



FIBRE CRAFT INDUSTRIES
THE FIBRE GLASS PEOPLE

FIBREGLASS STORAGE TANKS



ISO 9001
BUREAU VERITAS
Certification





1) Introduction

FCI combines more than 30 years' engineering proficiency and chemical expertise to provide full turnkey solutions in the field of FRP/GRP tanks, pipes and other associated equipment's used in diverse industrial setups with cost efficiency and superior performance. A strong market position and a diverse technical base make Fibre Craft Industries well positioned to meet your needs.

FCI is the country's largest manufacturer of specially engineered corrosion resistant, fiberglass reinforced plastics and dual laminate products providing integrated solutions for the handling, storage and processing of critical fluids and gases for the chemical water & waste water, power generation and other process industries. Dual laminate construction consists either of thermoplastic liner or fluoro-polymer liner reinforced with FRP.

FCI is a specialist in design, manufacturing, installation and service solutions for the processing, storage and transport of highly critical corrosive fluids and gases. The items fabricated at our facility are constructed from high quality composite raw-materials sourced from some of the best globally acclaimed suppliers. All the

products delivered from our facility are covered with standard company warranty that provides the customer free of cost repair or replacement in case of any malfunction.

FCI feels pride on designing and manufacturing high quality composite products custom engineered for each individual need. Tanks are made to conform to the most recent industry standards and each system undergoes stringent testing before being dispatched to the client. FCI's technical support team comprising of specialists assists customers in early planning and design stages of the project.

Fibre Craft Industries aims to reach an optimum end-result with solutions that reduce operational costs for its customers. Composite structures provided by FCI come in wide variety of materials, sizes, shapes and forms depending on the process specifications and end requirements. The versatility of working with today's composites combined with FCI's expertise result in an extensive range of integrated solutions with practically endless capabilities of final product.



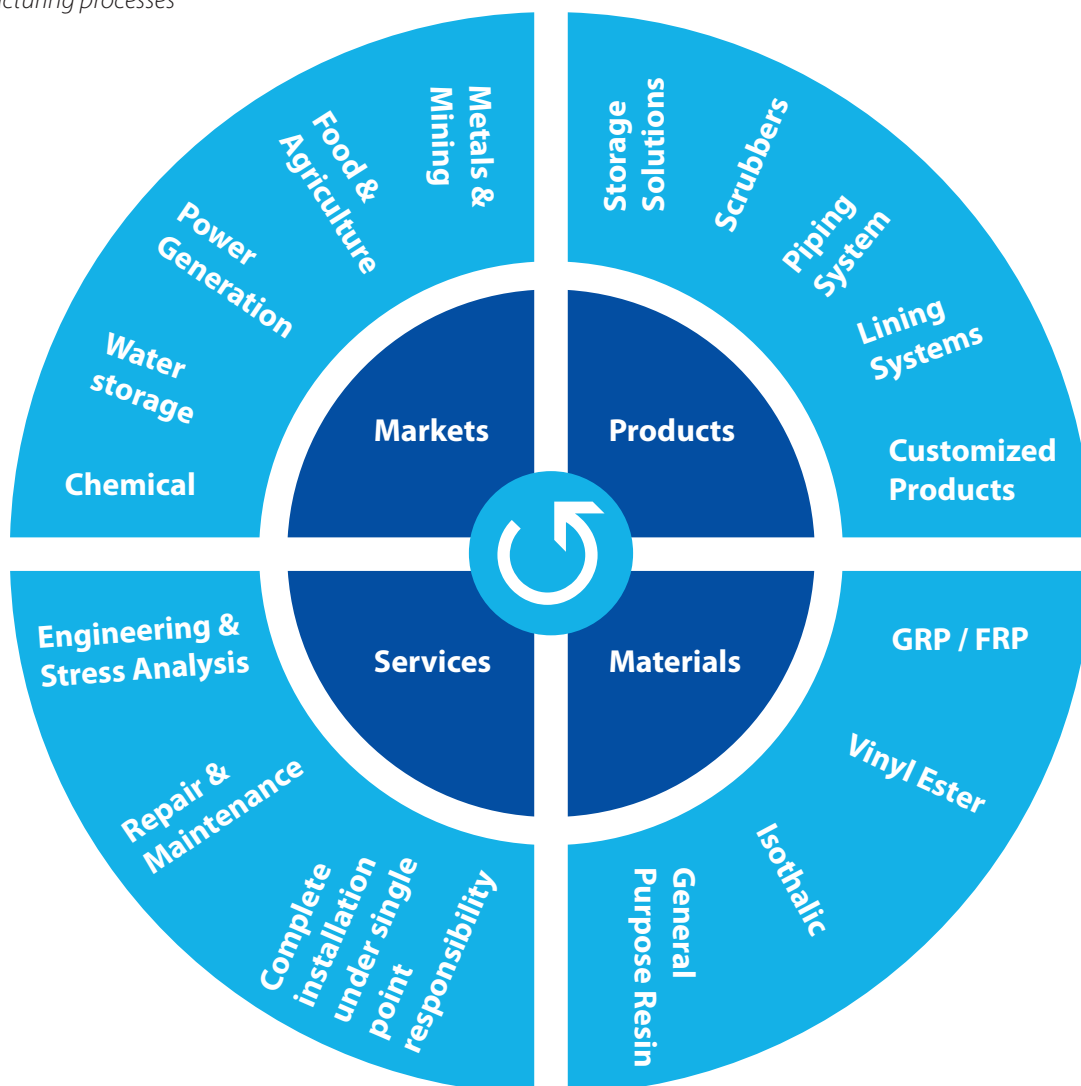
2) Markets we serve

Keeping in view the requirement of the industry we are providing a complete range of solution for various sectors with a wide variety of application, material and service. Our tanks are in service in more than 10 different sectors of the industry.

