

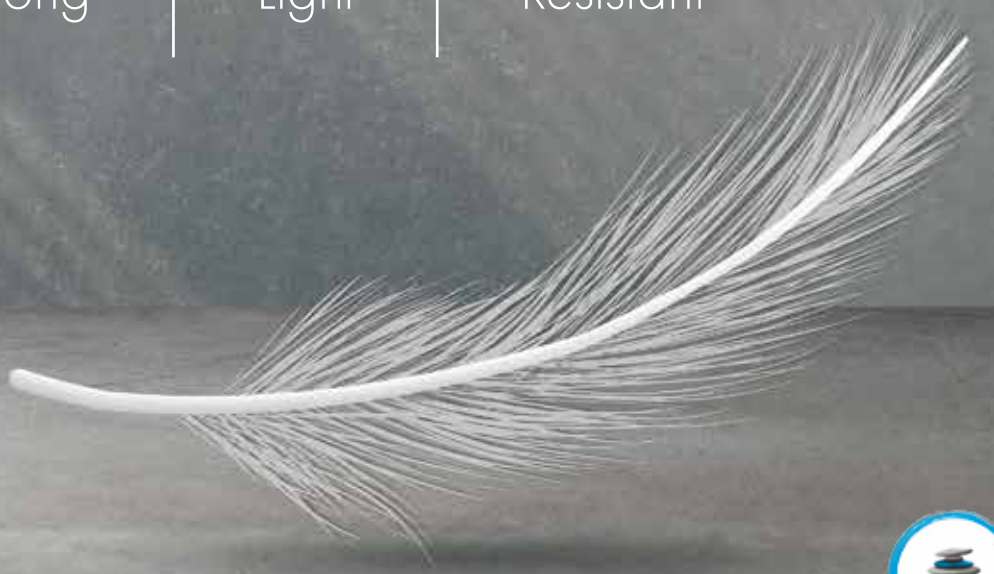
PULTRA

COMPOSITE

Strong

Light

Resistant



LIGHT
STRONG
RESISTANT

REVOLUTION

IN CONCRETE CONSTRUCTION





Who is Forta?

Forta Innovative Construction is a 100% Turkish capital enterprise with its expert engineer staff and has been established to provide innovative construction solutions to the Turkish construction sector in addition to export its knowledge about construction sector and products to the whole World.

Beyond supplying products, Forta Innovative Construction has become a solution partner of all the companies it serves in all areas so far with project consultancy and turnkey project services.

As a solution, since 1978, for primary concrete reinforcing technology, FORTA introduced **Forta-Ferro macro fiber reinforcement** technology which has been used as a concrete reinforcing primary reinforcement and made it irreplaceable product of industrial constructions and tunnels - has expanded its product range with **Mighty Mono micro fiber reinforcement** as secondary reinforcement.

Additionally, stainless **GFRP (Glass Fiber Reinforced Polymer) bar reinforcement** which has three times higher tensile strength than steel reinforcement and Polarbeton for light weight fills and insulation concrete are also other innovative products in concrete group.

For the asphalt group, which is one of the areas of expertise that Forta leads, all products that the sector needs are available in Forta and the success in the concrete group continues in asphalt section as well. Forta-Fi asphalt reinforcement,

which allows to build 2 times longer life roads with thinner asphalt thickness, has revolutionized road construction. Forta has become an irreplaceable solution partner for asphalt contractors with Warmax, which provides asphalt application in cold weather, Tarmax which avoids surface peeling and Fixalt, which provides fast and effective repair of holes formed on the asphalt surface. It also available to offer total solutions to asphalt technology with SBS and other similar asphalt products under the name of FORTA.

In Soil group, with the brand Geofor for geosynthetics products, alternative solutions are provided for strengthening/insulation of concrete and asphalt structures.

Forta Innovative Construction continues developing itself and contributing construction technologies industry with participation as executive members in ITA (International Tunneling Association), ACI (American Concrete Institute) and Turkish Tunneling Association with the technical knowledge we have brought from our experiences through years.

With the sensitive care on developing technical background and capacity of production in line with the needs of construction industry, FORTA continues contributing research and development for Turkish construction industry in every field of work with the newest production line, which has been recently established with the most advanced technology.

What is Composite (FRP) Material?

