterproofing, finishes, accessories, sanitary wares / plumbing systems and M&E installations.

Being subjected to wetting and drying, the construction of a bathroom demands a very high standard of workmanship, especially in the area of waterproofing. Should there be a leak found in the floor slab, the amount of time, cost and inconvenience caused could be extensive, as it is often difficult to trace the source, such as defective workmanship or cracks through the structural slab. Rectification work may require hacking floor tiles, exposing substrate and re-applying waterproofing membrane.

The Committee recommends designers to integrate precast / prefabricated bathroom units (PBUs) in their design, which offers significant opportunities for improvement in terms of delivery, quality assurance and productivity.

6.1 Types of Precast / Prefabricated Bathroom Units

PBUs have been widely used in Japan and the western homes and hotels for many years. In recent years, both the HDB and private developers have explored the possibility of using prefabricated bathrooms. A trial implementation programme for the PBUs was carried out by HDB in some of the public housing projects. As feedback from homeowners was very encouraging, PBU is likely to become the new approach to public and private housing.

There are many proprietary systems available in the Singapore market. Nevertheless, PBUs could generally categories into the following systems:

System 1

Precast concrete cell completed with finished wall and floor prior to delivery to site.

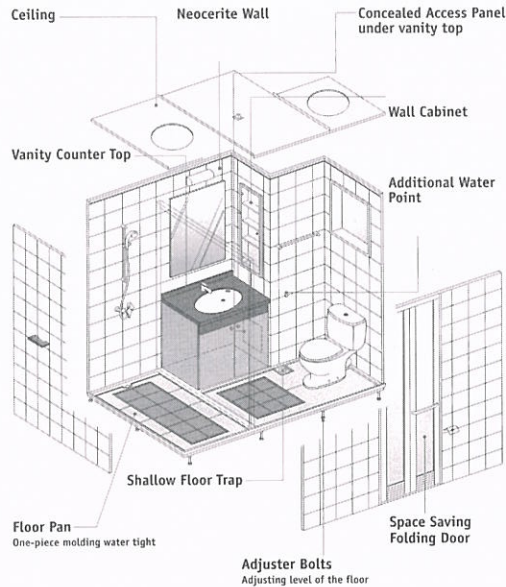


- Bathroom shall be cast as a volumetric concrete cell and pre-finished with floor and wall finishes prior to delivery to site.
- PBU shall be hoisted to location and the M&E services shall be connected to the mains of the building.

Figure 1 : Precast Concrete Cell with Finished Floor and Walls.

System 2

Wall panels and floor tray separately lifted and assembled at site.



- Floor tray shall be lifted to position and set up accordingly.
- Wall panels shall be lifted and assembled at site.
- Finally, Ceiling and sanitary fittings shall be assembled accordingly.

Figure 2: Wall Panels and Floor Separately Lifted

System 3

Wall panels and floor trays pre-assembled in factory prior to delivery to site.



- Wall panels and floor tray were pre-assembled in factory prior to delivery to site.
- PBU shall be hoisted to location and the M&E services shall be connected to the mains of the building.

Figure 3: Pre-assembled Bathroom Unit

Floor trays are usually made of reinforced concrete (RC), fibre reinforced polyester (FRP) or sheet moulding compound (SMC). Wall panels are commonly made of fibre reinforced polyester, special cement board, sheet moulding compound, galvanised metal sheet as well as sandwich panelling system. Lightweight ceiling materials such as PVC-coated alloy for rust resistance are available in the market.

Both the conventional “S-trap” and the new shallow “P-trap” system can be used for the sanitary plumbing system. The shallow “P-trap” and sanitary pipes have the advantage of being fully encased within the PBU floor tray / slab and connected horizontally to the main sanitary discharge stack in the service duct. This eliminates the exposure of unsightly sanitary pipings under the slab in conventional bathrooms. It also eases the maintenance process. As no pipes are protruding out of the ceiling of the unit below, all maintenance/repairing works can be carried out within the affected unit itself, avoiding the need to disturb the neighbours.