The tanks can withstand a range of chemical from simple water to the corrosive chemicals like acids and fuels. Typical fiberglass tank applications are;

- Chemical storage (sodium hypochlorite, HCl, NaOH etc.)
- Chemical processing and mixing
- Manufacturing processes

- Ultrapure water storage, demin water
- Wastewater treatment
- Potable water and fire-protection water storage
- Emergency water for health care facilities
- Food processing and storage (vinegar, mustard, etc.)
- Latex-paint storage
- Brine
- Agricultural product storage (olives, pickles, tomatoes, etc)



3) Advantages of FRP Tanks

A fiberglass tank, by virtue of its materials and design, is inherently the superior choice for safe, long-term storage and treatment of wastewater & chemicals for a wide range of applications. The best storage system is structurally strong, corrosion resistant, watertight, easily installed and cost-effective. All these elements come together in the design and manufacture of our Fiber Glass Tank.



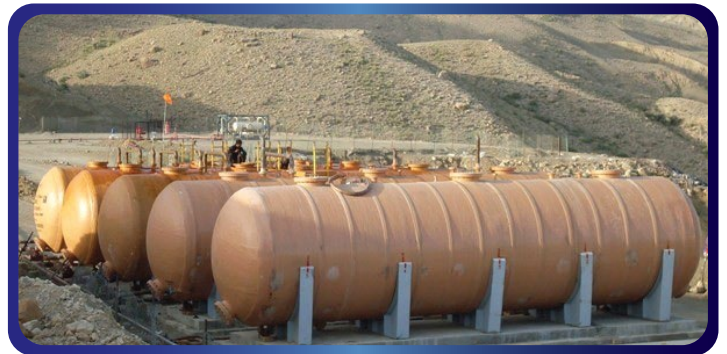
1. Corrosion Resistant

Corrosion is the deterioration of a material, usually a metal that results from a chemical or electrochemical reaction with its environment. Without implementation of appropriate corrosion-control measures, storage tanks will deteriorate. Most tanks are made of steel, a material highly susceptible to corrosion. Over time, uncontrolled corrosion can weaken or destroy components of the tank system, resulting in holes or possible structural failure, and release of stored products into the environment. FRP is resistant to more than 1000 chemicals and combination of chemicals from 5 °C to 150 °C. Unlike Steel or concrete, GRP does not require coating. The corrosion resistance is achieved by the choice of the resin and is enhanced by adding chemical resistant surface veil to the inner Liner in contact with chemicals.



2. Light weight

The tanks manufactured with steel and concrete impose many problems like corrosion, MIC, installation time and one of the problem is their weight. The tanks have large weights that make them difficult to transport and assemble and they are also prone to damage while transporting and assembling. FRP is the material of choice when it comes to light weightiness. The tanks are easier to transport and assemble and the cost required for transportation is highly reduced because of lesser weight.



3. Expansion & Contraction

Most of the material expand and contract when they are subjected to different weathering conditions. Fibre glass tanks doesn't contain such material and is free of any expansion & contraction. In what so ever environment it is; your tank will not change its dimension according to Weather.

Advantages of FRP Tanks



4. Maintenance free

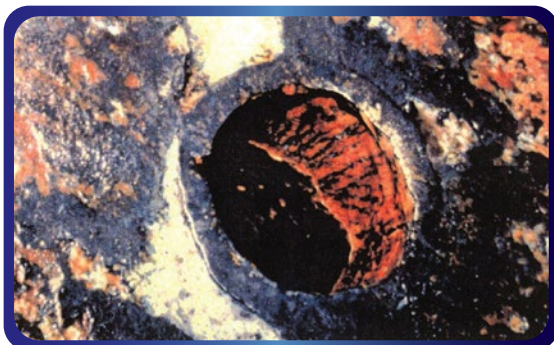
Tanks manufactured with concrete and steel need maintenance after regular interval of time, Because of their nature to corrode. You have to shut down the process for tank maintenance after sometime. With FRP tanks comes no maintenance, they are not prone to chemicals and hence are maintenance free.

5. Low thermal conductivity

Steel has high coefficient of thermal expansion which make it susceptible to extreme temperatures where it may lose its integrity. FRP offers low coefficient of thermal expansion which made it suitable for extreme temperature conditions.

6. Microbial Induced Corrosion

Microbiological organisms like algae and bacteria induce corrosion inside the rough surface of concrete tanks. They release oxygen which when come in contact with steel changes into ferrous oxide and cause corrosion of the steel infrastructure of the tank. Fibre glass tank's inner surface is smooth and prevent such microbial induced corrosion.



7. Easy Repair

Concrete & steel tanks are prone to cracks and leaking and are non-repairable. FRP tanks are very durable against cracks and leakage however if any cracks originate that can easily be patched using Fibre and resin.



8. Installation time

FRP tanks once fabricated can be delivered on a single truck that make assembly and installation very easy in comparison to concrete and steel tanks.

9. Quality

The quality of material being stored remain unchanged when in fibre glass tanks. The inner layer is rich in vinyl ester that is not prone to most of the chemicals being stored including diesel, fuel and acids.



