Pre-assembled bathrooms and sanitary rooms
made of GRP: an international experience

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Pre-assembled bathrooms made of GRP are well-known as in Europe as well in America and Asia.

In spite of the fact that bathroom is one of the smallest rooms of a house, it is one of the most labour intensive elements for construction, asking for proper waterproofing and careful quality control. Benefits of pre-fabricated bathroom units are reviewed as:

- 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 in waterproofing works in the factory environment,
- maintenance can be carried out within the unit rather from neighbouring unit,
- high 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


Fig. 1. Pre-fabricated bathroom and its montage. Pictures from
The idea of prefabricated bathroom as it is cannot be named as a new one: US Patent No.2,220,482 for prefabricated bathroom, obtained in 1940, has been filed by its author R.B.Fuller in 1938. As it is published by Wikipedia, R.B. Fuller chose aluminium for its light weight, great strength, and long-term durability, arguably factors that compensate for the initial production cost. Aluminum was also a logical choice if the homes were to be built in aircraft factories, which, since World War II had ended, had substantial excess capacity (http://en.wikipedia.org/wiki/Dymaxion_house).

Whereas low weight concrete is a regular material for modern manufacturing of prefabricated bathroom units, application of GRP gives a substantial weight advantage: for example, bathroom unit 2.4 x 1.7 m precasted of concrete weighs 2500 kg (with accessories), whereas GRP-made option offered by the same supplier weight only 450 kg.

Besides of quicker and easier construction, GRP surfaces create substantial advantages for regular cleaning/service of sanitary rooms in health care facilities, hotels and collective housing (retirement homes, student housing, social housing, military housing, etc.).

In Europe, ALTOR INDUSTRIE www.alto-industrie.co.uk has to be mentioned as one of the most remarkable market players using GRP for prefabricated bathroooms manufacturing. ALTOR INDUSTRIE is leading designer, manufacturer and installer of ready-to-install bathrooms for more than 30 years, especially in France and UK. In addition to housing applications, industrial clients such as Alston (trains), Aker Yards (cruise ships) and Accor (hotels) have seen the interest of bathroom pods and have chosen ALTOR INDUSTRIE to develop the right solutions for them.

The ALTOR INDUSTRIE concept is the polyester bathroom pod that meets all current standards:

- Resin with F2 fire resistance classification
- Gel coat for hygiene and easy cleaning
- Non-slip flooring

Products portfolio offered by ALTOR INDUSTRIE consists of more than 15 trademarks-product lines, provided with detailed descriptions in well-prepared leaflets at the company web-site. Here is a breakdown of prefabricated bathroom features by function:

- single function (shower) Hydra
- dual function (shower / sink) Therma
- triple function (toilet, shower / bath, sink) Tradiline, Oxygen, Elyséane, Eloise, Marean, Ileana, Harmony, Oasis, Oceane, Floreana, Baleani, Hydrogen, Clérane, Sabléane.
- disabled access (toilet, WC, shower, sink) Desirade, Kalyne, Symphonie

Fig. 2. Pre-fabricated bathroom “Oasis” as an example of ALTOR INDUSTRIE products. Pictures from www.alto-industrie.co.uk/ml/images/content/PDF_produits/en/oasis-uk-bd.pdf
Fig. 3. Assembling of bathroom made of GRP components. Pictures from www.altor-industrie.co.uk/en/bathroom-pods-concept.php
Swedish company HKF Nordic has production capacity of 35 000 units annually and produces a part of its using GRP materials, including SMC-molded. A complete bathroom unit can be easily installed by 2 trained installers in 4 to 5 hours. HKF’s prefabricated bathrooms are tested by SGS (Switzerland), Intertek (UK) and certified by VTT, a world class certification institute and an internationally accredited testing laboratory in Finland. Its recent 2010 expansion of production in USA allows to service North and South American market more effective and timely. HKF Nordic is able to install 100 units in less than 30 days (UHU Helsinki Project, Finland). Besides of activity in Europe and USA, HKF Nordic offers its products through contacts in China and Russia.
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Fig. 5. Pre-fabricated GRP bathroom by HKF Nordic (Sweden). Pictures from www.hkfnordic.com
In USA, compression molding of SMC of VIKRELL trademark is used for manufacturing of pre-assembled GRP bathrooms, supplied as kits, by STERLING Plumbing Group www.sterlingplumbing.com, a part of KOHLER company. Compression molding is made at pressure from 1500 to 1800 tons at 350°F.