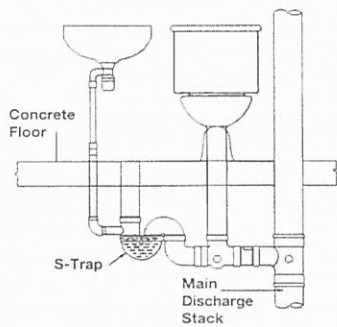


Figure 4 : Conventional Floor Trap

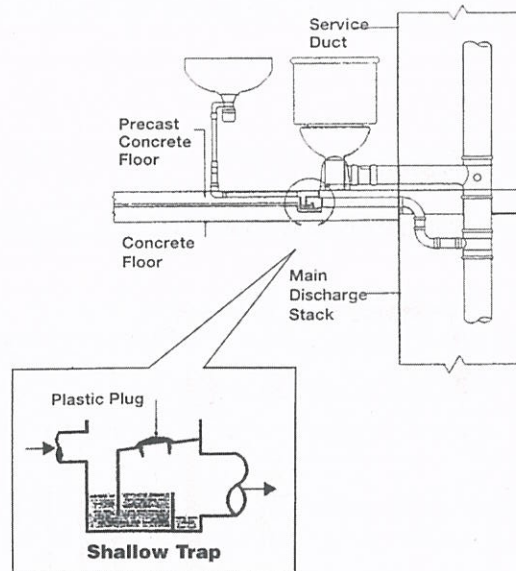


Figure 5 : New 'Shallow' Floor Trap

6.2 Benefits of Precast / Prefabricated Bathroom Units

The foremost benefits of precast / prefabricated bathroom units are:

- Higher quality finishes and low wastage of materials.
- Improved productivity of labour on site.
- Reduced wet work especially in the bathroom and less cleaning up work on site.
- Better quality control in waterproofing works in the factory environment.
- Maintenance can be carried out within the unit rather than from neighbouring unit.
- Higher buildability score.

These benefits translate into substantial savings in cost for developers, high and consistent quality product for designers and simpler quality control for contractors.

6.3 Architectural Design Considerations

Besides knowing the types of system available in the market, designers could consider the following factors and guidelines during the development stage of a project.

Treatment to external surfaces of PBUs' wall panels

Some PBU systems come with complete wall panels ready to receive skim coat and painting. Others would require external finishing panels (brickwall, block wall, dry wall, etc.) for the architectural treatment.

Treatment to the drop in soffit level of the slab

In most private residential developments, a drop at the entrance of bathroom is incorporated to contain water within the bathroom. Designers are therefore advised to consider the drop at the soffit level of the slab in the bathroom area. Alternatively, a designer may choose to provide a kerb at the bathroom's entrance to avoid creating a separate floor level.

Location of service ducts and access panel for maintenance

The location of the access panel is critical to suppliers, as the routing and connection of services have to be predetermined and co-ordinated with the appointed supplier prior to delivery.

Sanitary plumbing system

The “P-trap” system refers to “horizontal outlet” (or wall outlet) type of WCs and floor traps. The P-trap WC and floor trap are separately connected horizontally to the main discharge stack at floor level. P-trap system is normally used where the provision of a common discharge pipe below the slab is not feasible.

The conventional “S-trap” (i.e. vertical outlet) type of WC and floor trap are to pass through the floor slab and connect to a common discharge pipe below the floor slab (i.e. this pipe is within the lower unit) for the connection to the main discharge stack. Access for maintenance of the common discharge pipe is to be provided.

The P-trap system can be used in PBUs for the whole construction industry. However, the Qualified Person is advised to pre-consult the Sewerage Department of the Ministry of the Environment (ENV) on the design and layout of the sanitary plumbing system for the PBU and the whole building.

Location of PBU on floor plan

The location of PBU is important to the engineer who is responsible for the hoisting of the unit into the building. A detailed study into the building layout, site boundary, constraints, etc., is a prerequisite.

Performance of wall panel

Some developers and designers are particular in some of the wall panelling systems such that they may sound hollow. However, many suppliers in the market have confirmed that they can reduce it.