4) Manufacturing Technologies

Filament winding:

The majority of FCI's aboveground tanks are filament wound. A typical filament-wound tank has at least four layers. First, the inner surface of the tank is 20 mils thick, with a 90 percent, resin-rich surface reinforced with either a glass or synthetic veil. The second layer is a resin-rich, random-oriented, chopped-strand glass layer no less than 80 mils thick. This layer has an approximately 65 percent resin content and 35 percent glass content. Together, these first two layers create a 100-mil corrosion barrier. The resin for this barrier is determined by the specific liquid being stored and that liquid's required temperature limits. The third layer involves the process of filament winding. Resin-impregnated, continuous strands of fiberglass are applied to a rotating mandrel. The filaments are applied at approximately 70 degrees to the tank's longitudinal axis. This filament-wound layer is approximately 70 percent glass and 30 percent resin. The final layer of each tank is either a 10mil, resin-based, pigmented or clear gel coat that protects the tank from ultraviolet-ray degradation.

In some applications, additional or adjusted layers are required to meet specific site or usage requirements. For instance, continuous filaments of resin-impregnated glass can be applied at a 90-degree angle to the tank's longitudinal axis (rather than the earlier described 70-degree angle). This provides hoop strength and allows tapering of the tank-wall thickness in discreet steps. When tanks need to be designed and manufactured to protect against wind and earthquake conditions, unidirectional layers, comprised of resin-impregnated glass fibers, are applied along the longitudinal axis of the tank to provide additional reinforcements against buckling due to seismic or other loads. A tank can also be insulated with foam and covered with a fiberglass jacket.



Contact Molding:

Contact molding / open molding is the most flexible method of fabrication of composite parts. Typically this process is used for non-standard parts for which the mold costs become high in case of automated processes or which are not feasible for fabrication using filament winding. This process utilizes a gel / top coat on the mold surface by spray or manual method which leaves a very durable and resin rich surface. On top coats of various layers of fiber and resin are applied until desired thickness is achieved. The air is removed by pressing the layers using rollers to achieve good strength.



Hot Press Molding:

This technique produce high strength, two finished surface, variable shape parts with excellent repeatability. Metal molds are mounted between the mechanical and hydraulic press. The material is placed between two heated halves of the mold and the mold closes under high pressure. This process provides us with our new line of tanks commonly called as Panel tanks or Sectional Fiberglass tanks because of their special and convenient installation procedures. Panel tanks are made up of standard panels bolted together to erect a tank of any desired dimension. It is their feature of user friendliness and overcoming limitations of size that Panel tanks have achieved immense popularity in domestic as well as industrial water storage. Furthermore, the tank also provides benefits regarding the short assembly times, cost effectiveness, safe storage for drinking water and most importantly aesthetic appeal to the building. Moreover, tanks with integral insulation can also be provided based on customer's demands.



Manufacturing Technologies



Field Fabricated tanks:

The tanks with larger capacities & principal dimensions are difficult to transport by conventional transportation means. The solution of this problem is the field fabrication of tanks. The tanks are made in sections in our in-house facility, transported and joined on field or Field fabricated tanks are offered which are fabricated entirely at the location of installation.

FCI's tanks are designed and manufactured to meet the following standards, as well as other customer requirements and specifications:

American Society of Mechanical Engineers

■ ASME RTP-1

American Society for Testing and Materials

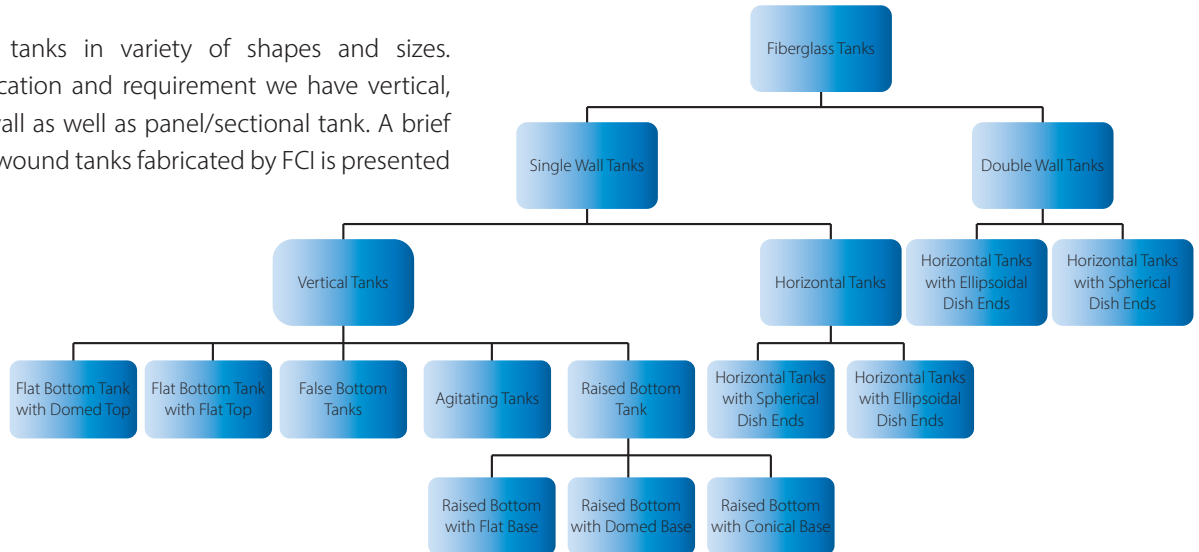
■ ASTM D3299

■ ASTM D 4097

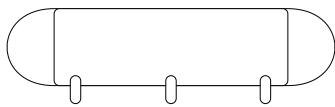


5) Types of FRP Tanks

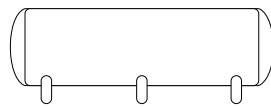
FCI fabricates FRP/GRP tanks in variety of shapes and sizes. Depending on the application and requirement we have vertical, horizontal, and double wall as well as panel/sectional tank. A brief classification of Filament wound tanks fabricated by FCI is presented as;