Basically, FRP material consists of thermosetting resins and fiberglass. The combination of resin and glass fibers, makes the main ingredient of FRP products. The resin brings the environmental and chemical resistance to the product and is the binder for the glass fiber in the structural base. Based on the chemical and environmental circumstances (given by the customer or user), a resin type is selected.

Each type of base has its specific function, therefore for each element, a different type of resin could be

selected for making a product. In general, FORTA works with three types of resin (polyester, vinyl ester or epoxy). Furthermore, we have different types of glass to be selected, based again: on the application and processes the final product will be used for. With regard to composing these ingredients and choosing the right resins, best reinforcing techniques and glass fiber components in order to guarantee the quality and the benefits of the materials, selecting the right manufacturer is highly important.

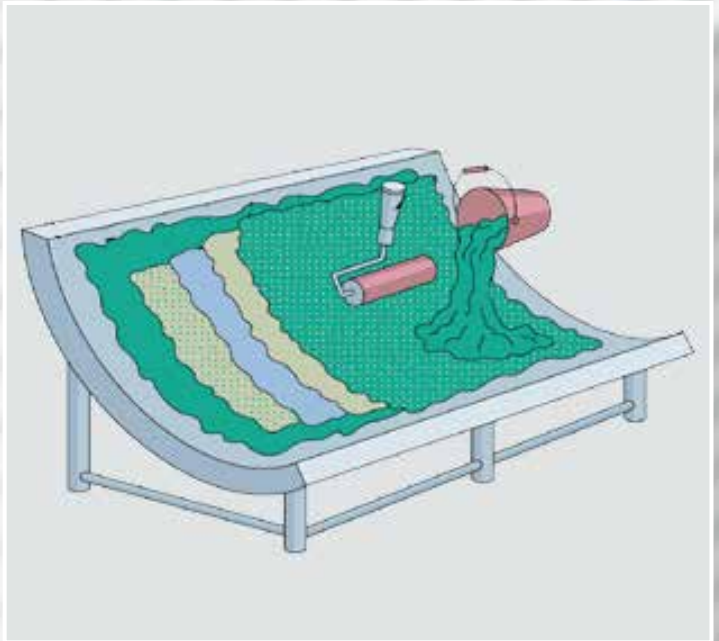
How is it Manufactured?



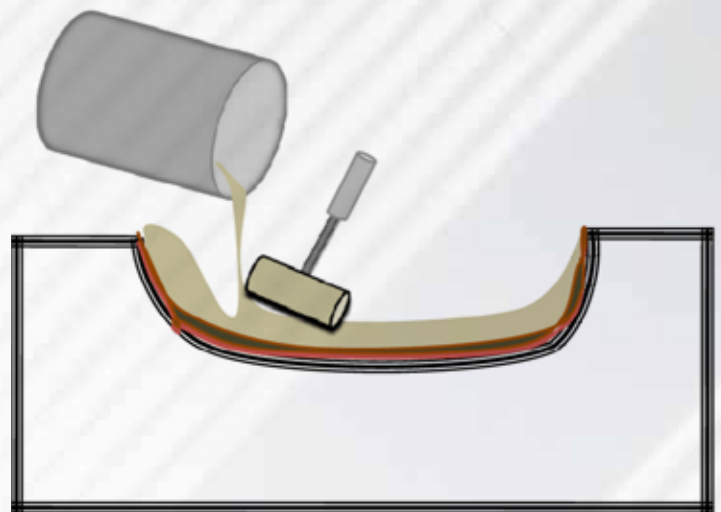
The end properties of a composite part produced from different materials is a function of the individual properties of raw materials, the way in which the raw materials themselves are designed into the part and the way in which they are processed. It is compared briefly between two commonly used composite production methods for FRP sections.

Pultrusion method is the most widely used production method of FRP structural sections.

Fibers are pulled from a creel through a resin (generally epoxy, polyester, vinylester and phenolic) bath and then on through a heated die. The die completes the impregnation of the fibre, controls the resin content and cures the material into its final shape as it passes through the die. This cured profile is then automatically cut to length. Fabrics may be introduced into the die to provide fibre direction other than at 0°. Although pultrusion is a continuous process, producing a profile of constant cross-section, a variant known as 'pulforming' allows some variation to be introduced into the cross-section. The process pulls the materials through the die for impregnation, and then clamps them in a mould for curing. This makes the process non-continuous, but accommodating of small changes in cross-section. This can be a very fast, and therefore economic, way of impregnating and curing materials. Resin content is accurately controlled. Structural properties of elements and sections can be very good since the profiles have very straight fibres and high fibre volume fraction is obtained. Resin impregnation area can be enclosed thus limiting volatile emissions. However, the method is limited to constant or near constant cross-section components. Heated die costs can be high. Putrusion typical applications are beams and girders used in roof structures, bridges, ladders, frameworks.