Types of finishes for the wall and floor

Some PBU systems do not encourage the use of tiled finishing. It is therefore essential that designers discuss their requirements with suppliers before choosing a PBU system.

6.4 Structural Design Considerations

Precast concrete floor trays can be designed as a structural slab and integrated into the structural system. This design concept will make the construction of bathroom unit a critical path of building project.

It is therefore a preferred choice to leave the prefabricated bathroom unit a strictly architectural precast element. The floor tray would then be designed as a secondary slab, carrying its self-weight with some live load from the sanitary fittings and human movement. This approach will make the bathroom unit a secondary operational component, giving more time for the designer, supplier and contractor to finalise the sanitary fittings as well as the finishes.

Other design factors to be considered when using PBUs are:

Weight of the precast / prefabricated bathroom unit

When carrying out the structural design of the bathroom tray, the structural engineer would have to consider the weight of the PBU, which could be obtained from the supplier. As a rough guide, the weight of PBU available in the market can range from 0.5 to 3 tonnes.

Method of hoisting

Occasionally, the method of hoisting PBUs into a building and the points of lifting are influenced or restrained by the final location of PBUs. As such the structural framing system of PBUs may have to be strengthened or modified to suit.

Type of floor trap

There are many methods to connect floor traps to main discharge stacks depending on PBU suppliers. Designer will need to liaise with the supplier and design the connection details accordingly. For example, if the conventional S-trap is to be used, it will be necessary to box out the structural floor slab.

The suppliers shall seek approval from the Sewerage Department (ENV) on the shallow floor trap. Shallow floor traps shall comply with the following basic requirements:

- (a) Depth of water seal shall not be less than 50mm and the parts / partition forming the water seal trap shall be of an integral part of the trap.
- (b) Depth of passage clearance shall not be less than 25mm.
- (c) Diameter of waste pipe connection shall not be less than 40mm (or 2 nos. of 25mm waste pipe connection).
- (d) Diameter of outlet pipe shall not be less than 75mm.
- (e) Floor trap grating shall incorporate with an anti-mosquito device.

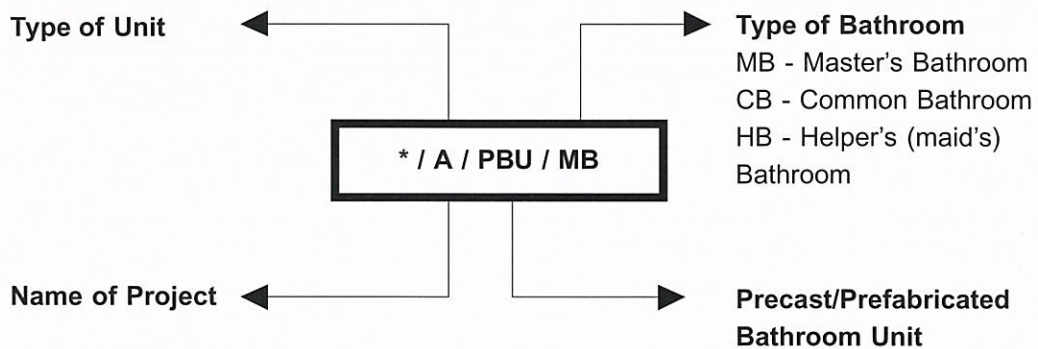
6.5 Dimensioning and Labelling System

A wide variety of proprietary PBU systems are available in the market. Most suppliers can produce PBUs to designers' specifications, including the size of the bathroom.

It is imperative that designers use the internal coordinating dimensions in multiples of 0.5M (where M is equivalent to 100mm) for the length, breadth and width of the bathroom, when designing the bathroom layout.

To support the application of modular system, the size and layout of the PBUs should be standardised in specific incremental dimension. The productivity and quality of PBUs would certainly be enhanced with the use of more industrialised materials and methods. More cost competitive PBUs could also be achieved through economics of scale.

