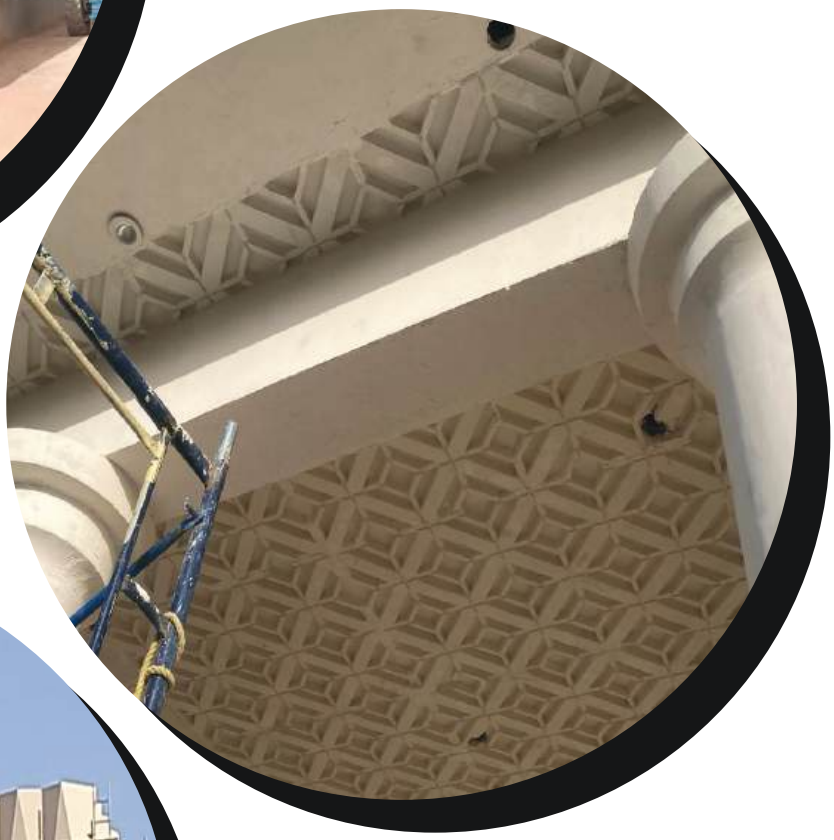
مصنع
عالم الأفق للصناعة

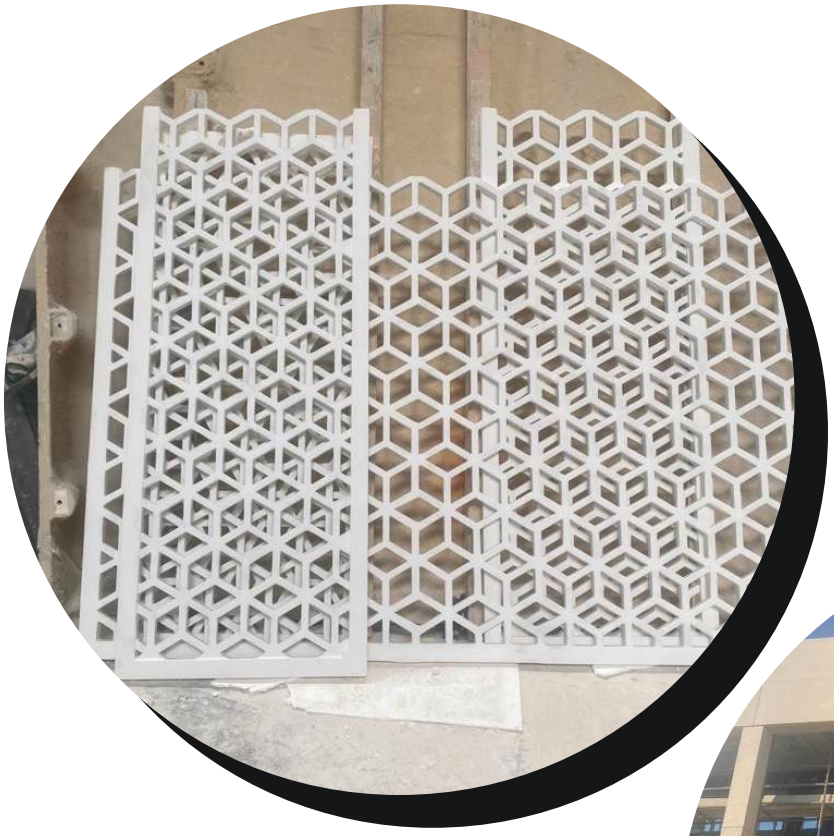
Horizon World

Horizon World Factory for Industry

GRC - GRG - GRP - Special Product

www.Horizon-World.info






BLVD
HALL


BLVD
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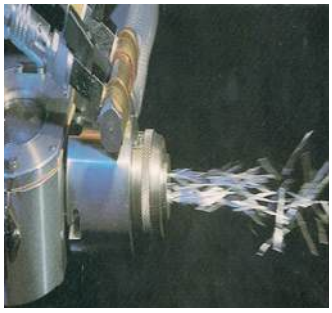
GRC & GRP

GRC means Glass Reinforced Concrete consisting of Matrix or cement and fine silica sand reinforced with glass fiber called CEM-FIL.

GRC precast products have the same shape of steel reinforced product in addition to the following advantages:

1. Have the strength and appearance of concrete but is only 15/ of the weight of concrete.
2. They are resistant to fire and humidity.
3. Reduce cost of delivery, handling and erection.
4. Resistant to all weather conditions.
5. Need minimum maintenance.
6. Many flexible applications in the arch design for the building, civil and general engineering industries.
7. GRC can be painted with any concrete paints.



We manufacture and distribute a various GRC Products like Cladding , screens Capitals , And various decorative Elements ..

Production Process

There are several manufacturing methods and process that a company can operate with namely

Manual Spray Method

Mechanized Spray Method Spray - Dewatering Process

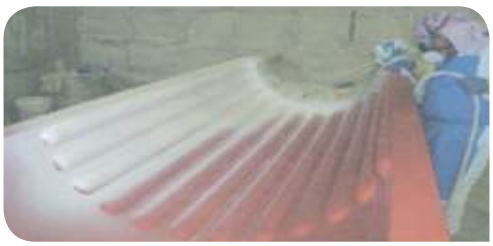
Premixed GRC

Miscellaneous Processes

In **HORIZON,** facilities operate on the Manual Spray Method and Premix GRC. Provisions for Mechanized Spray Method are now under study.

A: Sprayed GRC

In the manufacture of GRC by the spray process, simultaneous sprays of cement / sand mortar slurry and chopped AR glass fiber are deposited from a spray - head into or on a suitable mold. The spray head may be hand held or mounted on a machine.



Manual Spray method - The operator holds the spray-head in his hand and moves it to and fro across the mold, directing the stream of materials perpendicular to the mold surface, until the required thickness of GRC has been built up. Roller-compaction ensures compliance with the mold face, impregnation of the fiber by the slurry, removal of entrapped air and development of adequate density. The rolled surface maybe finally trowel led smooth. Thickness control is achieved by use of pin¬-gauges. A typical output of a single hand unit is 1012- kg of GRC per minute. The process results in one surface of the product having an ex-mold finish and the other surface a rolled or trowelled finish. Products are covered with polythene sheet after spraying and normally de molded the following day and then cured.

B: PRI-MIXED GRC

All premix processes involve the blending together of the cement, sand, water, admixtures and chopped stands of AR fiber in a mixer prior to being formed.
To produce a premix of the correct quality it is necessary to mix in two stages. The first stage is designed to produce high quality slurry to achieve the necessary workability and allow for the uniform incorporation of fiber. The second stage is the blending of fibers into the slurry.
It is more convenient to carry out both stages in the same piece of equipment, but separate mixers can be used for each stage.
The actual mix formulation used depends upon the type of product being made, but a typical mix has a sand/cement ratio of 0.5:1 and a water/cement ratio of preferably less than 0.35. It is essential to keep the water/cement ratio as low as possible consistent with maintaining workability of the mix, so admixtures are used.

SURFACE FINISHES

There is a wide variety of available finishes with the possibilities being broadly similar to those for concrete.
Modification to the Surface Texture.

A: Textured Molds

The cement/sand slurry matrix of GRC has a very fine particle size and hence can accurately reproduce the characteristics of the mold surface against which it is produced. However, the extent to which the glass fiber is able to penetrate surface detail depends on the scale of the detail; as such, the surface layers of a heavily textured panel may consist of un-reinforced cement/sand mortar. It is therefore important that such layers are not included in the thickness of the component for design purposes.