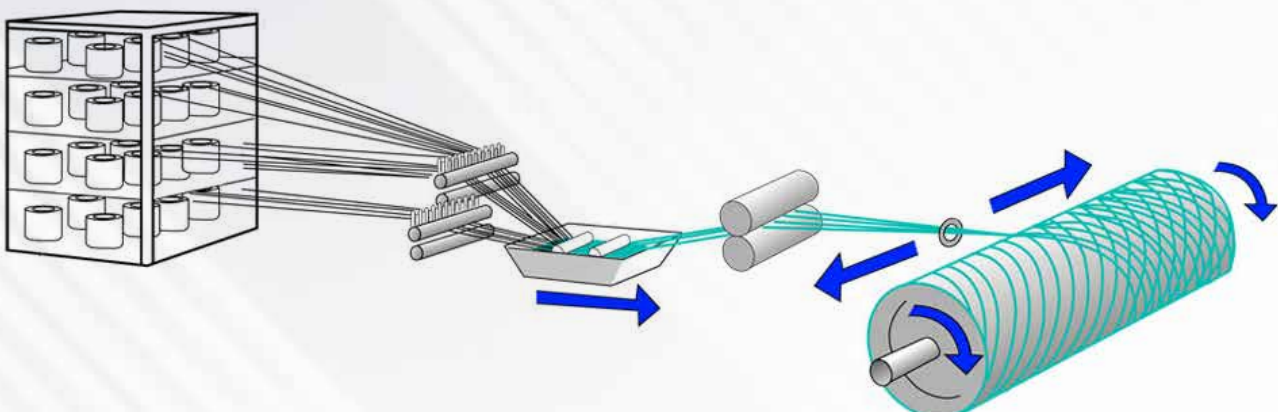
In the Wet Lay-up (Hand Lay-up) method, the resins are impregnated by hand into fibres that are in the form of woven, knitted, stitched, bonded or random fabrics. This is usually accomplished by rollers or brushes, with an increasing use of nip-roller type impregnators for forcing resin into the fabrics by means of rotating rollers and a bath of resin. Laminates are left to cure under standard atmospheric conditions. It has been widely used for many years since it may accommodate any type of resins (i.e. epoxy, polyester, vinyl ester, phenolic), with any type of fibres. It is a simple principles to teach, low cost tooling, higher fibre volume fraction may be achieved. However, resin mixing, laminate resin contents, and laminate quality are very dependent on the skills of workmanship. Low resin content laminates is not usually achieved without the incorporation of excessive quantities of voids. Resin needs to be low in viscosity to be workable by hand. It is quite important to demonstrate that manually moulded sections is handled in a satisfactory manner in terms of cutting, drilling and assembling of structural elements.



The manufacturing of plates could be summarized in 4 steps. Preparation of the Mould: A wooden mould was used for manufacturing the FRP plates with the required dimensions. Waxing and Colouring: In order to avoid that the polyester adhesive may stick to the mould used, protective marine wax was applied on the wooden mould. Thus, it will be easier to dismantle the moulded FRP plate out of the mould after hardening. Then, a gel coat was sprayed on the mould to give the moulded section the required colour. FRP plate made using bi-directional GFRP was cyan colour while the FRP plate made with random (mat) was grey colour. FRP Hand Lay-up: The FRP wrap layers were cut to size and were arranged in the mould. Liquid Catalyst was added to the polyester resin with the recommended manufacturer mixing ratio. The resin was applied using a manual brush and a roller to minimize internal air voids. Then, the next layer of FRP and resin was applied until the required number of layers was reached. Light GFRP wraps were added as the first and last layers for each plate. They were not counted in the required number of layers. A second wooden board was used on top so that the FRP plate was compressed to the required thickness using rocks (instead of a hydraulic jack) as a heavy load to minimize the void ratio. The section was left to cure for 24 hours. Cleaning the Edges: After hardening and curing of the FRP plate, the rocks were removed. The edges were cut clean by removing the excess fibres and resin that came off the mould. The FRP plate dimensions were cut to the exact required dimensions



Filament Winding is a method of reinforcing material fibers (glass fiber, carbon, etc.) used in the production of parts such as pipes and tanks combined with a suitable resin matrix and wrapped angularly around the axis rotating at a certain speed by a moving mechanism. The polymerization reaction takes place over time under atmospheric conditions. High-pressure resistant products are available. Produced pipes are suitable to be combined with lamination process.