There are many systems available in the market, the development of unit modular standardisation for the local PBU market is therefore essential. Standardised PBU label format may be adopted. A proposed example would be as follow:



6.6 Reference Sheets

INSTALLATION OF PRECAST / PREFABRICATED BATHROOM UNITS

The installation procedures for precast / prefabricated bathroom units varies from system to system. Designers are encouraged to liaise with suppliers for specifying PBUs in their projects.

The general rules are:

1. All loose concrete and debris such as loose timber and nails shall be removed. Surfaces shall be prepared and made good before receiving the unit.
2. Contingency discharge pipe should be cast in the structural slab as an outlet pipe for seepage of water through the PBU, eventhough most PBUs are waterproofed prior to delivery.
3. Debris in pipes shall be removed to avoid choking sanitary discharge pipes / stacks.
4. With the preparation works complete, care should be taken to prevent damage to PBUs when hoisting the unit to the respective floor level.
5. Palletiser could be used to transport PBUs. Final position shall be adjusted using pneumatic jacks and levelling shims.
6. Sanitary discharge pipes shall be connected to the main discharge stack in the service duct in accordance with the manufacturer's specifications.
7. Electrical service shall also be connected to the main switch of the building.
8. The gap between the bottom of the PBU and the structural slab shall be packed with non-shrink grout around the perimeter or treated in accordance with manufacturer's specifications.
9. If one of the PBU's wall panels is exposed or formed part of the external wall or façade, much care should be taken to prevent water seepage or migration.

LIST OF SUPPLIERS FOR PRECAST / PREFABRICATED BATHROOM UNITS

Name of PBU Suppliers	Tel / Fax No	Model	System
Eastern Pretech (Pte) Ltd 15 Sungei Kadut St 2, Singapore 729234	368 1366 368 2256 (Fax)	'Parma'	3
Eng Seng Cement Products Pte Ltd 45 Kallang Pudding Road #10-01 Alpha Building, Singapore 349317	746 4333 743 4085 (Fax)	'YES'	2 & 3
Fermold Pte Ltd 3 Tuas Basin Close, Singapore 638798	861 8836 861 2909 (Fax)	INAX 'KW'	3
Framework Building Products Pte Ltd 58 Tuas Basin Link, Jurong Town Singapore 638774	861 5838 861 3387 (Fax)	'Unilav'	3
G & W Precast Pte Ltd 21 Sungei Kadut St 2, Singapore 729238	368 2221 365 3927 (Fax)	House brand	3
Hong Leong Asia Ltd 7A Tuas Avenue 13, Singapore 638979	862 3501 861 0674 (Fax)	House brand	3
Keppel Sea Scan Pte Ltd 31 Shipyard Road Singapore 628130	262 6100 262 4231 (Fax)	'Keppel Sea Scan'	3
National Matsushita Electric Works (Asia Pacific) Pte Ltd 101 Thomson Road #25-03/05, United Square, Singapore 307591	255 5473 253 5689 (Fax)	'National'	2 & 3
Plus Link Industries Pte Ltd 40 Tuas West Road, Singapore 638389	269 0708 269 2808 (Fax)	'Plus Link Series'	3
Prefab Technology Pte Ltd 66 Sungei Kadut St 1, Singapore 729367	368 3233 365 8316 (Fax)	'P-Cube'	3

Note: The list of Suppliers for Precast / Prefabricated Bathroom Units is not exhaustive.

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER



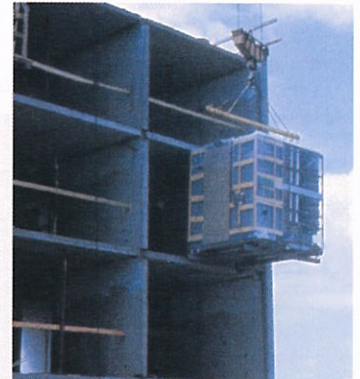
Eastern Pretech Pte Ltd

15 Sungei Kadut Street 2

Singapore 729234

Tel : (65) 3681366

Fax : (65) 3682256



Product Features “PARMA”