Fig.6. Pre-fabricated GRP elements made by KOHLER of compression-molded VIKRELL compound of SMC-type. Pictures from videos available at www.kohler.com/video/1/Sterling-Plumbing/
Fig. 6 (continued). Pre-fabricated GRP elements made by KOHLER of compression-molded VIKRELL compound of SMC-type: assembling. Pictures from videos available at www.kohler.com/video/1/Sterling-Plumbing/
Fig. 6 (continued). Pre-fabricated GRP elements made by KOHLER of compression-molded VIKRELL compound of SMC-type: assembling. Pictures from videos available at [www.kohler.com/video/1/Sterling-Plumbing/](http://www.kohler.com/video/1/Sterling-Plumbing/)
Fig. 6 (continued). Pre-fabricated GRP shower made by KOHLER of compression-molded VIKRELL compound of SMC-type. Picture from video available at www.kohler.com/video/1/Sterling-Plumbing/  

Not only floor, walls and ceiling are made of compression-molded VIKRELL SMC, but also some other parts of the shower/bathroom interior, like shelves and seats. Several designs of such additional GRP elements are protected by patent applications:

Fig. 7. Pre-fabricated GRP seated shower ACCORD from STELINGS’s catalogue www.sterlingplumbing.com/common/pdf/literature_request/SterlingCatalog.pdf (left) and corresponding picture from US patent application No.2011/0252561 (right)
The info presented by STERLING-KOHLER about VIKRELL material is featured by a detailed description of GRP repair procedure – “VIKRELL REPAIR” video guide to using STERLING Vikrell repair kits. Repair of different types of damages is described, and it looks as accurate and effective as repair of luxury boats used to be.

Fig. 8. Pictures from video guide “VIKRELL PRODUCT KNOWLEDGE / VIKRELL REPAIR”
www.kohler.com/video/1/Sterling-Plumbing/lvl1id?1/Vikrell-Product-Knowledge/

Amtech (USA) www.amtechcorp.com, being one of the largest composite and vacuum forming companies on the West Coast is a patent holder for its LAVTEC Solutions modular bathroom systems. LAVTEC Solutions modular systems are made “ceiling to floor” with seamless fiberglass that is impervious to water damage. Bathrooms are constructed by hand lay-up method using 18 oz woven roving and 1.5 oz chopped strand mat, polyester resin and have U.S. Coast Guard approval for Class 1 fire retardancy. Besides of standard dimensions, Amtech offers to customize the unit to meet individual requirements. Designs for parks or recreational area application are available, too.

Fig. 9. Lavtech® seamless constructions. Pictures from www.amtech.com

In Asia, the company COZY (China) http://en.chinacozy.com has to be mentioned which is the leading manufacturer of prefabricated bathroom units in China. Besides, COZY was recognized by the government as “national housing performance R&D base” and involved in drawing up the national standard of bathroom
unit. Cozy’s yearly production reaches more than 100 hundred thousand now. After construction of two new factories in Wuhu and Chongqing; Cozy will become the biggest prefab bathroom pods manufactory in the world with a yearly production of 500 hundred thousand sets after all built.

Cozy has established over 40 sales service offices, providing timely and considerate pre-service and after-service. Cozy unit bathroom has been applied in more than 20 countries and 150 internal cities. In April 2008, Cozy prefab bathrooms were installed in Linglong broadcasting center at Beijing Olympics, providing first class sanitary facilities for the successful operation of the center. Cozy estimates its market share as more than 50% (http://en.chinacozy.com/about.asp).

Floor, walls and ceiling of the bathroom are compression molded of SMC on 2,000 ton and 3,000 ton press machines. Bathroom units can be supplied in kit form or fully assembled. As kit form, it only take 2 workers 4 hours to complete a unit. In general, a typical COZY unit bathroom can be fully installed by 2 workers in 4 to 6 hours.

Fig.10. COZY (China) pre-fabricated GRP bathroom assembling. Picture from http://en.chinacozy.com

Fig.11. COZY (China) pre-fabricated GRP bathroom product examples. Pictures from http://en.chinacozy.com
Another Chinese producer of prefabricated bathrooms made with SMC-molded GRP elements is “YUANDA Science & Technology Development Company”, which supplies its in three series: Luxury, Comfort and Fashion.

![Image of prefabricated bathroom by YUANDA (China)](http://br2.mofcom.gov.cn/accessory/200910/1255697250205.pdf)

SMC is published to be used for prefabricated bathroom manufacturing by the company Framework Building Products Pte Ltd. (Singapore), but current web-site [www.framework.com.sg](http://www.framework.com.sg) does not give any info about.

![Image of pre-fabricated bathroom made of SMC offered by Framework Building Products Pte Ltd. (Singapore)](http://www.bca.gov.sg/Publications/BuildabilitySeries/others/stdcom_ch6.pdf)
Matushita Electric Works (Japan) was published to cover 35% of Japanese market of prefabricated bathrooms. The used one-piece polyester fiberglass molded design provides the weight 350 kg only, with experience of installation of > 3 000 000 units as in Japan as well abroad.