What is Pultra?



PULTRA is Glass Fiber Reinforced Polymer (GFRP) Rebar Reinforcement. PULTRA is being used for structural reinforcing for long term and short term needs of the project. Corrosion problem of conventional steel reinforcement will no more be problem by using PULTRA. Besides, PULTRA will provide 2-3 times higher tensile strength with easier labour and lighter reinforcement than steel.

Technical Advantages

- Non-corrosive
- Higher Tensile Strength
- Longer lifetime
- Lower weight
- Non-conductive (Electrical-Electromagnetic)
- Easy handling

High Tensile Strength

PULTRA has double/triple strength of steel reinforcement. Strength values may vary depending on project needs. Tensile strength of PULTRA is higher than 900 MPa.

Longer life span

PULTRA is not effected by environmental conditions during time. Thanks to non-corrosive

contents (glass and polymer resin) PULTRA has much higher durability values than steel reinforcement. PULTRA is not effected by salt, freze-thaw, chemical materials.

Lightweight

PULTRA, depending on the grade of production, has unit weight varying between 1,4-2,1 gr/cm³. That value is 4-5 times lower than steel reinforcement.

Easy Handling

Pultra is produced special for project needs. Thus, there will be no additional labour in job site for mounting. For straigh bars it is easy to cut in job site for any kind of change in dimension.

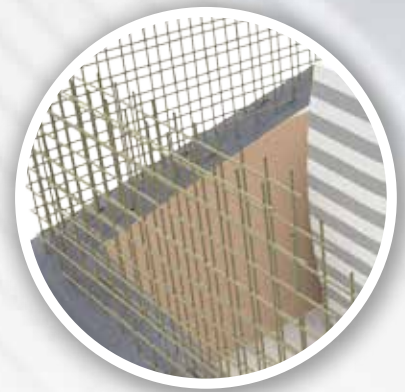
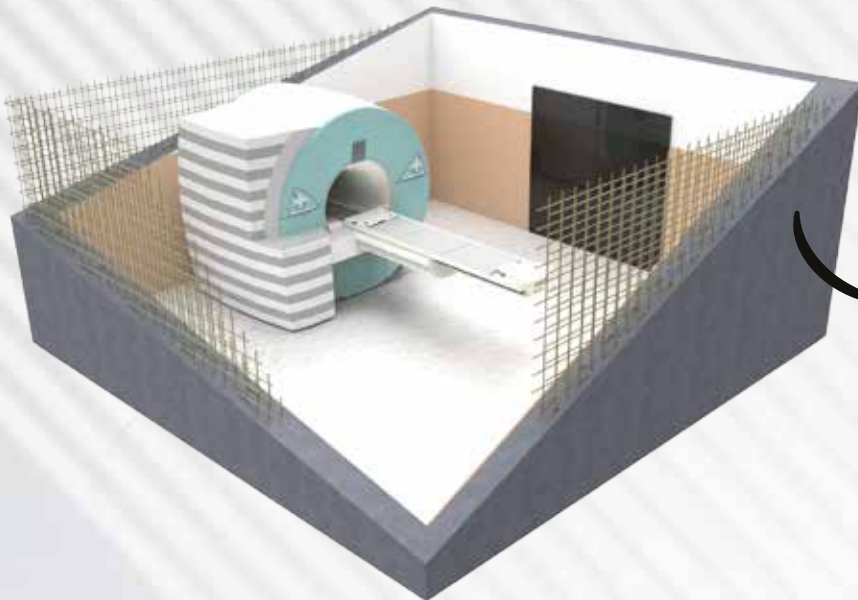
Field of Use