- Walls and ceilings consist of plastic-coated hot-dipped galvanised steel sheet cassettes jointed together with mechanical connection.
- Walls are 50mm thick and tiles or marble are applied to the walls with a special adhesive.
- Reinforced concrete floor slab shall be 100mm thick, laid to fall with waterproofing membrane.
- Patented PVC sanitary piping and shallow floor trap system concealed within floor slab structure. No sanitary pipes need to penetrate the floor slab, thus cutting down the possibility of leakage into the apartment below.
- Fully furnished with all sanitary wares, fittings, electrical and services within the unit in the factory.
- Quality of workmanship under controlled ideal factory conditions. Quality control includes tests on water proofing, plumbing and electrical wiring.
- PBU would be ready for use after hoisting it into final position and connecting its plumbing and electrical services. M&E connections are all done from outside of the unit.
- Unit weight approximately 2 tonnes.

Project Reference

- HDB Public Housing (3184 units)
- Redevelopment of Gurkha Camp (848 units)
- NTU Student Hostels (421 units)
- Malaysia projects: Pudu Hotel (168 Units), Kemayan Hotel (208 Units), Ambassador Hotel (368 Units)

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER



Eng Seng Cement Products (Pte) Ltd
45 Kallang Pudding Road
#10-01 Alpha Building
Singapore 349317

Tel : (65) 7464333
Fax : (65) 7434085
Email : sales@engseng.com.sg
URL : www.engseng.com.sg

The New Yes Bathroom Unit



Part of Interior Finishes

Model: Yes0001



External View

Product Features

- Standard FEcon Unit 2.4 X 1.7 with accessories weighs 2,500Kg (Option for lightweight GRP unit >450Kg)
- Preformed one-piece concrete/GRP floor tray with FEcon wall panel system
- Whole unit is cast/assembled with quality finished and sanitary wares in controlled factory environment. Alternatively, due space constraint, individual panels may be assembled at construction sites
- Flexible custom-design units allow solutions for all applications according to building structures and architectural design. Many styles, colours and finishing materials can be chosen from our wide collection to suit individual tastes.
- High structural strength, long lasting, good sound insulation value, maintenance-free, quick and easy installation are some of the advantages that come with YES bathroom unit.

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER



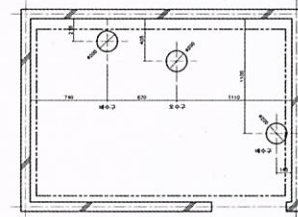
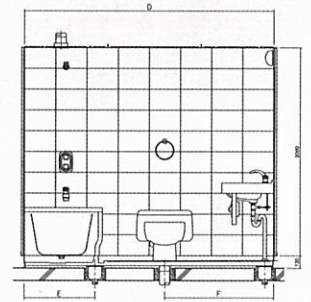
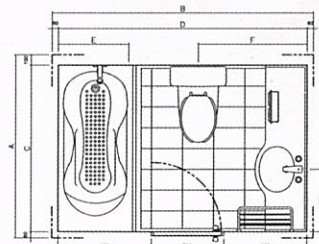
FERMOLD PTE LTD

