PowerBar - Glass Fiber Reinforced Polymer (GFRP) Bar

PowerBar is manufactured by pultrusion process with in-line winding and sand blasting on the surface to provide bond adhesion to concrete.

PowerBar is made from remarkably durable materials - vinyl ester resin (V), the highest level of corrosion protection or Isophthalic polyester (ISO), the is a premium grade resin providing outstanding corrosion resistance, with fiberglass reinforcement to form a rod shape.

PowerBar offers strength as well as excellent corrosion resistance properties in sever chemical and alkaline conditions, which is substantially has the betterment of the longevity of civil engineering structures.

Features and Benefits

For the following benefits, **PowerBar** for reinforcing concrete, are required:

- Electromagnetically Neutral
- Thermally / Electrically non-conductive
- Non-Corroding
- Weight Reduction, 1/4 of the weight of an equivalent size steel rebar.
- Tensile strength higher than steel.
- Bond Strength in Concrete better than steel

Applications

- **Waterfront structures in or near water:** piers, wharfs, basements, condos, offshore platforms; swimming pools and aquariums.
- **Tunneling/Boring applications:** structures including mining walls, underground rapid transit structures and underground vertical shafts.
- **Require electric or magnetic neutrality:** MRI's, communications, airports, transformers, Aluminum and copper smelting plants, telecommunication towers, airport control towers, hospitals and railroad.
- **Weight sensitive structures:** poor load bearing soils or remote locations
- **Long-term durability required:** reservoirs, tunnels, infrastructure, industrial plants
- **Thermally sensitive applications:** Apartment patio decks; thermally insulated concrete housing and basements; thermally heated floors and conditioning rooms.
- **Subjected to de-icing salts and corrosive agents:** bridge, parking decks, platforms, curbs; retaining walls and foundations, roads and slabs on grade.

Gentle Glory International Enterprise Ltd
Room 6B, Kingpower Commercial Building
409-413 Jaffe Road Causeway Bay, Hong Kong
Tel: (852) 2563 5129 Fax: (852) 2548 4098 E-mail:info@gentleglory.com

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Tensile Stress, Nominal Diameter & Cross-sectional Area, Modulus of Elasticity

Bar	Diameter		Cross-Sectional Area		Guaranteed Tensile Strength		Ultimate Tensile Strength		Tensile Modulus of Elasticity	
Size	(inch)	(mm)	(inch)	(mm)	(MPa)	(ksi)	(MPa)	(ksi)	(GPa)	(psi 10^6)
2	0.25	6.35	0.049	31.67	825	120	910	5.89	41	5.94
3	0.375	9.53	0.110	71.33	760	110	830	12.1	41	5.94
4	0.5	12.70	0.196	126.68	690	100	790	19.6	41	5.94
5	0.625	15.88	0.307	198.06	655	95	740	29.1	41	5.94
6	0.75	19.05	0.442	285.02	620	90	700	39.8	41	5.94
7	0.875	22.23	0.601	388.12	586	85	650	51.1	41	5.94
8	0.875	25.40	0.601	506.71	550	85	610	51.1	41	5.94
9	1.25	31.75	1.227	791.73	480	70	530	85.9	41	5.94

Tensile strength tests per ASTM D7205.

Shear Stress: 160 MPa

Glass Fiber Content by Weight: 70% minimum per ASTM D2584

Specific Gravity: 1.9 per ASTM D792

Coefficient of Thermal Expansion
Transverse Direction: 33.7 x 10^{-6}/℃
Longitudinal Direction: 6.58 x 10^{-6}/℃

Barcol Hardness: 50 min. per ASTM D2583

Stirrups, Shapes and Bends

All bends in **PowerBar** must be made at the factory as bends are fabricated by shaping over a set of molds or mandrels prior to curing of the resin Matrix. Research has shown that bends typically maintain 38% of ultimate tensile strength through the radius. It is recommended to work with the factory in the early stages of design as not all bends and shapes are available. The narrowest inside stirrup width is 10". Bends are limited to shapes that continue in the same circular direction. Otherwise lap splices are required.

Creep

A phenomenon known as creep rupture that all structural materials including steel may fail suddenly after a period of time when subjected to a constant load. Creep tests indicate that if sustained stresses are limited to less than 60% of short term strength, creep rupture does not occur in GFRP rods.

Duration of PowerBar

The durability of **PowerBar** is longer than traditional steel reinforcement in the environment, that would degrade steel reinforcement, generally due to that the typical portland concrete pour water is alkaline with a pH of approximately 13. Most durability studies have focused on subjecting GFRP Rebars to alkaline solutions of 13pH at elevated temperatures to simulate service lives on the order of 50 years.

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Design with FRP Rebar

Since the properties of FRP Rebar is different from steel reinforcement, the design of concrete reinforced with FRP products will be also different in many cases. Design engineers should consider, the appropriateness of reinforcing concrete with FRP bars, the following basic points in their designs:

— Direct substitution of FRP Rebars in a concrete member designed with steel bars is not possible in most cases.

— Lower modulus of elasticity of FRP Rebar will limit the applications

— FRP rebar is limited to a maximum sustained stress of 20% of the guaranteed design tensile strength based on ACI 440 design guidelines

— Important Design Differences between FRP & Steel

☆ Physical Properties
☆ Tensile strength
☆ Bond Strength to Concrete
☆ Stress Strain Curve
☆ GFRP is linear elastic to failure, Steel has ductility

— Current knowledge restricts the use of FRP bars for:

☆ Seismic Zones
☆ Zones where moment redistribution is required
☆ Moment Frames
☆ Compression Reinforcement in both beams and columns
☆ Structures subject to high temperature

Major Projects - we have done

The subway between Guangzhou city and Foshan city

The No.5 subway of Beijing in China

The East Fuxing Tunnel and light rail station of Yishan in Shanghai in China

The freeway between Shijiazhuang city and Taiyuan city in China

Earthquake monitoring station in Lanzhou city in China

International Projects in Europe, America, India, Middle East and Southeast Asia

駿 榮
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Room 6B, Kingpower Commercial Building
409-413 Jaffe Road Causeway Bay, Hong Kong
Tel: (852) 2563 5129 Fax: (852) 2548 4098 E-mail:info@gentleglory.com