B: Post Treatment Processes

Acid Washing e.g. hydrochloric acid.
Light sand or grit blasting is a similar manner to concrete.
The use of retarding systems on the mold surface, i.e. solutions, papers.

C: Aggregate Facing Materials

Aggregate facing materials are, in general inorganic based. Inert aggregates e.g. crushed rocks, gravels and sands, are bound with various cement types, including rapid hardening, ordinary Portland and colored cement.

QUALITY ASSURANCE

Quality control procedures have been established:
To ensure correct operation of the manufacturing process.
To ensure that correct material properties are being achieved to assess final product.
These procedures may be generally described as follow:

Process Control

Determination of:
Fiber output (from spray unit) Slurry output (from spray unit) Slump characteristics of slurry Glass content of uncured GRC Water/solids ratio of uncured GRC
Production of GRC is also controlled by keeping a check of such items as raw materials usage, thickness of product and final product weight

ERECTION:

Fixing the GRC to the building is basically the same as for ordinary precast concrete, by anchoring it to the building structure, but the anchoring system should be considered is design to allow the volumetric change movement of G RC and to carry the specific weights and forces occurred due to wind or any surcharge loads.
Small ornamental units can be connected with cast-in anchors, inserts, straps, wires or any mechanical fastener designed to withstand anticipated forces.
Due to volumetric changes within GRC product and due to building movement, cracks in GRC joints will appear, unless the joints are sealed with elastomeric sealant such as silicon, urethanes or polysulfide. Sealants must be able to withstand anticipated joints movements.

GRC in Architecture

GRC presents architects and engineers with a material from which the most ambitious designs can be created. It can be molded to form modern futuristic designs or to replicate traditional historic features. GRC can be painted, faced with fine aggregates, colored or simply left with a natural white or grey, smooth or textured finish.

Key features..

GRC products are lightweight, easy to handle and fast to erect
GRC products reduce loadings on buildings leading to significant savings in superstructure and foundations
GRC is excellent for reproduction and renovation
GRC is environmentally friendly

GRC provides the designer with a complete technology that few other materials can match for versatility.

GRC in Building

In recent years, a shortage of skilled workers combined with the need to produce lighter weight building components has led to significant advancement in the use of prefabricated GRC elements. Builders worldwide are appreciating the increase in speed of construction that GRC provides.

Furthermore, engineers are discovering that small additions of alkali resistant glass fibers can benefit the quality of traditional concrete elements, whether precast or cast in-situ. Research has shown that high-modulus alkali resistant glass fibers can help to control cracking and improve durability.

Key features
GRC is easy to MOLD
GRC is fast to fix
GRC durable
GRC is crack resistant

GRC in Engineering

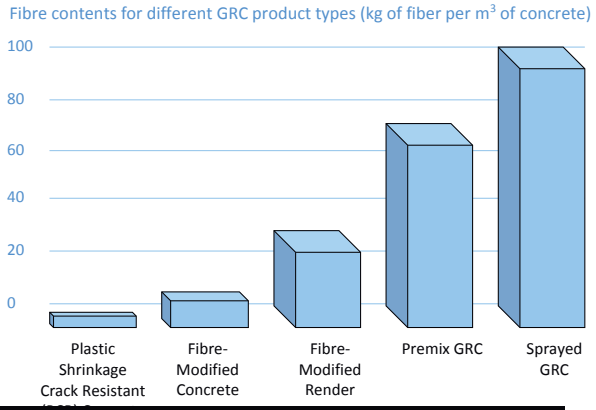
Compared to traditional concrete, GRC offers the engineer an unrivalled range of material properties. GRC is not a single material. Its properties can be engineered to suit each application. For example, for products such as permanent formwork, high short-term strength is required. While for utility and drainage products light weight combined with durability give GRC a considerable advantage.

Key features
GRC is durable
GRC lightweight
GRC is easy to handle and transport
GRC is fast to install

Examples of engineering applications can be found worldwide.

GRC Technical Appendix

GRC is a family of materials that can be defined by the addition rate of alkali resistant glass fiber. At one end of the spectrum low dosages of dispersible fibers are used to control plastic shrinkage cracks in normal concretes (PCR). At the other end, integral fibers are used at high dosage levels to reinforce cement-rich mortars (GRC).



Most GRC products are manufactured by one of two processes - Vibration Casting and Spraying.

The vibration cast form is normally referred to as “Premix GRC”. Premix GRC is produced in a two stage process. A mixture of cement, sand, water and chemical admixtures is first prepared in a high speed mixture. Fibers are added in the second stage with a slower speed. The Premix GRC is then poured into MOLDs and compacted by vibration.

Sprayed GRC is sometimes called «Hand Spray GRC» or «Machine Spray GRC» depending on the method of manufacture. A mixture of cement, sand, water and chemical admixtures is prepared in a high shear slurry mixer. This is then placed in a machine that conveys the slurry to a special spray gun where the fibers are added at the nozzle as the GRC material is sprayed onto a MOLD.

Property	Hand or Machine Spray GRC	Vibration Cast Premix GRC
Glassfibre Content by Weight of Mix	5%	3%
Bending		
Ultimate Strength (Modulus of Rupture – MOR) MPa	20- 30	10- 14
Elastic Limit (Limit of Proportionality – LOP) MPa	7- 11	5- 8
Tension		
Ultimate Strength (Ultimate Tensile Strength-UTS) MPa	8- 11	4 -7
Elastic Limit (Bend Over Point – BOP) MPa	5 -7	4 -6
Shear		
Interlaminar Shear Strength MPa	3- 5	N.A.
In-plane Shear Strength MPa	8- 11	4 -7
Compressive Strength MPa	50 -80	40 -60
Impact Strength KJ/m2	10- 25	10- 15
Elastic Modulus GPa	10 -20	10- 20
Strain to Failure %	0.6- 1.2	0.1 -0.2
Dry Density Tonne/m3	1.9- 2.1	1.8 -2.0

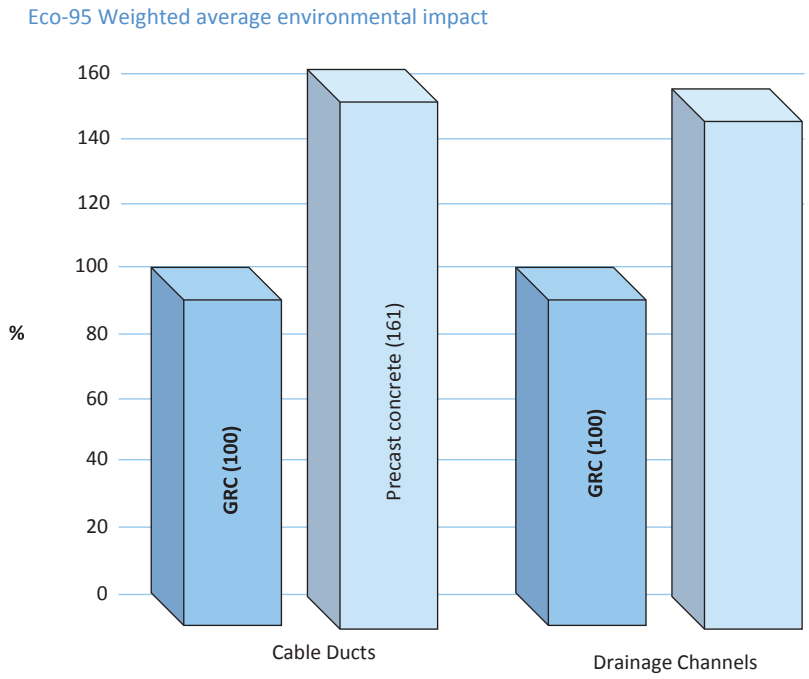
Hand Spray GRC

Spraying Premix GRC render

Vibration Cast Premix GRC

GRC and the Environment

The main constituents of GRC are based on the naturally occurring earth oxides that are used in the manufacture of cement and glass fibers. These are not generally regarded as pollutants. Wash water from the manufacturing process contains cement and this is alkaline. It is normal for factories to have settlement tanks so that solids do not enter the drainage system.



The reduced weight of GRC compared to steel reinforced concrete products does provide environmental benefits. An assessment carried out as part of a UK government DETR/ Concrete Industry Alliance ‹Partners in Technology› project compared two precast concrete and GRC products that fulfill the same function. The results show that GRC has a lower environmental impact.