3 Tuas Basin Close
Singapore 638798

Tel : (65) 8618836

Fax : (65) 8612909

E-mail : fermold@pacific.net.sg



**FERMOLD
DAELIM-INAX UBR**

Product Features

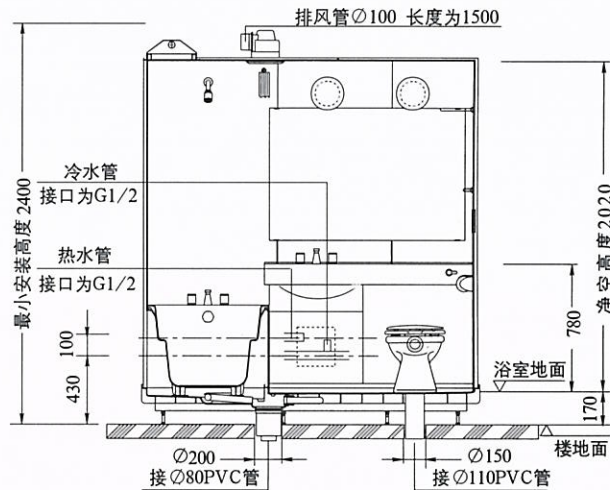
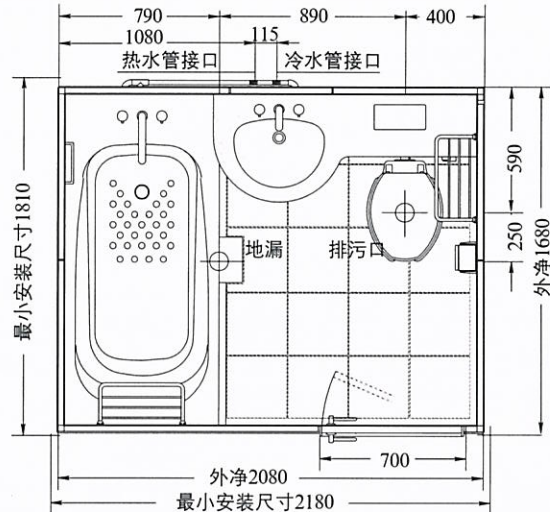
- Variety of quality components
- Easy maintenance for services within unit
- Established UBR system in Japan and Korea
- Design with drawing details package
- Weight less than 2.5 tonnes
- Flexibility for alteration

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER



FRAMEWORK
Building Products Pte Ltd
 58 Tuas Basin Link
 Singapore 638774

Tel : (65) 8615838
 Fax : (65) 8613387
 Website : <http://www.framework.com.sg>



Product Features

- Use lightweight, strong and impact resistant Sheet Moulding Compound (SMC), commonly used in aerospace and marine industries.
- SMC is durable, environmentally safe, corrosion and thermal resistant, with bending and compressive strength much greater than alloy and cast iron.
- Available in different sizes, configuration and colour choice with finishes.
- Fabricated in factory environment with systematic quality control and stringent tests.
- One piece machine moulded floor plan ensured waterproofed requirement.
- Ease of installation and complete with bathroom fittings and fixtures.
- On-time and one trade installation, save time, labour and money.

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER



G & W Precast Pte Ltd

21 Sungei Kadut St 2
Singapore 729238

Tel : (65) 3682221

Fax : (65) 3653927



Product Features

- PBU are lightweight but very sturdy so as to ensure durability and easy handling.
- Reinforced Concrete floor incorporating UPVC pipings and P-trap within the slab.
- Body made up either of steel sheet cassette or galvanised angle sections assembled to form the shell. Building boards are then secured onto the cassettes or angles being the wall of BTU - to replace the conventional use of concrete wall / brickwall.
- Pipings for water installation are fixed onto the external of the shell. All other pipings within the unit are carefully concealed so that is aesthetically pleasing.
- BTU comes complete with accessories ranging from basin mixer, bath and shower mixer to frameless mirror.
- Accommodate flexible varying design in layouts with different fittings and accessories to requirements.
- Versatile choice of finishing preference from ceramic tiles, marble to granite.

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER



Hong Leong Asia Ltd

7A Tuas Avenue 13
Singapore 638979

Tel : (65) 8623501

Fax : (65) 8610674

Email : hlsales@hlasia.com.sg

Cubic System

Where the prefab bathroom is completely factory assembled, with all the necessary sanitary fittings, and delivered to site in a cubic form.



Knock-down System

Where only the base tray, with water proofing & tiling (marble), is installed first. Wall panel modules, ceiling & sanitary fittings are site installed later. This system gives a freedom to change the wall panels at any future time.



Product Features

- Floor tray is made of waterproof reinforced concrete. It can be either the structural floor or an elevated secondary floor.
- Walls are made of PVC laminated steel plates with plaster board backing or fibre cement boards with hand laid wall tiles. All vertical joints are made waterproof.
- Ceiling is made of PVC laminated steel plates or fibre cement boards with access opening.
- Wash basins are wall mounted with or without pedestal bases.
- Water closet can be of either the 'P' type or the 'S' type. All other fittings such as long baths, shower roses, towel racks, etc. can be included. Fitted with hot and cold water plumbing.
- All plumbing and electrical wiring are preformed and, when the Units arrive on site, all that is necessary is to roll them to their places and provide the simple connections.
- Developed PBU with technical consultancy from TOTO Ltd of Japan - a company internationally renowned for its sanitary fittings and unit baths.
- Enhance buildability, save cost (and time) and offer superior quality products, possibility to change the wall panels (tile/marble type) at any given future time.