Tunnels

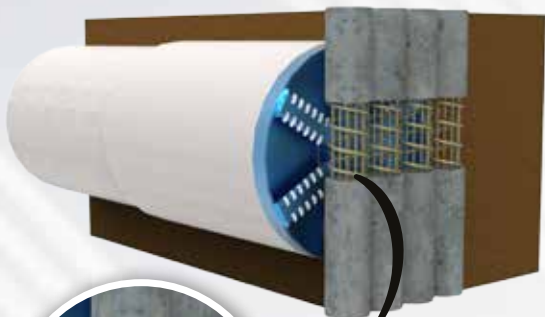
- Soft Eyes
- Piles
- Diaphragm Walls
- Temporary Structures
- Precast Segments
- Final Linings

Slabs

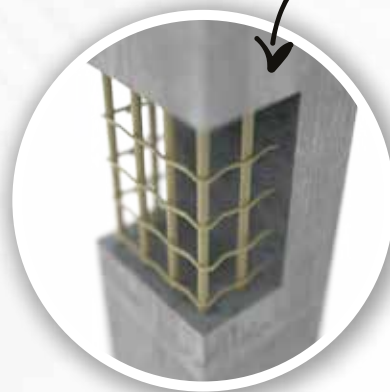
- Slab on Ground
- Bridge Decks
- Salt Storage Facilities
- Swimming Pools
- Wave Breakers
- Pier Caps



Electromagnetic Neutrality



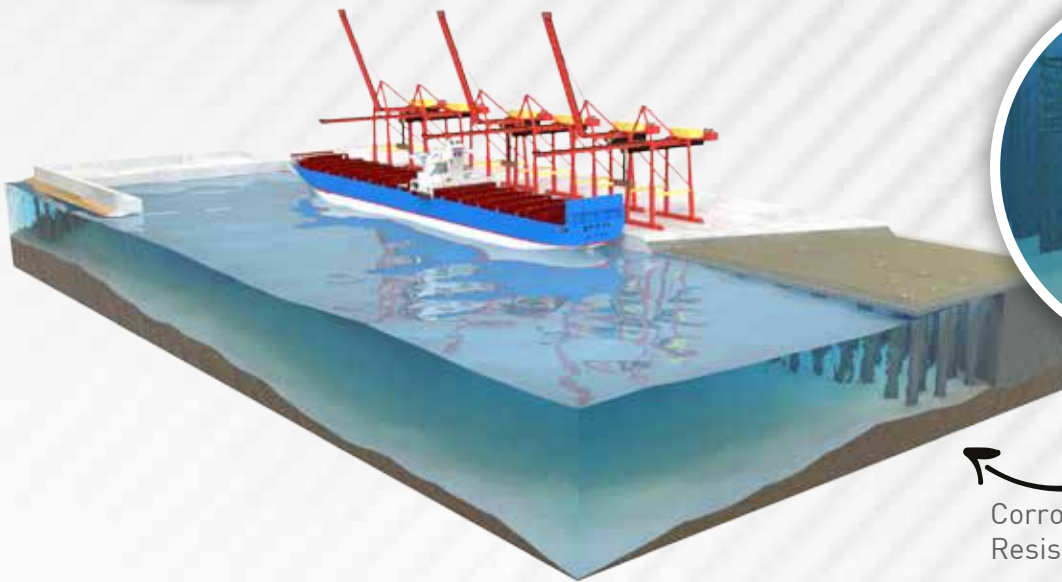
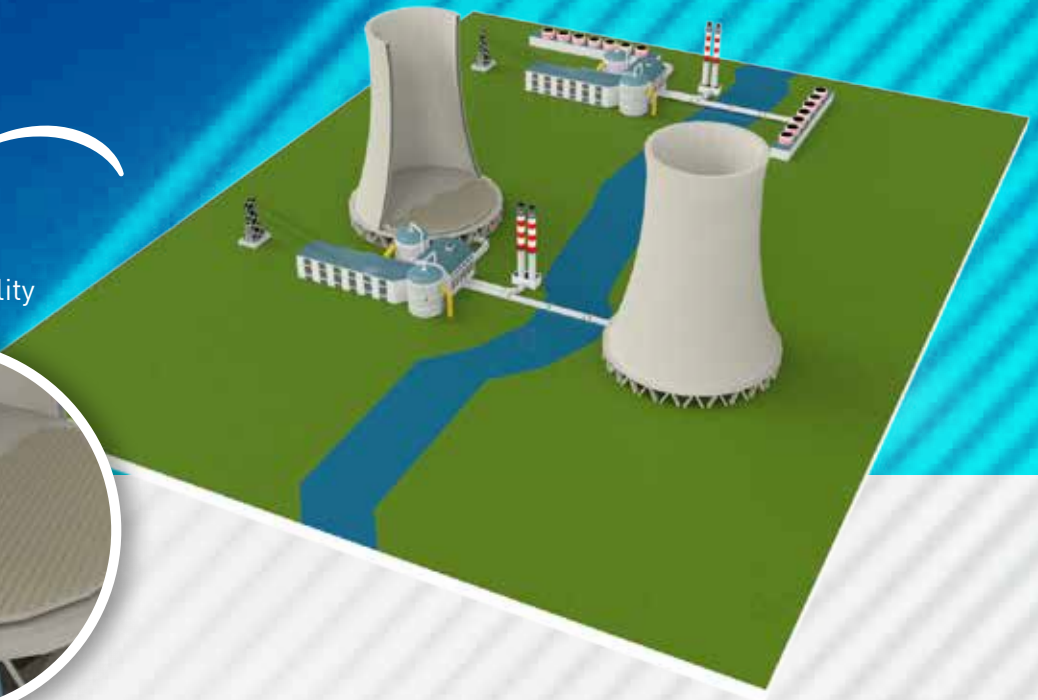
TBM Soft Eye