The main reasons for the reduced environmental impact of GRC compared to traditional precast concrete are:

- Reduced cement usage per product
- Reduced transport costs

SOME OF OUR Projects :

Project Name : Al-Muzahmia Mall .
Customer Name : Aba Namy Contracting Co

Project Name : Blue Musque in Haiel
Customer Name : Al-Rajhi Contracting Co.

SOME OF OUR Projects :

Project Name : Jareer Boock store
Customer Name : Arabian Services Contracting Co.

Project Name : Court Building .
Customer Name : Al-Yamy Contracting Co.

OTHER COMPLETED PROJECTS

LOCATION	PROJECT NAME	COMPANY NAME
DAMMAM	AL-KHODARY COMPAOND	AL-KHODARY
AL-RIYADH	HEAD OFFICE BUILDING	AL-MAKHALED EST
AL-RIYADH	UNI-STEEL FACTORY	ABDULRASHEED EST
DAMMAM	PRIVATE VILLA	ABDURAHIM AL-SHAREEF
AL- ASIM	JARIR BOOKSTORE	ARABIAN SERVICES
AL-JUBAIL	FENCE LOGO	YASOOB CONTRACTING EST
AL- ASIM	MEDICALCENTER	HORIZON CONTRACTING CO
AL-RIYADH	P - VILLA	MOHD AL-OBAIDY
AL-KHOBER	AL-KHOBER P.VILLA	NESMA CO
DAMMAM	MEDICAL CENTER	HAIF TRADING
AL-RIYADH	CAR SHOWROOM	AL-SWAIEH CO
AL-RIYADH	PC SHOWROOM	ALBASSAM EST
AL-RIYADH	PRIVATE VILLA	ABDULATEEFAL-HANI
DAMMAM	SHOPING CENTER	ALWADI CO
AL-RIYADH	PRIVATE VILLA	RAMLAN CO
AL-RIYADH	TECHNICAL COLLEG	ALSWAIEH
AL-RIYADH	PRIVATE VILLA	DR. RASHHED AL-AJMY
DAMMAM	RESTURANT	ALBAJADI EST
AL-KHOBER	PRIVATEVILLA	MR FAISALALOBEEDY
DAMMAM	PRIVATE VILLA	MODERN ART CO
DAMMAM	PRIVATE VILLA	SAUD ALGHAMDI

More about GRC

GRC, Glass Fiber Reinforced Concrete is a composite material consisting of hydraulic cement, fine silica sand mortar reinforced with alkali resistant glass fibers. It may contain additional filler materials and admixtures. Fiber content is typically 5% or 3.5% by weight depending on product application and production method.
Final properties of GRC depend on a wide range of variables such as follows:
1. Method of Manufacture
2. Mix formulation
3. Fiber product – Type, Length and Orientation
4. Admixtures
5. other raw materials
6. Meeting HORIZON requirements of specific application

GRC materials with a common aggregate: cement ratio of up to 1:1, incorporated with AR glass fiber and made by the spray and premix processes have been widely used for a number of years. Their properties and characteristics were extensively studied.
GRC is a composite material which combines the high compressive strength properties of cement mortars with significantly increased impact, flexural and tensile strengths imparted by the fiber reinforcement.
GRC does not contain asbestos; it has good chemical resistance and will not rot or corrode. GRC is made of inorganic materials and will not burn, has negligible smoke emission and offers good fire resistance. GRC is made containing polymer materials which may affect the fire performance properties.
There are two distinct methods of manufacture, spray and premix method.
Spray Method – spraying of fiber and slurry onto a MOLD by manual or mechanical means.
Premix Method – premixing the fiber and slurry and then casting into a MOLD.
Spray Process typical products – architectural cladding panels, agricultural components, tanks, façade elements, ducting and formworks, cornices, capitals, friezes, etc.
Premix Process typical products – sunscreens, planters, electrical transformer housings, junction boxes, drainage components.

2. RAW MATERIALS

2.1 AR Glass Fiber

Alkali resistant glass fiber with high durability in cement. The fiber composition lies within a critical region of the Na2O-CaO-ZrO2-SiO2 system.
Some typical properties of AR Fiber are as follows:

• Single filament tensile strength	-	3.5 GN/m²
• Strand tensile strength	-	1.7 GN/m²
• Young's Modulus of Elasticity	-	72.0 GN/m²
• Specific Gravity	-	2.68
• Strain at breaking point (strand)	-	2.4%
• Filament Diameter	-	13µm or 20µm

Product forms used in cement reinforcement are chopped strands, for use in premix GRC, and as reinforcement in render materials, and ravings, for use in the spray production of GRC and for chopping for use as chopped strands.
Chopped strands consist of strands chopped into uniform lengths while maintaining the integrity of the original strands. They are available in lengths of up to 50mm of which 12mm and 25mm are standard lengths. Chopped strands are normally designated by length, by the Tex (mass in grams of a kilometer length) of the individual strands and by reference to their size coating. The size coating on chopped strand is designed to give resistance to mechanical damage in processing. Chopped strands are supplied packed either in boxes or bags, or in bulk shipments,
A Roving is a grouping of individual parallel strands wound as a bundle into a cylindrically shaped package containing typically 20kg of fiber. It maybe:

1) Chopped on site thus minimizing the difficulties in transporting, handling and feeding already chopped strands.
2) Chopped in a 'gun' and sprayed simultaneously with a matrix material to provide composites which maybe of complex profile.

Ravings are designated by the Tex of the bundle and the number of strands they contain and by reference to their size coating. Ravings are normally shrinking wrapped in plastic film and packed in cardboards cartons.

2.2 Cements

The most widely used cements in GRC manufacture are Ordinary Portland Cement (OPC) and Rapid Hardening Portland Cement (RHPC) and should be to British Standard Specification BS12 or equivalent.
RHPC is chemically very similar to OPC but it is more finely ground and because of this develops strength more rapidly at early ages and is often preferred for GRC for this reason. It should be noted that the term 'rapid hardening' has a different meaning to the term 'quick setting'. GRC made with rapid hardening cement stiffens and initially hardens at a similar rate to that of OPC: it is after the initial hardening that the strength gains more rapidly. It should stored and used in the same way as OPC. RHPC is slightly more expensive than OPC.
White Portland Cement is made from raw materials containing only a very small quantity of iron. It is used in GRC where a white or light colored finish is required. Because of this and the fact that white cement costs more than OPC, extra care must be taken in handling the cement to avoid contamination, and in the batching, mixing and transportation to ensure hat all equipment is kept clean. It is equally important to make sure that the finished GRC is protected against discoloration. The setting and strength development properties are similar to those of grey OPC and, apart from the extra care necessary, there is no difference in the methods of using it or in storage.
Care should be taken when curing white GRC because it gets dirty very easily in the early stages of its life and is very difficult to clean later.

Other types of cement, such as High Alumina Cement, Sulphate Resistant and Rapid Setting Cements maybe used in certain applications and should be to the relevant British Standard or equivalent. Care should be taken that the choice of cement is relevant and complies with statutory regulations.
It is important that cement is correctly stores. Cement must be kept dry, and damp air can be as harmful as direct moisture. Cement stored in bulk in a silo will be satisfactory up to about 3 months. Cement in normal 3-ply paper bags stored under good conditions can lose about 20% of its strength after 4 to 6 weeks.

2.3 Fillers

1. Sand

Silica Sands to the following specification are readily available.

- A. All sand should be washed and dried – It will then contain less soluble matter and fine HORIZON ples, and also allow control of water: cement ratio.

- B. METARA shape and surface texture – BS 812
HORIZON Shape – rounded or irregular preferred. (Flaky and/or elongated should be avoided)
Surface Texture – smooth preferred. (Honeycombed should be avoided)

- C. Chemical Composition (%) – Sands of the following composition have been used in UK and have been found to be satisfactory.
    1) Silica > 96
    2) Moisture < 2
    3) Soluble Salts (ie alkalies) < 1
    4) Loss on Ignition < 0.5
    5) Organic Matter - must not affect the setting of the cement.
    6) SO3 - 0.4 (4000ppm) max.m
    7) Cl – 0.06 (600ppm) max.m
- D. Grading
    1) PMETARAle size – 1.2 mm max.m (i.e. 100%passing BSS 14, ASTM 16 sieve) for sprayed GRC 2.4mm max.m i.e.100% passing BSS 7 sieve) for premix GRC.
    2) Fine fraction - max.m 10% passing 150µm (BSS100, ASTM 100 sieve)

The silica content of the sand need not necessarily be as high as 96%. There are good quality sands with much lower silica content which are suitable fo GRC manufacture.