Project Reference:

- HDB Hougang Contract N1 C11 (1995).
- TOTO Japan has produced & installed thousands of Unit Baths - as they are called in Japan- for over 30 years. Projects ranging from residential housings to star class hotels.

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER



Keppel Sea Scan Pte Ltd
31 Shipyard Road
Singapore 628130

Tel : (65) 2626100
Fax : (65) 2621231, (65) 2624403
E-mail : sscan123@seascan.com.sg



Product Features

- Used precast concrete flooring with steel wall panels.
- Good sound insulation using wall elements with air gap in between.
- Weighing about 1.5 to 2.0 tonnes, 2m(L) x 2m(B) x 2.4m(Ht).
- Lightweight construction and easy installation without compromising on sound proofing and solid feel of a private bathroom.
- Wall and floor could be delivered with completed marble, tiles, PVC or paint finishes. Only require to connect the services to the main building.
- Capable to complete 3000 to 4000 PBU units per year.
- PSB approved waterproofing materials to be used.
- Manufactured under controlled environment.
- Design to meet client's requirements.

Project Reference

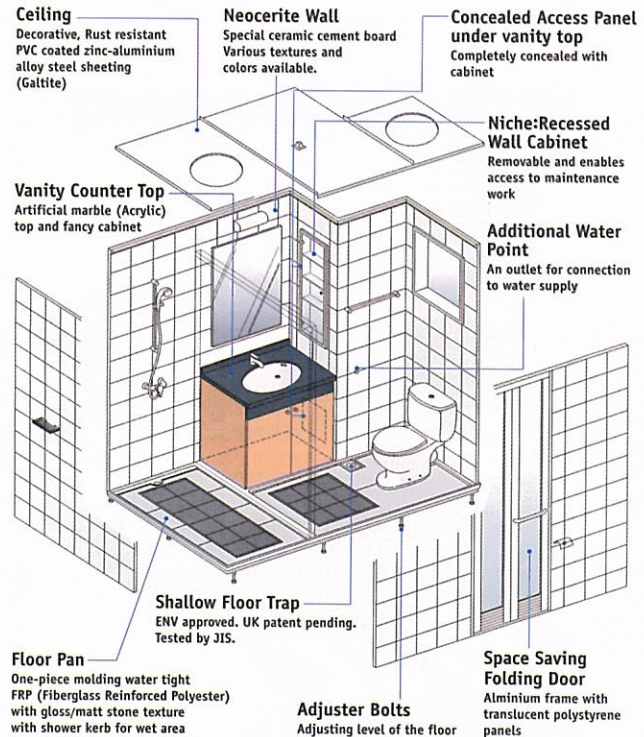
- Worked closed with Wartsila - Principals in Finland
- Hotels, offices and residential housing projects in Finland, Germany and Korea

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER

National Matsushita Electric Works (Asia Pacific) Pte Ltd

101 Thomson Road, #25-03/05
United Square, Singapore 307591

Tel : (65) 2555473
Fax: (65) 2535689



Product Features

- Weighing only 350kg.
- Used one-piece moulding watertight fiberglass reinforced polyester with gloss/matt stone texture.
- Neocerite wall panels finished with ceramic surface cement boards. Wide range of textures, colours and designs are available.
- Concealed access panel under vanity top.
- Ceiling made of zinc-aluminium alloy steel sheeting, coated with decorative PVC, for rust resistant.
- ENV approved type of shallow floor trap, UK patent obtained.
- 100% waterproof guarantees long life of property.
- Assembly chiefly by fastening bolts from inside therefore making dismantle and remodeling easy.
- Undertake complicated installation of toilet as a package.
- Guaranteed quality assurance of the product.
- Design to meet client's requirements.
- Various designs also available for selection.