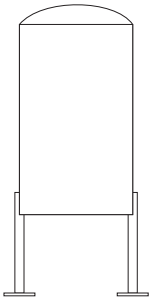
Models of FCI STORAGE TANKS



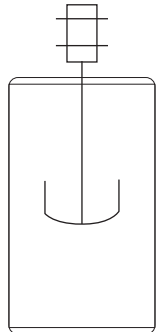
Horizontal Tank with Spherical Dish end and saddle support



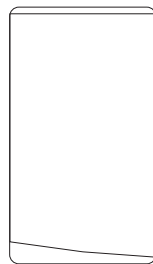
Horizontal Tank with Ellipsoidal Dish end and saddle support



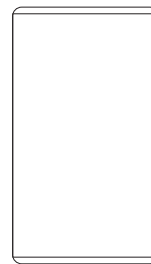
Raised Bottom Tank with flat Base



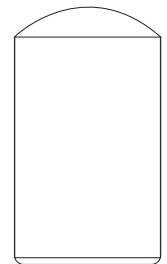
Agitation Tank



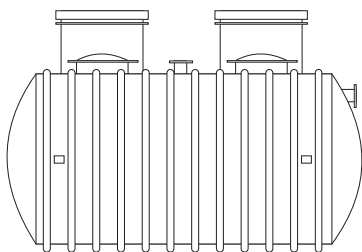
Vertical Tank with False Bottom



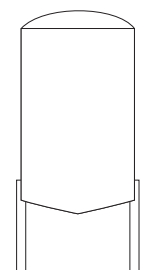
Vertical Tank with Flat bottom & Flat Top



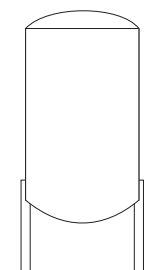
Vertical Tank with Dome Top



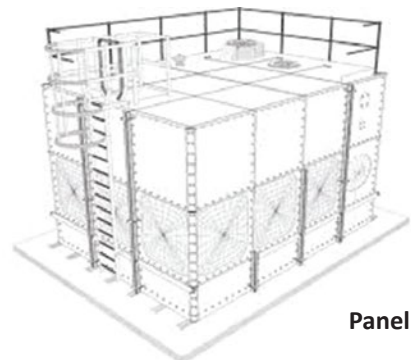
Double Wall Tank



Raised Bottom Tank with Conical Base

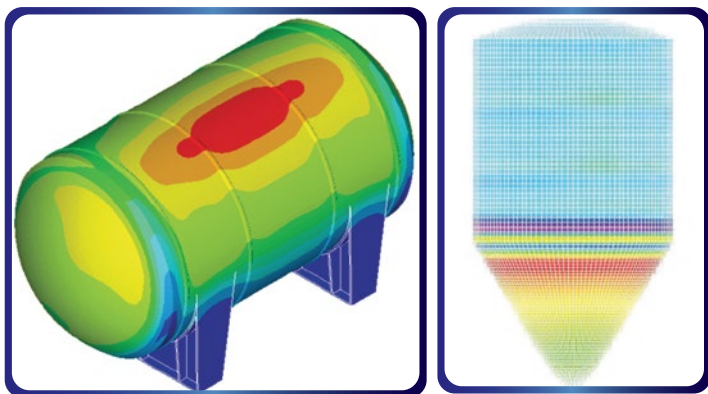


Raised Bottom Tank with round Base



Panel Tank

6) TECHNOLOGY TO FIT THE CHANGING NEEDS OF MARKET PLACE



FCI's aboveground tanks are designed to meet load conditions specified by customers, which can include building codes such as the Uniform Building Code, the International Building Code and local codes. The analysis performed for these prescribed loads is based on finite-element models, as generated for specific tank and vessel geometries and operating conditions. The computer-generated, finite-element models provide a realistic and accurate analysis of the vessels and tanks, thus allowing for

optimum design of the various tank elements – such as wall thickness, material selection and anchoring systems.

Through the use of different glass fabrics and glass roving, each tank or vessel laminates are optimized to satisfy not only the building codes, but also various fiberglass specifications, such as those prescribed by ASME RTP-1 and ASTM (American Society for Testing and Materials). FCI tanks are manufactured to comply ASTM D 3299, ASTM D 4097 as well as RTP-1 criteria as per client's requirement.

Custom Fabrications

While FCI offers a full line of standard tank and pipe sizes, it also is able to fabricate a wide range of engineered fiberglass structural products to meet specific customer requirements. Examples of this custom fabrication are contact-molded tanks, piping, ductwork, free-standing exhaust stacks, air stripping towers, scrubbers, precision-built transportation cases, wastewater holding tanks, food-processing tanks and brine makers etc.

7) Features of our Tanks

Diameter	We offer Diameters up to 4000mm. For Tanks larger than 4000mm Dia, we offer field fabricated tanks.
Thickness	Thickness is customized and selected based on design requirement.
Capacity	The capacity can be up to 40,000 US Gallons in House. The tanks with larger capacity will be field fabricated.
Chemicals	Our tanks can handle chemicals from water to acids and fuels without causing corrosion.
Allied Accessories	We provide complete set of accessories with tanks that includes level gauges, access ladders, platforms, safety railings & anchoring lugs.