The value for loss on ignition can be accepted up to 3%, providing the materials is hard, non-crushable, non-reactive and of similar shape and grading to that described above.

2. Crushed Aggregates

Many varieties of aggregates used for concrete may be crushed to a suitable grading for use in GRC. Examples of such aggregates are marble, limestone and granite.

3. Pulverized Fuel Ash

PFA is a pozzolanic material and is the ash extracted from flue gases of boilers fired by pulverized coal. PFA should be to British Standard BS 3892 or equivalent. Blended PFA cements suitable for concrete manufacture are available in many countries. Typically contain 2535%- PFA.

2.4 Water

Water to be clean and free from deleterious matter and should meet British Standards BS3148 (Test on water for making concrete), or equivalent.

2.5 Admixtures

Standard concrete admixtures or those specially formulated for GRC manufacture may be used as appropriate to the METARA process and to obtain the required properties of GRC. Admixtures are generally added to produce the following effects.

In manufacture of GRC -

- Increasing the workability without increasing the water/cement ratio.
- Improving the cohesion
- Reducing segregation
- Reducing bleeding
- Retarding the setting (stiffening) process
- Accelerating the setting (stiffening) process

On properties of hardened GRC -

- Increasing the rate of early strength development
- Increasing the strength
- Decreasing the permeability
- Improving fire resistance

Admixtures are added to mixes in small amounts and care must be exercised to ensure that only the correct dose as specified by the manufacturer is added. Calcium chloride is normally acceptable as an admixture except when metal fixings are used.
Useful reference British Standard BS 5075 Concrete Admixtures.

2.6 Pigments

Pigments to British Standards BS 1041 or equivalent may be used to color the GRC, though special care is required to achieve uniformity of color in certain applications.

A. Fiber – Fibers 13μ and 20μ diameter are substantially above the range of reparable METARA. Evidence to date has shown that these fibers cause no long term health hazard, although some temporary skin irritation may be experienced.

B. Other Component Materials – The manufacturer's recommendations regarding the handling and use of these materials should be followed.

2.7 REFERENCES:

BS	12	-	Specification of Portland Cement
BS	915	-	High Alumina Cement
BS	1014	-	Pigments for Portland Cement and products
BS	3148	-	Methods of tests for water for making Concrete
BS	3892	-	Pulverized Fuel Ash for use in Concrete
BS	4027	-	Specification for Sulphate Resisting Portland Cement
BS	5075	-	Concrete Admixtures

Basic Properties of GRC

Property	Unit	Hand or Mach. spray	Premix
Fiber content	% by wt	5	3
Density (normal)	tonne/M3	1.92.1-	1.82.0-
Compressive strength	N/mm2	50.80	4.-60
Tensile strength (UTS)	N/mm2	611-	36-
Bending Strength (MOR)	N/mm2	2131-	812-
Impact Strength (IZOD)	N/mm/mm2	1025-	612-
Bending Elastic Limit (LOP)	N/mm2	711-	58-
Young's Modulus	KN/mm2	10.25	1318-
Passon's Ratio	--	0.200.25-	0.200.25-
Strain to failure	%	0.601.2-	0.10.2-
Interlaminar shear strength	N/mm2	35-	N/A
In Plane Shear Strength	N/mm2	811-	36-

MANUFACTURING METHODS

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2. Mechanized Spray Method
3. Spray – Dewatering Process
4. Premixed GRC
5. Miscellaneous Processes

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In the manufacture of GRC by the spray process, simultaneous sprays of cement / sand mortar slurry and chopped AR glass fiber are deposited from a spray – head into or on a suitable MOLD. The spray head may be hand held or mounted on a machine.

The mortar slurry is fed to the spray gun from a metering pump unit and is broken into droplets by compressed air. Fiber roving is fed to a glass fiber chopper/feeder, mounted on the spray head which chops the fiber to predetermined lengths, typically 2540-mm and injects the chopped strands into the mortar spray so that a uniform felt of fiber and mortar is deposited on the MOLD. The slurry has typical sand/cement ratio of up to 1:1 and a water/cement ratio of 0.33. The water/cement ratio should be kept as low as possible consistent with satisfactory spray and incorporation characteristics, as increasing the strength of the product. Admixtures are added to obtain the required workability. The proportion of fiber to slurry is adjusted so that the resulting composite contains typically 5% by weight of glass fiber.

Manual Spray method – The operator holds the spray-head in his hand and moves it to and fro across the MOLD, directing the stream of materials perpendicular to the MOLD surface, until the required thickness of GRC has been built up. Roller-compaction ensures compliance with the MOLD face, impregnation of the fiber by the slurry, removal of entrapped air and development of adequate density. The rolled surface maybe finally trowelled smooth. Thickness control is achieved by use of pin-gauges. A typical output of a single hand unit is 1012- kg of GRC per minute. The process results in one surface of the product having an ex-MOLD finish and the other surface a rolled or trowelled finish. Products are covered with polythene sheet after spraying and normally deMOLDed the following day and then cured.
The process is labor intensive but is capable of producing complex shapes and is extremely a wide range of components including cladding panels, agricultural components, façade elements, Capitals, brackets, friezes, formworks and ducting.

B. Premixed GRC

All premix processes involve the blending together of the cement, sand, water, admixtures and chopped stands of AR fiber in a mixer prior to being formed.

To produce a premix of the correct quality it is necessary to mix in two stages. The first stage is designed to produce high quality slurry to achieve the necessary workability and allow for the uniform incorporation of fiber. The second stage is the blending of fibers into the slurry.
It is more convenient to carry out both stages in the same piece of equipment, but separate mixers can be used for each stage.

The actual mix formulation used depends upon the type of product being made, but a typical mix has a sand/cement ratio of 0.5:1 and a water/cement ratio of preferably less than 0.35. It is essential to keep the water/cement ratio as low as possible consistent with maintaining workability of the mix, so admixtures are used.

Up to 4% by weight of chopped strands can be incorporated into the mix, but typical fiber content is 3.5%. The fiber length is normally 12mm because above this length the mix becomes difficult to work. A fiber length of 25mm is generally found to be the maximum useable.

Although the glass fiber strands are designed to withstand the mixing action, it is normal, as indicated above, to add the fiber at the end of the mixing cycle to minimize fiber damage.

Vibration casting process is very similar to the vibration casting of precast concrete. It involves pouring the wet GRC premix into an open or double walled MOLD and vibration enables the slurry to flow and removes trapped air. Alternatively the premix may be pumped to the MOLD through a hose using a peristaltic pump. For standard products a timed

discharge can be used to produce constant product weights. The process is extensively used to make large sunscreens or screen walling panels using polystyrene or rubber MOLDs which have sufficient flexibility to absorb the small shrinkage that takes place as during setting.

Other products produced by this process include Balustrades, Decorative moldings, etc.

CURING OF GRC PRODUCTS:

The hydration of cement is relatively slow process at ambient temperatures and for this reason concrete products are usually allowed to hydrate or cure for several weeks after casting to give full strength development.

GRC products are normally of comparatively thin section, manufactured with a lower water/cement ratio than most conventional concretes, and are prone to rapid drying. If this occurs before hydration is complete the cement never achieves its full strength and the properties of the GRC are adversely affected, so more attention to curing conditions is necessary.
Moist curing is made to ensure complete hydration. Products are kept moist immediately after manufacture and during the curing period. HORIZON, facility is capable on storing products in a humidity chamber or fogged area and total immersion in water. HORIZON storage areas are controlled areas and all weathering facilities are adopted by the products.

For all products, the curing period can be divided into three parts:

i. A pre-remolding cure to give sufficient strength to the product for remolding. This is important and is carried out by covering the component closely with polythene to minimize air flow across the GRC surface thus enabling the component to retain as much water as possible. Steam curing is used to speed-up the production rate by putting MOLDs on steam chambers.

ii The main cure as described above.

iii. Post-curing during which the product is normalized to the ambient conditions prior to storage or use, HORIZON purely in extreme hot or cold conditions.

he rate of hydration will be different in each of these periods, but at the end the curing cycle the GRC should have been brought up to the final strength requirements. The **HORIZON,** curing regime will depend upon the product, manufacturing process and mix design, and must be such that the required level of properties is achieved.

During curing period the strength of the GRC products will be building up from an initially low level and care is necessary in remolding, handling and METARA in the main cure to ensure that products are not overstressed whilst in a relatively weak state since they could be permanently deformed or subjected to damage which may not be visible.