![Image](image1.jpg)


Such products could be met in Tokyo, for example, in economic but respectable hotel KAZUSAYA which is located in central part of Tokyo since 1891:

![Image](image2.jpg)

Fig.15. Pre-fabricated bathroom made of GRP installed in hotel KAZUSAYA, Tokyo, Japan. Picture from [www.booking.com/hotel/jp/kazusaya.en.html](http://www.booking.com/hotel/jp/kazusaya.en.html)

Another Asian companies which use SMC/BMC compression molding technology for manufacturing of prefabricated bathroom components, are GENSCO Co., Ltd. (Korea) [www.gensco.co.kr](http://www.gensco.co.kr) and J-LIVING Inc. [http://j-living.co.kr](http://j-living.co.kr). In spite of the fact that both mentioned WEB-sites are in Korean language only, an approach to the bathroom structure and design is illustrated by pictures:
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Fig. 16. Picture from www.gensco.co.kr, www.gobizkorea.com/blog/ProductView.do?blogId=shinhwab&id=795103

Fig. 17. Pictures from www.gensco.co.kr
Fig. 17 (continued). Picture from www.gensco.co.kr

Fig. 18. Pictures from www.gensco.co.kr

Fig. 19. Pictures from www.gensco.co.kr, http://j-living.co.kr
In Australia, prefabricated bathroom having “molded floor, walls and ceiling”, are produced by the company “PUB bathrooms” [website]. Depending on the size and the set, the unit weight is in between of 90 kg and 300 kg.

Fig. 20. Pre-fabricated bathroom offered by PUB Australia. Picture from [website].

Another Australian producer of both bathroom units and shower cubicals made of GRP is “Add-A Bathroom” [website]. Its parts are finished with gelcoat, including floor, walls and ceiling. Bathrooms are supplied as kits packed up to 6 ones to a pallet.

Fig. 21. Pre-fabricated bathroom by Add-A Bathroom (Australia): montage and packing example. Pictures from [website].
One of the most economical versions of pre-fabricated GRP shower cabins is offered in Colombia by Aqua Fibra Tank S.A. [www.aquafibratank.com](http://www.aquafibratank.com):


In Russia, pre-fabricated bathrooms are produced for cruise ships only, by “ARIS and GESER” company (Otradnoe town of Leningrad reg.) [www.aris-geser.ru](http://www.aris-geser.ru) - which does not use GRP, due to more rigid FR-standards applied in Russia for such application in comparison to rules valid in Europe and Asia: accordingly to Russian FR testing lab procedures, GRP parts are able to provide only “hardly-burnable” FR property, whereas the standards ask for “not-burnable” qualification. Of course, the products answering such a high FR demands will provide certification demands of DNV and Lloyds, too.

In the same time, there are companies in Russia which are using GRP for several elements of toilet blocks for passenger trains, like VOYAGE (Moscow) [http://npovoyage.ru/] and COMPOSITE-GRUPP (Moscow) [www.composite-group.ru], so in principle they are very closed to pre-fabricated sanitary blocks manufacturing similarly to examples presented in other world. Due to rather small manufacturing output, both companies are using mainly hand lay-up technology with flame-retardant UP-resins and gelcoats. Another point limiting implementation in Russia of higher output technology like SMC compression molding is that manufacturing of SMC compounds has been started in Russia just in 2011, so both the raw material and compression molding facilities are not so much available there yet; changes are expected by the 2nd half of 2012 – beginning of 2013.
Such products are looking to be similar to hybrid products composed by sandwich panel / composite / metal construction of railcar toilet blocks produced by Clagi – Coplass (Italy-Romania) http://clagi-coplass.com – a famous producer working for more than 30 years at European railcar market, which uses not only HLU, but also RTM, vacuum infusion and high-pressure molding technologies, with gelcoats / polyester resins as raw materials (mainly) and also with phenolic resins.
It is reasonable to suggest that high growth of civil and housing construction in countries with emerging economies will bring a growth of prefabricated GRP bathrooms as an effective tool of acceleration of the construction process, with simultaneous keeping of high quality level, and this growth will cover the countries where the market niche of prefabricated GRP bathrooms is not filled yet.

Fig.28. Passenger railcar toilet systems produced by CLAGI-COPLASS. Table from slide #14 of the company presentation [http://clagi-coplass.com/images/stories/docs/Clagi-Coplass_presentation_2010-08.pdf](http://clagi-coplass.com/images/stories/docs/Clagi-Coplass_presentation_2010-08.pdf)

Fig.29. Moving of prefabricated unit bathroom into position at construction of St Regis Hotel and Residences. Picture from “The Singapore Engineer”, February 2010, p.18 [www.ies.org.sg/publication/se/fcb10.pdf](http://www.ies.org.sg/publication/se/fcb10.pdf)