Project Reference

- 1996 - 1st HDB public housing project at Hougang (1216 units).
- 1999 - 1st private condominium project in Singapore - Trellis Towers (686 units).
- Current 35% market share of PBUs in Japan, accumulated more than 3,000,000 units installed.

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER



Plus Link Industries Pte Ltd

40 Tuas West Road

Singapore 638389

Tel : (65) 2690708

Fax : (65) 2692808

E-mail : Pluslink@mbox5.singnet.com.sg



INTERIOR



EXTERIOR

Product Features

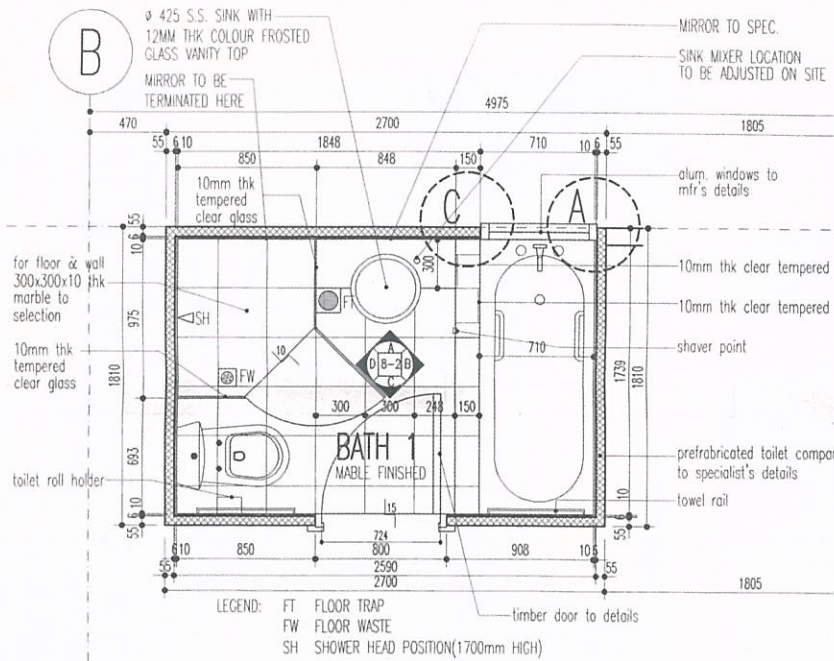
- To facilitate easy handling at site, PBU is of lightweight construction, using concrete as floor and steel cassettes as walls and ceiling panels. A typical unit weights approximately 2 tonnes.
- Installation on site is easy, fast and simple. Typically, a 4-man team, with the use of a crane, is able to install a single unit at the designated position in just 30 minutes.
- Concealed services and pipings.
- In-house design team capable of producing fast and flexible solutions to meet design and engineering requirements.
- Products manufactured and installed with total care and precision. QC team on each stage of manufacturing process.
- 10 years warranty on waterproofing.

PRECAST / PREFABRICATED BATHROOM UNIT SUPPLIER



Prefab Technology Pte Ltd
 66 Sungei Kadut Street 1
 Singapore 729367

Tel : (65) 3683233
 Fax : (65) 3658316



Product Features

- Used prefabricated waterproof reinforced concrete slab.
- Used sandwich wall system that completes with fully concealed piping, wiring and finished external walls, thus requiring only skim coating and painting on site.
- Other features include built-in sound buffers that eliminate the 'hollow' sound effect, and doing away with the need to erect a brick wall on site.
- Finished wall is thinner than conventional brickwall, thus increasing sable GFA.
- Used ceiling board with light fittings.
- Cast in door frame, window frame and glass panel.
- Manufacturing process thoroughly tested at stages. Achieved the requirement of ISO9000 standard.
- M&E maintenance works carried out within the unit rather than servicing from the neighbouring unit.
- Water tightness warranty from fabricator.
- Shop drawings to be provided by fabricator.
- Prefabrication reduces site coordination of many trades.

Project Reference

- 10 storey flat comprising 17 apartment units at 27 Ewe Boon Road.