8) FCI PANEL TANKS

FRP Panel tanks are extensively used worldwide as an alternate to traditional water tanks. Fibre Craft Industries has introduced FRP Panel tanks for the first time in Pakistan. The main advantages of Panel tanks include ease of installation and transportation, for future extensions it is convenient to add further panels to increase the overall storage capacity of the tank. Moreover, panel tanks can be opened as many times as desired to shift from one place to another. The tanks are manufactured by hot press molding in a standard 1 x 1 m panels. The general specifications of Panel Tank are given below:

Standard: FCI GRP/FRP Sectional Water Tank complied to Singapore Standard SS 245 : 1995 and BS 7491 Part3 : 1994

Materials:

- *Resin: Iso-phthalic unsaturated polyester resin with technical requirement as in BS 3532 Specification.*
- *Reinforcement: Reinforcement of a sandwich like construction consisting of a non-woven synthetic core with large diameter fiber, with fiberglass on other side and mechanically stitch bonded.*
- *Woven Roving used is in accordance to woven roving fabrics of E-glass fiber for the reinforcement of polyester resin systems BS3749 specification*

Manufacturing Process:

1. Resin Transfer Moulding(RTM) Hot Closed Mould Injection

(Manufacturing FRP products under certification ISO 9001;2015)

2. Hot Press Moulded (SMC)

Support for Panels:

1. External reinforcement-Hot Dipped Galvanized Steel
2. Internal reinforcement-Stainless Steel Grade 304 tie - rod or tie - bar

Sealing Materials: Non-toxic Rubber Foam to be used for all jointing between tank panel flanges.

Bolts, Nuts and Washers:

1. Internal-Stainless Steel 304
2. External-Hot dip galvanized steel

Tank Cover: Cover panel support by FRP/GRP pipes complete with one 600 mm diameter manhole for each compartment.

Ladder:

1. External Ladder-Pultruded FRP straight ladder with aluminum rungs.
2. Internal Ladder- Pultruded FRP/GRP ladder with corrosion resistant fiberglass rungs

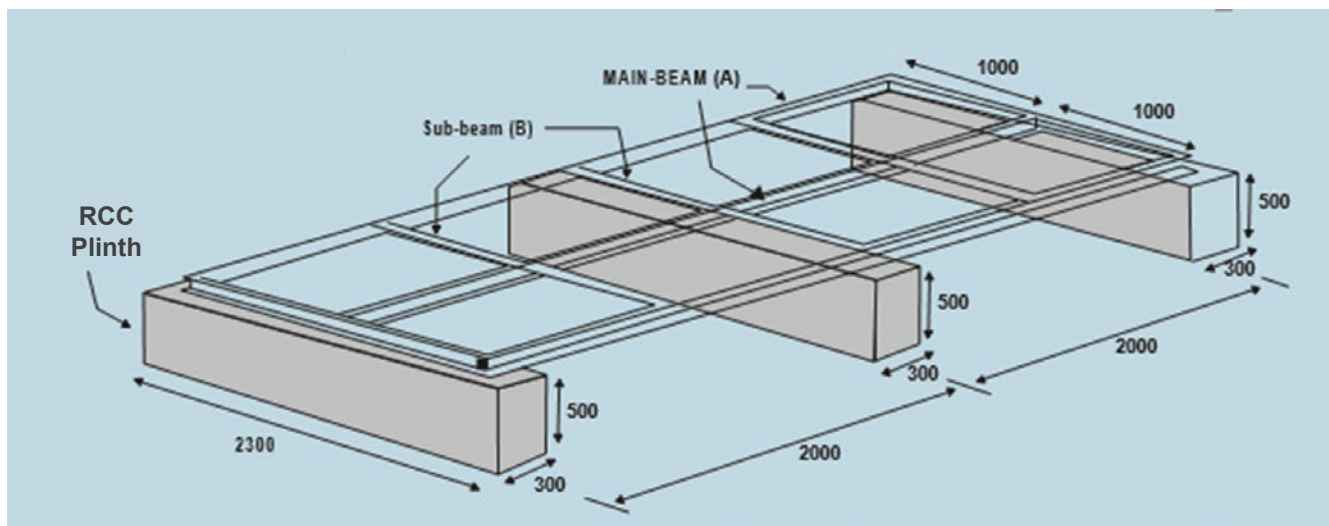
Water Level Indicator: Transparent tube complete with level marking and fiber/steel casing. or ultrasonic level gauge, as desired by the client.



FCI PANEL TANKS



Tank Height	Main Beam "A"	Sub Beam "B"	R CC Plinth C/C
1.0m	C-Channel - 125 x 65 x 6mm	Angle - 65 x 65 x 6mm	2.0m C/C
1.5m	C-Channel - 125 x 65 x 6mm	Angle - 65 x 65 x 6mm	2.0m C/C
2.0m	C-Channel - 150 x 75 x 6mm	Angle - 75 x 75 x 6mm	2.0m C/C
2.5m	C-Channel - 150 x 75 x 6mm	Angle - 75 x 75 x 6mm	2.0m C/C
3.0m	1-Beam - 150 x 100 x 13.39kg/m	Angle - 75 x 75 x 9mm	2.0m C/C
3.5m	1-Beam - 150 x 100 x 17.86kg/m	Angle - 75 x 75 x 9mm	2.0m C/C
4.0m	1-Beam - 203 x 133 x 26.79kg/m	Angle - 75 x 75 x 9mm	2.0m C/C