As a guide to practical curing regimes, GRC products will achieve a substantial proportion of their ultimate strength when the main cure is carried out for 7 days, in humidity of greater than 95% RH, and with a minimum temperature of 15ºC. A suitable post-curing regime will allow the remainder of the strength to be realized.

HORIZON, incorporates admixtures to its products such as polymeric materials into the GRC mix formulation to enable the moisture be retained and hydration to continue. The polymer materials are normally added at dosage rates of between 2% and 10% of polymer solids to cement weight. Concurrently, GRC products can be allowed to cure in ambient air conditions. Note that it must be ensure that air temperature is above the minimum film formation temperature of the polymer.

SURFACE FINISHES

There is a wide variety of available finishes with the possibilities being broadly similar to those for concrete.

A. Modification to the Surface Texture

(a) Textured MOLDs

The cement/sand slurry matrix of GRC has a very fine size and hence can accurately reproduce the characteristics of the MOLD surface against which it is produced. However, the extent to which the glass fiber is able to penetrate surface detail depends on the scale of the detail; as such, the surface layers of a heavily textured panel may consist of un-reinforced cement/sand mortar. It is therefore important that such layers are not included in the thickness of the component for design purposes.
If GRC is produced against very smooth surfaces a 'gloss' finish can be obtained but this tends to accentuate small surface defects, gives a patchy appearance when used in large areas, and tends to weather badly. These problems can be overcome by making use of the natural roughness of plywood or other sanded timbers in the MOLD, to give a smooth but slightly matt finish. A much coarser texture can be produced using suitable prepared MOLDs.

In common with other cement based products, cement-rich areas of GRC surfaces may suffer micro-cracking (crazing).

Microscopic examination has shown that such micro-cracks normally travel no further than the nearest fiber and hence do no significantly impair the long term performance of the component. Crazing can be eliminated or considerably reduced by:

i. Minimizing the thickness of any un-reinforced cement/sand mist coat on the component surface.
ii. Increasing the aggregate content in the mist coat, e.g. 2 parts sand: par cement.

The visual effect of crazing can be reduced by using a coarse surface texture. The textured coat thickness should be additional to the designed thickness of the GRC.

(b) Post Treatment Processes

1) Acid Washing e.g. hydrochloric acid.
2) Light sand or grit blasting is a similar manner to concrete.
3) The use of retarding systems on the MOLD surface, i.e. solutions, papers.

The finishing treatments should not be aggressive enough to penetrate into the GRC, exposing fibers at the surface.

These techniques are **HORIZON,** valuable in removing any excess cement/sand mist coat and hence reducing the tendency to craze.

Skill is, however, needed in applying these treatments and care must be taken to ensure that the required minimum component thickness is retained after treatment.

(c) Aggregate Facing Materials

Aggregate facing materials are, in general inorganic based. Inert aggregates e.g. crushed rocks, gravels and sands, are bound with various cement types, including rapid hardening, ordinary Portland and colored cement.
The exposed aggregate finish is widely used in the architectural precast concrete industry and, subject to certain limitations on

aggregate size; similar techniques can be used on GRC panels. Three basic methods are available:

1- Sprinkling or placing aggregate on to the green, wet panel upper surface and tamping in to achieve a mechanical bond, followed by brushing off excess aggregates when the panel is cured.

2- Placing a layer of aggregate on the face of the MOLD before spraying up the panel. Larger aggregate can be placed in a sand bed to control the depth of embedment.

3- Mixing the aggregate with cement, sand and water to form a concrete render and coating a layer of this on the MOLD surface prior to spray up (face down technique) or on the top face of the panel after spraying (face up technique). In the face down technique a set-retarding paint or paper can be placed on the MOLD surface prior to casting of the concrete and, after deMOLDing, the retarded matrix is brushed or washed off to expose the aggregate to the depth (determined by the type of retarder used).

Alternatively, the concrete can be allowed to cure normally and the aggregate exposed by acid washing or sand blasting.

The later method can also be used in the face up technique, or the setting matrix can be caught at the correct time in the cure cycle and the aggregate exposed by brushing or washing off the partly cure matrix to the required depth.

Most of these techniques have been successfully used in the production of GRC panels and in general, the factors which affect the quality of such finishes on precast concrete also apply to GRC. However, the following factors should be born in mind.

a. The sprinkling/placing technique should be limited to very small aggregate since penetration of the GRC face occurs and this will affect the panel strength.

b. The recommended maximum aggregate size for use with GRC is 12mm, to fully utilize the low weight, thin section characteristics of the material.
c. Aggregate facings can substantially increase the weight of a panel and this must be allowed for in both panel design and the design of fixing and lifting sockets.
d. All cement based materials, including GRC, are subject to moisture movement in that they expand during water uptake and contract when drying. One effect of this phenomenon is that if one face of a GRC component is covered with a facing material which prevents the expansion or contraction of the substrate due to moisture movement, or causes a difference in the rate of moisture change between the faces, then bowing of the component can occur. This may appear soon after removal of the panel from the MOLD but even a panel which is apparently flat at this stage may show bowing later. Consideration should, therefore, be given to this at the design stage.

On removal from cure, it is recommended that both panel faces should be allowed to dry out at an equivalent rate

B. Applied Finishes

The following properties are important in determining the suitability of applied finishes for use on GRC;

- Resistance to alkalinity
- Moisture compatibility
- Moisture vapor permeability
- Ability to cover rough and/or porous surfaces
- Weathering characteristics
- Mechanical Flexibility
- Special knowledge or equipment required
- Renewal problems.

HORIZON, care should be taken in the use of finishes having low moisture vapor permeability characteristics, which can introduce the following problems:

i. Moisture already precast in the panel or entering from the back face may migrate to the paint/GRC interface where it is unable to escape and may cause bubbling or flaking of the finish.

ii. In sandwich panels the presence of a very low permeability film on the outer face greatly increases the risk of interstitial condensation.

These problems can be minimized by taking the following precautions:

i. Ensure that the panel is as dry as possible before painting.
ii. Seal the back face of the panel with a material of similar or lower permeability.

Applied finishes, which are essentially organic, based, cover a wide range of chemical types, which can be summarized as follows:

Type 1

These are the frequently used, high moisture vapor permeability (breathable) systems. They are mainly water based synthetic latex emulsions such as PV acetate co-polymers, acrylic co-polymer, styrene acrylic and styrene butadiene rubbers (SBR).
Care must be exercised in preparation of the GRC substrate before coating, including removal of friable material (laitance) and any residual MOLD release agent.
Emulsions are also available which contain a high percentage of fine quartz or stone granules, giving textured or exposed aggregate facings.

Type 2

These are usually in a solvent carrier and dry by an oxidation and polymerization process, e.g. alkyd resin based gloss paints.
For satisfactory use of this type of coating, primers should be alkali resistant and GRC surfaces should be allowed to condition at ambient temperatures until relatively free from water, as the coatings exhibit low vapor permeability characteristics.

Type 3

These are the most complex and include the 2 part epoxy and urethane types.
Properties include excellent resistance to chemicals, water and abrasion. Great care must; however, be exercised when using the systems on GRC. These too possess low moisture permeability characteristics and in practice are difficult to handle because of the criteria necessary in mixing individual components and the preparation of the GRC substrate prior to application.

Coatings of this nature should only be considered when the requirement is to resist the most aggressive exposure conditions.

C Cement Paints

These are generally based on white Portland cement and are available in a range of colors. They contain special additives to assist in ease of application and to render the coating water repellant. They are supplied in powder form for mixing with water on site.

D. Colored Cements

The basic colors of cement are grey and white and therefore other methods of coloring the GRC matrix must be considered.

QUALITY ASSURANCE

Quality control procedures have been established:

- To ensure correct operation of the manufacturing process.
- To ensure that correct material properties are being achieved
- To assess final product.

These procedures may be generally described as follow:

A. Process Control

Determination of:

(1) Fiber output (from spray unit)
(2) Slurry output (from spray unit)
(3) Slump characteristics of slurry
(4) Glass content of uncured GRC
(5) Water/solids ratio of uncured GRC

Production of GRC is also controlled by keeping a check of such items as raw materials usage, thickness of product and final product weight.

B. Product Control

Test on cured GRC specimens take either from product or a test board representative of the product.
Determination of:

(1) Dry and wet bulk density, water absorption and apparent porosity.
(2) Limit of proportionality (LOP), modulus of Rupture (MOR) and directionality ratios.

British Standard BS 6432 details test for 4,5,6 and 7. Test methods are also given in the GRCA, ASTM standards.