High Strength



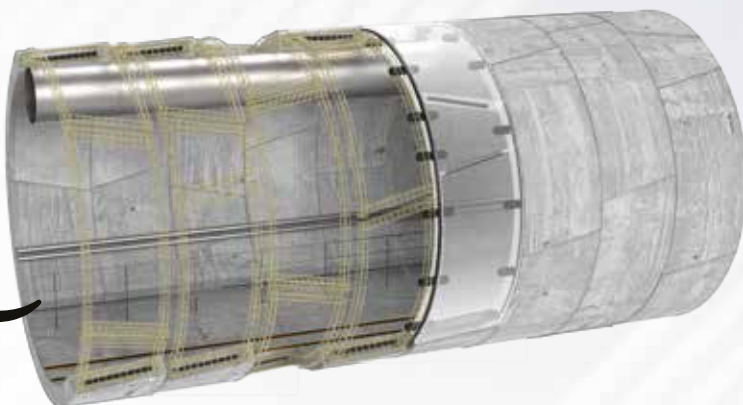
Chemical Neutrality



Corrosion Resistance



Ergonomic Design



PRODUCT TYPES



FRP PIPE AND FITTINGS

With Filament Winding technology, we produce pipes with high strength and resistant to corrosive environments by the angular filament winding.

Corrosion resistance is high

- No Cathodic Protection and Coating Required
- Resistant to chemicals and high temperatures

Low Density

- 20% lighter than steel pipes
- Low Assembly Workmanship
- Easy Shipping
- Low Section Supporting Elements

Economical and Reliable

- Long life
- No maintenance required
- Cheap assembly
- High electrical resistance
- Low pressure loss
- Low thermal expansion and conductivity

Production Size

We manufacture pipes according to the accepted standards of ASTM D3517 and AWWA C950.

We comply with AWWA M45 standards for assembly applications.

STRUCTURAL FRP PROFILES

FRP profiles, manufactured by FORTA, are best alternatives to the traditional materials with their superior properties, such as high strength, low thermal and electrical conductivity. Beside standard profiles like I beam, square tube, rod, U channel etc... PULTRA FRP also produces customized profiles requested by its customers. Our profiles are widely used for cooling towers, buildings, platforms and many other applications with no extra maintenance.

- U Profiles
- Bar and Pipe Profiles
- Deck Profiles
- Angle Profiles
- I Beam Profiles
- Square Tube Profiles
- Plate Profiles
- Custom Made Profiles



(Type of Structural Profiles)