8) FCI PANEL TANKS

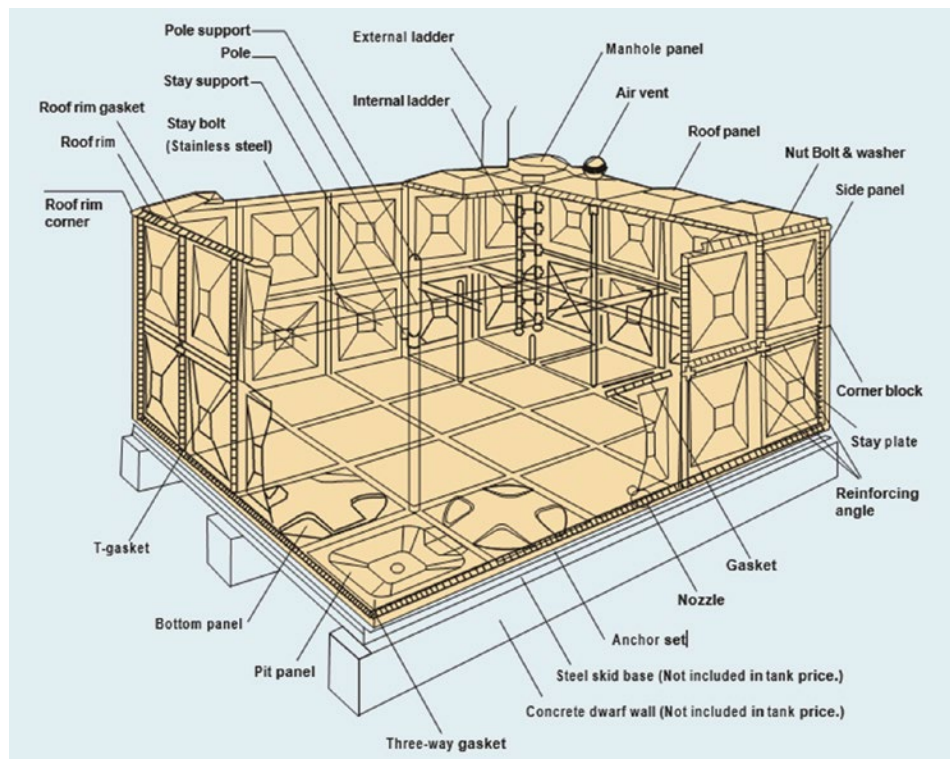
FCI's FRP PANEL MATERIAL CHARACTERISTIC

- Specific gravity: 1.8
- Glass content: more than 40%
- Tensile strength: 1,020kgf/cm (9.996KN/cm)
- Young's modulus: 1.40×10 kgf/cm (13.7Gpa)
- Flexural strength: 1,650 kgf/cm (16.17 KN/cm)
- Impact strength: 52.5 kgf/cm (0.515KN/cm)
- Compressive strength: 3010 kgf/cm (29.50 KN/cm)
- Shear strength: 960kgf/cm (9.41KN/cm)
- Thermal expansion: $2.16 \times 10^{-5} / ^\circ\text{C}$
- Thermal conductivity: 0.15 Kcal/m hr (630 J/ m hr C)
- Coefficient of overall heat transmission: 5.0 Kcal/m hr (21 KJ/m hr C)
- Water absorption: Less than 0.2%
- Light transmittance: 0.00%

DOUBLE WALL TANKS



- Apart from FRP Single Wall Storage Tanks and Panel Tanks, FCI also fabricates double-wall fiberglass reinforced plastic tanks as per UL guidelines.
- These tanks are designed for high-end fuel storage applications as the conventional FRP Tanks can't handle such underground pressures and chemicals.
- Moreover, these are provided with best quality leakage detecting sensors for safety purpose.





9) Typical accessories for FRP tanks

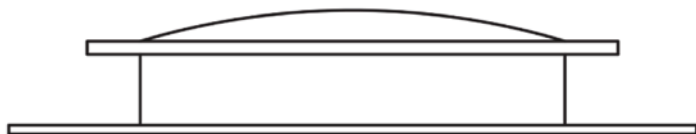
FCI designs and manufactures a complete line of accessories and fittings to equip tanks for a variety of applications and to meet the building codes in any geographical area. Mounting brackets and other structural accommodations can be factory-fitted to facilitate field installation of special accessories, such as a variety of float-gauge systems, internal piping or electronic sensors.

All tanks must have a vent, and manways are required for horizontal and closed-top vertical tanks to allow internal bonding of dome ends and tops. Unless otherwise specified, a FCI tank carries a label showing date of manufacture, capacity, resin system, inner-liner data, temperature limits and serial number.

Customer-specified items, such as logos, may generally be added to tank exteriors. See illustration below for placement of frequently ordered accessories.

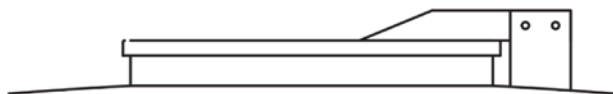
Manways

Standard side and top manways are available in both 20-inch and 24-inch diameters. Larger diameter manways are also available. Manways are designed to meet all requirements of ASTM D 3299, ASTM D 4097 or ASME RTP-1. Cadmium-plated bolts, nuts and washers, and flat faced neoprene gaskets are standard on manways. Stainless steel hardware is available for an additional charge. Manways are required for horizontal and closed-top vertical tanks to allow internal bonding of dome ends and tops.



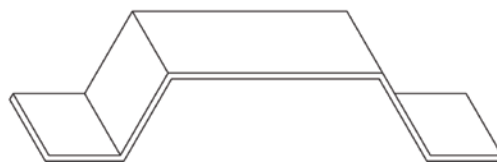
Hinged Manways

Hinged manways offer quick and easy access to tank interiors through the tank top. The hinged manway does not offer an airtight or watertight seal. However, when seated and locked down, this manway prevents rainwater and contaminants from entering the tank.



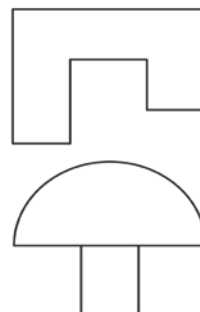
Mounting Brackets

The mounting brackets provide the necessary restraint for both internal and external accessories, such as piping and instrumentation. Unless otherwise specified, they are fiberglass. Valves, controllers or other heavy items connected to tank nozzles should be independently supported.