C. Component Inspection and Testing

Final product inspection for surface flaws, color, finish and overall product dimensions should always be carried out. In certain circumstances it may be necessary to mechanically test the finished product.

ERECTION:

Fixing the GRC to the building is basically the same as for ordinary precast concrete, by anchoring it to the building structure, but the anchoring system should be considered is design to allow the volumetric change movement of GRC and to carry the specific weights and forces occurred due to wind or any surcharge loads.

Small ornamental units can be connected with cast-in anchors, inserts, straps, wires or any mechanical fastener designed to withstand anticipated forces.

Due to volumetric changes within GRC product and due to building movement, cracks in GRC joints will appear, unless the joints are sealed with elastomeric sealant such as silicones, urethanes or polysulfide›s. Sealants must be able to withstand anticipated joints movements.

A. Coordinate required blocking for attachment of panels to substructure. Provide when necessary, wood preservative treated of metal stud framing as may be required to attached and reinforce panels for a solid installation.

1. Coordinate installation with any metal gutter lining work or flashing above and wood/metal substrates.

B. Erect panels plumb, square and true to line and level. Follow drawings with regards to installation clearances, notches and formation of panel-to-panel joints.

C. Install sealant, joint fillers and accessories as work progress, so as to make the work weather tight.

D. Provide each panel with joints such that adjacent panels mate to produce flush joints. Recess blocking or notch continuously behind each panel joint. Set panels to ensure a maximum joint thickness of 10mm.

E. Prepare each panel section for installation by carefully sanding joints and shrinkages where blocking occurs to assure a tight flush fit.

F. Fill joints with continuous bead of sealant. Tooling finished joints to a slightly concave profile ensuring complete filling and flush installation.

G. Carefully monitor ambient temperatures at time of panel installation and observe all panels' clearances as recommended and detailed in drawings.

H. Do not cut or abrade finishes, which cannot be completely restored in the field. Installer to make small inconspicuous finish repairs using color matching fills finish. If repair is too large, panels are needed to be return to factory for alterations and/or replacements.

I. Use only connectors (stainless or galvanized steel) as approved and agreed upon with the Client. And which will develop the strength required as per calculation. Installer shall follow and use connectors as instructed and shown in the approved shop drawings.

J. Countersink all exposed fasteners. Patch all attachment holes with fill finish matching the panel color. Finish the attachment points so that there is no detectable difference in the completed panel surface.

K. Clean installed panel to remove all dirt, smudges and construction dirt. Use only those cleaning products and procedures as recommended.

HORIZON, GRC panels are labeled, marked and numbered for ease of installation. Pre-determined fixing points and fixtures are distributed in the panel for the ease of assembly and installation.
Every panel are designed and engineered to be cost effective for quick and easy installation with minimum labor. Pre-fitted bolt flanges (outside/inside) assemblies when required insure a perfect fit for the job.

DO NOT INSTALL PANELS UNDER ENVIRONMENTAL CONDITIONS OUTSIDE MANUFACTURER'S ABSOLUTE LIMITS.

HANDLING AND SHIPMENT

A. Transport, lift and handle units with care. Avoiding excessive stress and preventing damage by the aid of appropriate equipment.
B. Store the delivered product in a clean dry area off the ground and protected from weather, moisture and damage. Storing the panels upright and not stacked unless it permitted.
C. Store and dispose of solvent-based materials in accordance with the requirements of local authorities having jurisdiction.

INTRODUCTION:

Glass Fiber Reinforced Plastic GFRP ..

Glass reinforced polyester (plastic) is commonly known as GFRP or sometimes as FRP (fiber reinforced polyester). It is a composite laminate of glass fibers in a polyester resin matrix.
GFRP is a highly versatile material used in buildings for exterior cladding panels and also as fully structural load-bearing elements including complete buildings or roofs. It can be used to make roofing infill panels, drainage components, interior and exterior decorative features. It can be made translucent or opaque and can be used for door and window frames, for waterproof membranes and as form work for concrete structures.

Practically any size, shape and surface texture can be produced in a hand-laminated GFRP MOLDing. Any limitations are likely to be economic rather than physical ones. All GFRP resins can be pigmented to any color including metallic finishes. Specially

formulated resins for translucent GFRP give light transmittance and appearance similar to translucent glass. Typical color ranges used for polyester pigmentations are the BS 4800 range, RAL and Mussel, but all paint manufacturers' ranges of colors can be reproduced with accuracy.

Glass Reinforced Polyester (GFRP) is a light, durable and astonishingly tough constructional material which can be fabricated into all manner of products. It may be translucent, opaque or colored, flat or shaped, thin or thick. GFRP is a composite of a resilient durable resin with an immensely strong fibrous glass. The resin is the main component and is normally a polyester resin. Just as concrete may be reinforced with steel rods, so polyester resins may be reinforced with glass fibers to form GFRP. This is the fabrication process, a single surface MOLD on which is impregnated layers of glass mat with liquid resin until the required thickness has been built up and the laminate is then extracted from the MOLD. Glass fibre is one of the strongest of all materials (Table 1). The ultimate tensile strength of a freshly drawn single glass filament (diameter 915- microns) is about 3.5 GPa. It is made from readily available materials, it is non-combustible and chemically resistant.

Material	Glass Content %Volume	%Weight	Specific Gravity	Tensile Strength MPa	Tensile Modulus GPa	Specific Strength MPa
Polyester / glass roving	54	70	1.9	800*	30*	400*
Polyester / glass cloth	38	55	1.7	300	15	200
Polyester / glass mat	18	30	1.4	100	7	70
Mild steel (structural)			7.8	310	200	40
Duralumin			2.8	450	70	150
Douglas Fir			0.5	75	13	150
Hickory			0.8	150	15	200
Portland cement			2	10	17	5

GFRP PERFORMANCE

One of the design considerations is the expected performance of the product in the environment in which it is to operate in practice. Several tests have been conducted in order to predict the likely performance of our products in most applications. The weather and water resistance of GFRP laminates is largely a function of the gel coat since in most applications it is the gel coat surface,

which is exposed to attack. The recommended gel coat is used where resistance to water and mild chemicals is required. For optimum chemical resistance combined with high structural performance a resin rich surface is obtained on the face of the MOLDing, which is exposed to the hostile environment.

Panel Material Characteristics

DESCRIPTION	GFRP
Specific Gravity	1.8
Glass content	More than 30%
Tensile strength	1,020kgf/cm² (9.996KN/cm²)
Young's modulus	1.40x105 kgf/cm² (13.7Gpa)
Flexural strength	1,650 kgf/cm² (16.17 KN/ cm²)
Impact strength	52.5 kgf/cm² (0.515KN/ cm²)
Compressive strength	3,010 kgf/cm² (29.50 KN/ cm²)
Shear strength	960 kgf/cm² (9.41 KN/ cm²)
Thermal expansion	2.16x105-/ºC
Thermal conductivity (single panel)	0.15 Kcal/m hrºC (630 J/ m hrºC)
(insulated panel)	0.02 Kcal/m hrºC (84 J/ m hrºC)
Coef. of overall heat transmission (single panel)	5.0 Kcal/m hrºC (21 KJ/ m hrºC)
(insulated panel)	1.0 Kcal/m hrºC (42 KJ/ m hrºC)
Water absorption	Less than 0.2%
Cavity	Less than 2%
Light transmittance (grey panels)	0.00%

Design Conditions

Depth of Tank (m)	Panel Strength kgf/cm² (Kpa)	Hydrostatic Pressure kgf/cm² (Kpa)
1.0	More than 0.6 (59)	0.07 (6.9)
1.5	1.0 (98)	0.12 (12)
2.0	1.3 (130)	0.16 (16)
2.5	1.7 (170)	0.21 (21)
3.0	2.1 (210)	0.26 (25)
3.5	2.5 (250)	0.31 (30)
4.0	2.9 (280)	0.36 (35)

TECHNICAL DATA PARAMETERS

Wind Velocity 60m/sec
Snow Load 60 kgf/ m²
Man Load 120 kgf
Seismic load:
Horizontal Seismic coefficient Kh= 0.3
Water temperature 40ºC **
Anchor Bolts shall be used to tie down a tank.

Notes:

Panel strength is the actual "bursting" pressure.

**Sample panel exposed to 80% humidity and 80o C for a period of one month, remained unaffected.

GFRP Technical Product Data METARA

HORIZON GFRP:

In imperial measurements, (e.g. USA) the unit used is grams per square foot of product.