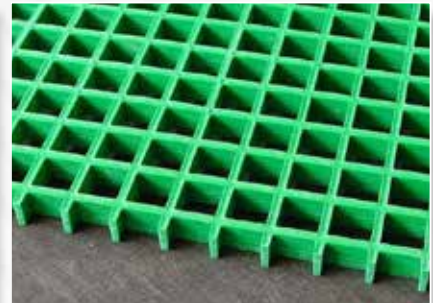
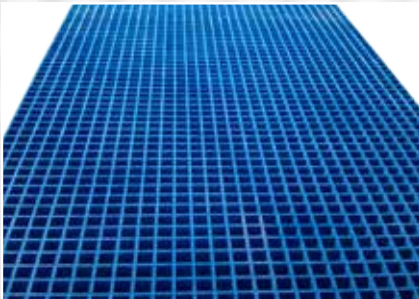
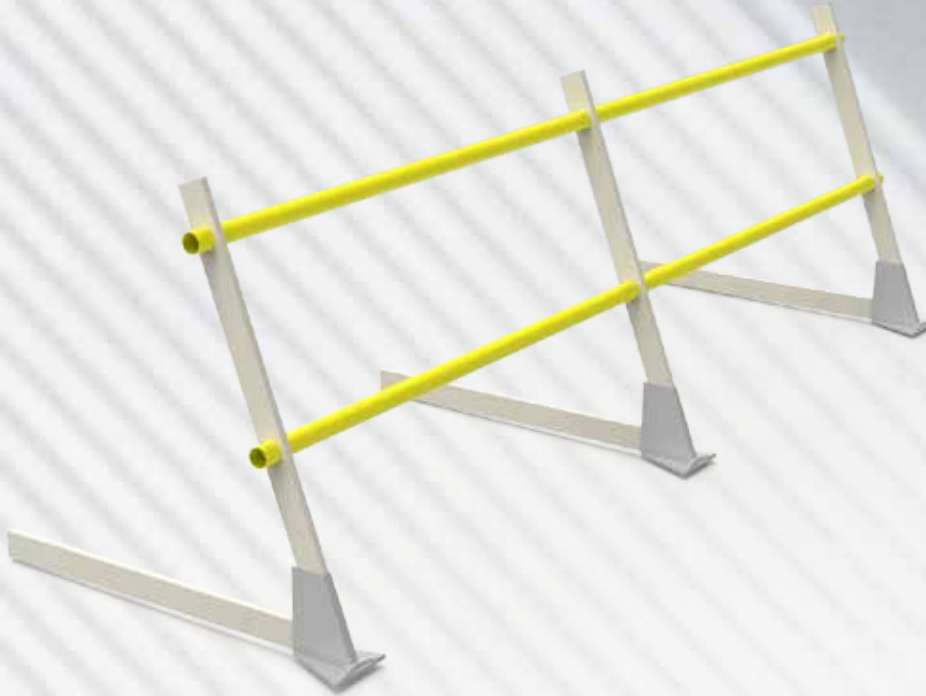
FRP PLATFORM AND HANDRAIL

FORTA handrails, platforms and walkways, which are produced by PULTRA FRP, have features far superior to metal railings. FORTA can offer different solutions with its high chemical and mechanical strength, easy installation and the ability to be produced in desired color. Railings designed and manufactured with appropriate fittings in different types of pipes and boxes are especially preferred in corrosive environments.



FRP CUSTOM MADE PROFILES

Except the standard products, FORTA manufactures different products according to customers' requests, we can design, manufacture and apply in different fields such as Chemistry, Defense Industry, Waste Water Treatment Facilities, Special Applications.



How FRP Compares?

Wood rots, Steel rusts, Aluminum dents. Fiberglass reinforced plastic lasts. Traditional building materials have their place. But for harsh, corrosive environments, PULTRA fiberglass reinforced polymer (FRP) is the best choice.

FRP vs Aluminum

PULTRA FRP shapes won't corrode and are non-conductive. Unlike aluminum, FRP has low thermal conductivity, so it's a good insulator. And FRP pultrusions won't deform under impact.

FRP vs Steel

PULTRA FRP reinforced plastic is highly corrosion resistant. So unlike steel, it won't rust when it's exposed to harsh weather and chemicals. It's also nonconductive and impact resistant. Pound for pound, our FRP structural members are stronger than many steels in the lengthwise direction, and weigh up to 75% less. Compared to steel, PULTRA FRP offers these advantages:

- 3 times more strength of steel at 1/4 the weight
- Simple fabrication with standard tools — no welders or cutting torches
- Molded-in color and resin options, including fire retardant

FRP vs Wood

When it comes to structural applications, FORTA's fiberglass reinforced plastic offers significant advantages compared to timber. Unlike wood, our fiberglass shapes won't warp, rot or decay from exposure to moisture. They're resistant to corrosion, insects, mold and mildew. Best of all, they don't need environmentally hazardous coatings or preservatives to deliver exceptional durability.

CERTIFICATES



PULTRA
COMPOSITE

www.forta.com.tr

PULTRA
COMPOSITE



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