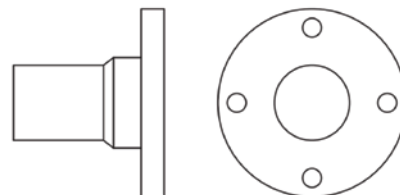
Vents (Gooseneck and Mushroom)

All tanks must be vented to prevent serious damage from the excess pressure or excess vacuum that typically occurs during loading or offloading of liquids. FCI offers two standard vent styles – the common gooseneck vent and the mushroom vent. Both vent types are equipped with bird screens. Minimum vent size should exceed the size of the largest inlet or outlet nozzle.



Flanged Nozzles

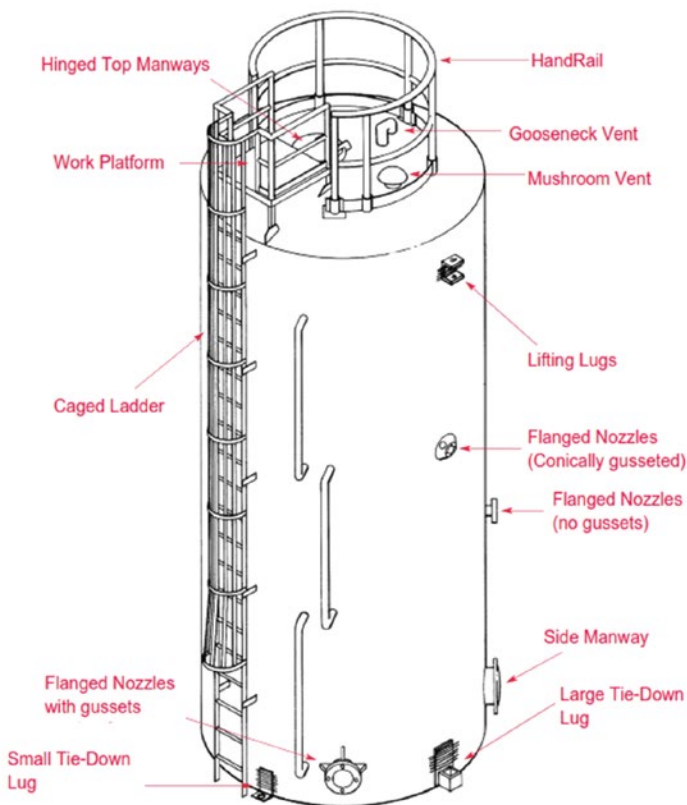
FCI supplies both hand-lay-up and filament-wound flanges. Flanged nozzles are available in 1-inch through 42-inch internal diameters. When required, nozzles can be strengthened by either plate or conical gussets. All FCI flanges meet ASTM D 3299, ASTM D 4097 or ASME RTP-1 standards, as specified. Flange dimensions and bolting correspond to ANSI B16.5. Mating flanges must be flat-faced using a full-face gasket. FCI can also manufacture custom flanges.



Typical accessories for FRP tanks

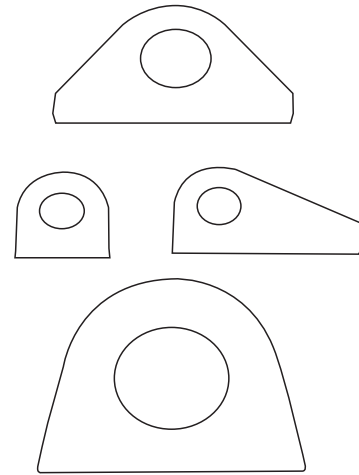
Ladders

For access to tank tops, ladders are available in fiberglass, aluminum or carbon steel. All ladders are factory-fitted to the tank but disassembled for shipment and subsequent field installation by others. Ladders that are 10-feet high and higher must be ordered with safety cages. Safety cages can also be ordered for shorter ladders. (See page below for ladder illustration.)



Lifting lugs

Unless otherwise specified, all tanks are equipped with two opposing galvanized steel lifting lugs. Fiberglass lifting lugs are available for certain sizes of tanks. Some tie-down lugs can be used as lifting lugs when unloading the tank. However, the client must consult with FCI's team before unloading.

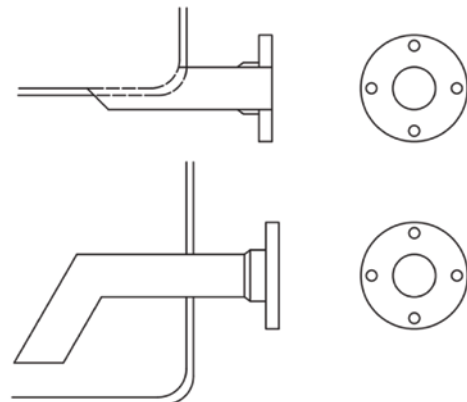


Tie-down lugs

FCI offers various different designs of galvanized steel tie-down lugs. These lugs are incorporated into the design for each vessel to fit the vessel's specific requirements, whether it be for seismic, non-seismic and/or wind-load conditions. These lugs are usually filament-wound onto the outside of the completed tank wall. Lugs are also available in fiberglass and special metals.

Drains

FCI supplies several different styles of drain fittings. The two most popular styles are the siphon drain (which is installed in the sidewall of the vessel and has internal piping that terminates close to the inside bottom of the tank) and the full drain (which is installed with the centerline level with the tank bottom). Full drain nozzles are equipped with three plate gussets and require a notch in the foundation. Other drain styles include the side bottom drain, side shell drain, bottom drain and bottom elbow drain.