Nominal thickness of profiled GFRP roof sheeting should not be used, as this measurement will vary slightly from profile to profile when a uniform production weight is used. All continuous line laminating plants in the world manufacture to a mass or weight parameter, and not thickness.

The three weights available are as follows:

Standard industrial : 1.4 kg / m²
Heavy industrial : 1.8 kg / m²
Extra heavy industrial : 2.4 kg / m²

1.4 and 1.8 kg / m² sheets satisfy most industrial applications in our products . Where a special or unusual application applies, or if any doubt exists, the Technical Department should be consulted.

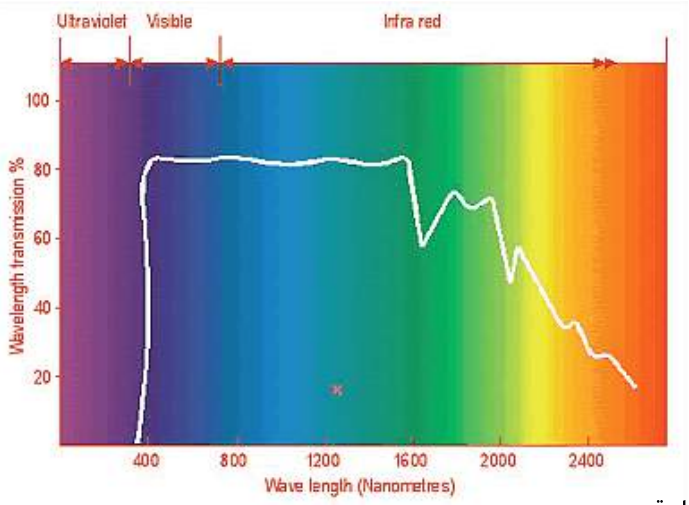
2.4 kg / m² (extra heavy industrial sheeting) is generally recommended where:

- The length of sheet exceeds 9.0 meters.
- Excessive wind loading will be experienced.
- Excessive water loading is likely to be encountered.
- Additional strength could be advantageous e.g. in a known hail belt.

Domestic range of products is manufactured between 1.0 kg / m² and 1.4 kg / m². These are designed to suit less aggressive conditions than those encountered in industrial applications.
Other weights can be manufactured to specification depending on particular requirements.

LIGHT AND SOLAR ENERGY TRANSMISSION - HORIZON GFRP

Different translucent roof sheeting applications could call for varying levels of light transmission. With different colors these levels change.
Not only does the natural (or visible) light level vary, but the amount of solar energy (heat) also varies. The diagram below depicts the approximate transmission of the various wavelengths of the light spectrum for a clear GFRP sheet.



More than 70 % of the heating effect of the sun is carried between 350 and 800 nanometers (generally, the visible light spectrum) and we can see that these wavelengths are generously transmitted through a clear **HORIZON,** GFRP sheet - more than 80 %.

Why does heat buildup in a room?

As illustrated, a high percentage of the visible short wave radiation has been transmitted through a clear sheet.

This radiation is absorbed by surfaces inside the room, and these surfaces become heat radiators. The heat emitted from these «radiators» is long wave radiation which is not so readily transmitted out of the room through the sheet. The result is that the trapped heat builds up in the room. This is also known as the «greenhouse effect».

An effective method of combating heat build-up in a room is to have good through ventilation. This can also be improved by selecting the most appropriate GFRP roof sheet.

The table below shows the various percentages of transmitted light and solar energy, and also that amount of light and solar energy which is reflected and absorbed by the different colored sheets.

Color QUEST Colorimeter Test Results
GFRP Translucent Roof Sheets

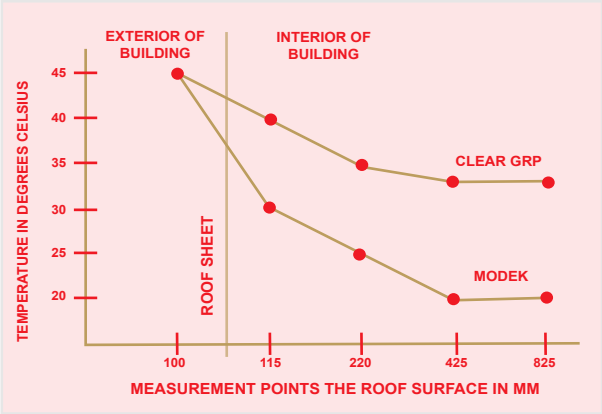
GFRP ROOF SHEET TINT	CLEAR	BLUE	GREEN	OPAL 50
VISIBLE SPECTRUM (380 nm - 700 nm)				
% Light Transmission	85	40	50	50
% Light Reflectance	15	8	10	48
SOLAR ENERGY (350 nm - 2100 nm)				
% Rejected	16	40	34	42
% Direct Transmission	83	47	57	57
% Direct Reflectance	12	7	8	39
% Absorbtion	5	46	35	4
% Total Transmission	84	60	66	58
SHADING COEFFICIENT	0.97	0.69	0.76	0.67

Notes:

- Shading coefficients are used for comparing solar heat transmission properties of different glazing materials to that of clear float glass 3 mm to 4 mm thick, the glass being given a value of 1. To be used for comparative purposes only.
- For practical purposes, GFRP sheets do not transmit harmful UV rays.
- GFRP roof sheets are manufactured with randomly dispersed fibreglass reinforcement material.

This results in a very good diffusion of natural light, thereby substantially reducing the amount of glare inside the building. This, in turn, means a more comfortable working environment.
Should there be any further requirements regarding the light and solar energy transmission of GFRP roof sheets, contact the Technical Department.

The following graph indicates the performance characteristics of a roof sheet as compared to that of a conventional clear sheet.



Considerably less solar energy is transmitted, which reduces the greenhouse effect within the building.

This heat protection characteristic of sheets is useful when it is necessary to provide natural light without heat, such as in supermarkets, public walkways, food storage areas, and so on.

All the physical properties, and price, remain the same as the other GFRP sheets, and can be specified in any industrial profile.

WEATHERABILITY

New generation UV stabilized unsaturated polyester resins are used in the manufacture of GFRP sheets by means of a thermosetting process.

A gel coat layer, consisting of extremely high grade orthophthalic neopentyl glycol polyester resin, is chemically bonded to the weathering surface of all SABS 11501984/ grade sheets. This technology was developed in the USA and is licensed .

Extensive weathering tests have been done, proving that, because of the gelcoat layer, no fibers become exposed during the normal lifespan of the sheet, and the layer of gelcoat cannot peel off.

The end result is a high-gloss surface providing a tried and tested method of protection against damage from exposure to the weather, UV, chemical attack, corrosion and surface abrasion.

GFRP, as with almost all plastics, will be adversely affected by UV attack, over a period of time. This is called photo degradation.

What occurs during this process is the following:

The aggressive short wave length UV rays are absorbed into the polyester resin. They «excite» the chemical molecular bonds of the polymers, causing them to separate, resulting in a yellowing of the sheet.

This process is radically slowed down in a GFRP sheet because of the presence of UV stabilizers and the excellent surface protection afforded by the gel coat surface treatment which also incorporates UV absorbers.

The noticeable change in a GFRP sheet, after a prolonged period of outdoor exposure, will be a slight yellowing, and the following light transmission levels can be expected :

There will be virtually no change to the physical properties over this period, and, under normal conditions, a GFRP gelcoated sheet will remain structurally sound for more than 20 years.

CORROSION AND CHEMICAL RESISTANCE - GFRP

Standard GFRP sheets will resist chemical attack in most usual industrial and marine environments.

Extensive laboratory research has been carried out on the resistance of GFRP sheets to various chemicals encountered in the industrial sphere. The broad results of this research have shown that:

- GFRP sheets are very resistant to most industrial chemicals generally encountered in industrial situations.
- GFRP sheets may be unreservedly recommended for continuous use in the presence of water, weak acids, hydrocarbons, alcohol, peroxides, carbonates and diluted halogen salts (chlorides, bromides, fluorides and iodides).
- GFRP sheets are suitable for use with intermittent exposure to strong acids, weak alkalis, mild solvents and halogen salts.
- GFRP sheets are not recommended in the presence of strong solvents and alkalis.
- GFRP sheets are ideal for coastal applications.
- GFRP sheets are resistant to attacks by micro-organisms, fungi, larvae, insects and mildew.