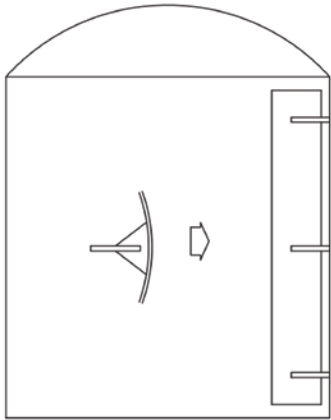




Typical accessories for FRP tanks

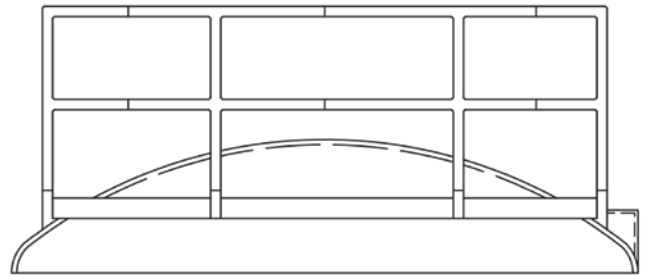
Baffles

Fiberglass baffle assemblies can be installed inside the tank to promote mixing. Baffles are available in both custom designs and a standard standoff baffle configuration, with standard widths of 1/12 the tank diameter.



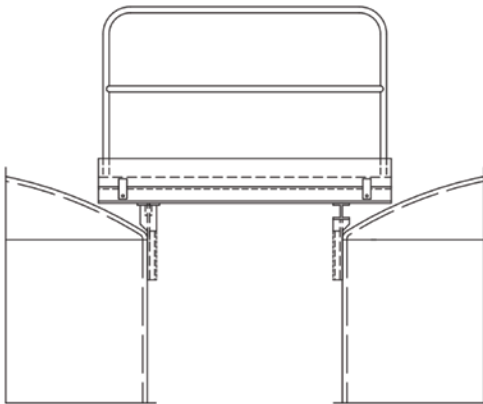
Handrails

Handrails are available in fiberglass, aluminum or carbon steel. They are shop-fit to the tank but disassembled for shipment and field installation by others.



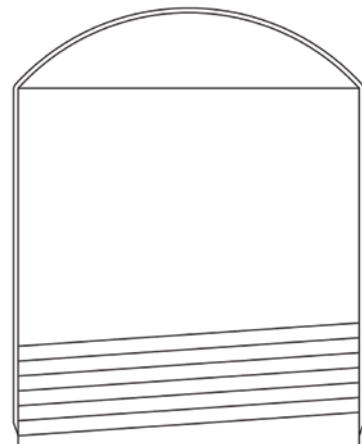
Work platforms and catwalks

Work platforms and catwalks that connect two or more tanks provide access to tank tops (and meet current OSHA specifications). They are available in fiberglass, aluminum or carbon steel. These accessories are shop-fit to the tank but disassembled for shipment and subsequent field installation by others.



Heating and insulation

Self-regulating heater cable, designed for each application, is attached to the tank with aluminum tape. The heating cable distributes the heat to hold liquids to desired temperature minimums. Along with the heating unit, insulation conserves energy and provides temperature stability. Heating tape is applied to the tank's external wall (typically on the lower quarter). Agitators or some type of liquid recirculation may be required to achieve temperature requirements, depending on the application and environment.

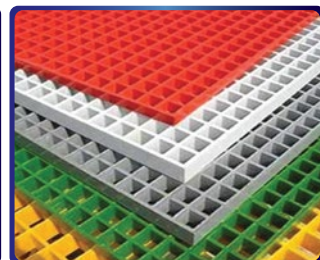
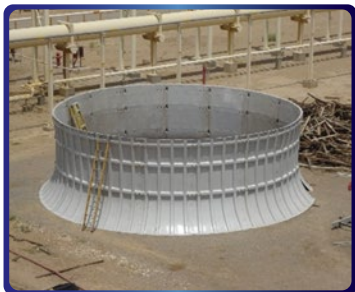


10) Other FRP/GRP Solution for Industries

We have a complete range of FRP/GRP products for your industry.

1. Cooling Tower & Accessories

Industrial processes and machines generate such large amounts of heat that continuous dissipation is necessary for efficient operation. The heat must be exited to the environment. This involve heat exchanging process. This exchange of heat is done with a cooling tower. We at FCI provide a complete solution of Cooling Tower with all the accessories. The accessories involve PVC fills, drift eliminators, fan blades, fan stack etc.



2. GRP/FRP Pipe

The process streams in the industry need continuous motion from one unit operation to another, taking into account the nature of the process fluids steel pipes are not suitable for most of the fluids as they cause corrosion. GRP / FRP pipes are the best choice as they are corrosion resistant and temperature resistant also.



3. GRP/FRP Molded & Pultruded Grating

FRP / GRP gratings are chemical resistant and can be used to cover the drains of process fluids and used as passage ways for transportation of chemicals.

4. Chemical resistant GRP/FRP Pumps

Corrosive chemicals are continuously transported from one equipment to another in an industry. The pumps made with conventional material are prone to corrosion and many other problems. Our GRP/FRP pumps are best suited for such corrosive chemicals in industry.



5. Fume Gas Scrubbers

In most cases, chemicals stored in polyethylene tanks require venting. In some instances, the harmful fumes emitted from the chemicals cannot be directly released to the atmosphere. In order to reduce the harmful fumes before they evacuate the system and to control air pollution, fume scrubbers are installed. We at FCI make FRP/GRP Fume Gas Scrubber that are light weight, corrosion resistant and more durable as compared to conventional material.

6. Chemical resistant coatings

We provide GRP / FRP chemical resistant coatings for tanks and floors. The floors are prone to chemicals and they get highly damaged because of spilled chemicals our epoxy coatings are the best choice for flooring.



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