The following list indicates the chemical resistance of GFRP to various chemical substances:

• Sulphuric acid 30 %	B	• Sodium chloride 10 %	A
• Nitric acid 10 %	A	• Distilled water	A
• Sulphuric acid 3 %	A	• Carbon tetrachloride	A
• Hydrochloric acid 10 %	A	• Cutting oil (comm grade)	A
• Sodium hydroxide 10 %	B	• Toluene	A
• Acetic acid 5 %	A	• Chlorine	A
• Sodium hydroxide 1 %	A	• n-Heptane	A
• Sodium carbonate	A	• Oleic acid CP	A
• Isopropyl alcohol 99 %	A	• Phenol solution 5 %	C1
• Hydrogen peroxide	A	• Ethyl acetate	C
• Isopropyl alcohol 50 %	A	• Ammonium hydroxide	C2
• Citric acid 10 %	A	• Ethylene dichloride	C

A - Recommended for continuous exposure
B - Recommended for intermittent or limited period of exposure
C - Not recommended for prolonged exposure or immersion
1 - Cause a light yellow discoloration
2 - Cause a light greenish-yellow discoloration

PHYSICAL AND MECHANICAL PROPERTIES - GFRP

Tensile Strength	72 MPa (minimum) - SABS 11501984/
Flexural Strength	140 MPa (minimum) - SABS 11501984/
Shear Strength	70 MPa (minimum) - SABS 11501984/
Modulus in Flexure	3 000 MPa (minimum) - SABS 11501984/
Thermal Movement	Coefficient of linear thermal expansion (clear) 24 x 106-m/°C. ASTM D-696
Water Absorption (in situ)	0.3 % by mass after 24 hours at 20°C. ASTM D-570
Hardness	Over 40 Barcol.
Operating Temperature	Temperature range over which sheets may be used in construction is from -20°C to + 80°C. Sheets do not become brittle at low temperatures and are unaffected by frost.
Thermal Conductivity	Clear 0.145 W/mK. ASTM C-177
Diffused Light	The diffusion is achieved through the inclusion of randomly dispersed fibreglass reinforcement material in the sheet.
Scratch Resistance	Highly scratch resistant and therefore easily handled on site.
Profile Variety	GFRP sheets can be manufactured to match almost any profile. A wide range of standard roof sheet profiles is available.
U.V. Light Opaque	Protecting furnishings, materials and people from harmful U.V. radiation.

Technical Specifications for GFRP Sandwich Boards

General Description:

panels are manufactured by press bonding **HORIZON** GFRP onto a range of core materials to produce an attractive, yet functional, cladding / infill solution for a wide variety of new build and refurbishment applications.

Weight of Panel

Thickness [mm]	Weight [kg/m2]
24 (ply)	18.11
24 (foam)	9.00
48 (foam)	11.00
57 (foam)	13.00

Fire Resistance

Products can be manufactured to different degree of fire resistance

1. General Purpose (GP grade – all products)
2. BS 476 Part 7 Class 1 (surface spread of flame, all products)
3. BS 476 Part 6 Class 'O' (heat release, all products)
4. BS 476 Part 7 Class 2 (surface spread of flame, all products)
5. Phenolic

Surface Finishes

Standard surface finishes include:

1. Smooth / Crinkle
2. Smooth / Smooth
3. Smooth / Leatherette
4. Crinkle / Crinkle
5. Smooth / Resotex
6. Leatherette / Leatherette

Thermal Co-Efficient of Expansion

30 x 10¬^(-6) /Deg C

Note: Compared with many other plastics GFRP has minimal expansion and contraction characteristics and will not bow and warp in extremes of temperature.

Colour Range

Black, grey and yellow colour as a standard. Although panels can be manufactured to the following:

1. B.S. 4800 Colour Range
2. B.S. 5252 Colour Range
3. RAL Colour Range

A colour match service is also available.

lexural Strength

193 MPa

Note: Flexural strength can be enhanced by the addition of woven reinforcement if required.

Thermal Conductivity

HORIZON: 0.2 w/mK

Fybacore: The thermal conductivity is entirely dependent on the chosen substrate, but better than 0.35 "U" value is achievable.

Tensile Stength
123MPa

Tensile Modulus
7.1 GPa
Note: GFRP sheet is up to seven times stronger than mild steel on a weight for weight basis.

Size & Thickness
Panels can be manufactured to a length of 3,300mm and a width of 1,525mm. Standard product range can be manufactured with either a plywood or Styrofoam filling – or even a mixture of both, and sometimes also includes a sheet of diamond mesh reinforcement. Thicknesses vary from 9mm to 100mm.

Logistics
Panels are usually supplied on pallets and can be delivered anywhere in the UK within approximately 710- working days under normal circumstances. Each panel can be marked with a location code and panel size on the protective covering of the goods if required.

Notes
Due to the wide variety of products and variations available in the Fybacore range, these technical specifications should be considered as a guide only. Please contact us directly for more accurate product qualities and performance ratings.

Technical Specifications for GFRP Solid Color Panels

General Description:

HORIZON panel – GFRP solid colored panel, designed for use in a general cladding, lining applications. Manufactured by combining hundreds of thousands of glass strands with pigmented thermoset UV resins.

Weight of Panel

Thickness [mm]	Weight [kg/m2]
3	4.00
4	5.10
5	6.80
6	8.10

Fire Resistance

Products can be manufactured to different degree of fire resistance:

1. General Purpose (GP grade – all products)
2. BS 476 Part 7 Class 1 (surface spread of flame, all products)
3. BS 476 Part 6 Class 'O' (heat release, all products)
4. BS 476 Part 7 Class 2 (surface spread of flame, all products)
5. Phenolic

Surface Finishes

Standard surface finishes include:

1. Smooth / Crinkle
2. Smooth / Smooth
3. Smooth / Leatherette
4. Crinkle / Crinkle
5. Leatherette / Leatherette
6. Smooth / Smooth
7. Smooth / Resotex
8. Table Finish / Crinkle
9. Table Finish / Smooth
10. Table Finish / Leatherette
11. Table Finish / Resotex
12. Crinkle / Leatherette

Table finishes primarily used when one surface is to be bonded and unseen
Smooth / Smooth only available on 6mm plus

Thermal Conductivity

Fybacore: The thermal conductivity is entirely dependent on the chosen substrate, but better than 0.35 "U" value is achievable.

Colour Range

Black, Grey (RAL 7001) and Yellow (08 E 51) color as a standard. Although panels can be manufactured to the following:

1. B.S. 4800 Color Range
2. B.S. 5252 Color Range
3. RAL Color Range

A color match service is also available.

Flexural Strength
193 MPa
Note: Flexural strength can be enhanced by the addition of woven reinforcement if required.

Tensile Strength
123MPa

Tensile Modulus
7.1 GPa
Note: GFRP sheet is up to seven times stronger than mild steel on a weight for weight basis.

Size & Thickness
Panels can be manufactured to any length but with a width restriction of 1525mm. Standard product range can be manufactured in thicknesses from 3mm upwards.

MANUFACTURING METHOD

PRODUCTION FACILITIES

Workshops must be warm, dry, clean and well ventilated. Cease manufacture if the temperature falls below 10°C or if dew point is reached. The size of the facilities required depends on the method and volume of production. In general, the following provisions are essential:

- Dry storage facilities for raw materials. Materials should be kept above freezing and protected from direct raining or sunlight
- A dry, draught-free area of at least 15°C for production
- Mixing and processing equipment
- A product curing area preferably with a minimum of 40°C and with a maximum of 50°C
- Facilities to hoist and transport freshly demolded or green products without overstressing
- A dry area of at > 35°C, to store finished products for at least three days
- An area to finish products: patching, coating, packaging, etc.

MOLDS PATTERN WORK

Depending on the type, shape of the unit, the Production Manager Production Supervisor decides whether the pattern shall be prepared or not. If required, the pattern shall be made of Gypsum, plywood, Polystyrene or combination of them in accordance to the approved production drawings. Production Supervisor & Production Manager will inspect the pattern work.

MOLD WORKS

If pattern work is required, the MOLD shall be prepared from the approved pattern; otherwise, the MOLD will be prepared as per production drawings.

All MOLDs must be having appropriate supporting system to avoid any distortion during casting. Each MOLD/panel would have unique identification. Production Supervisor will inspect the MOLD. Only approved MOLDs shall be used for casting of units. The following materials are suitable:

- GRG
- GRP
- Steel
- Coated plywood
- Elastomeric mold materials, such as latex, silicone, urethane.

Molds should be rigid under their own weight but also together with the weight of the product. They should have round corners. Raised edges should form an angle of 95° with the horizontal to enable removal. If vertical surfaces are required, it should be possible to take out parts of the mold.

RETENTION OF MOLDS:

After manufacturing ceases retain MOLDs and store in a reusable condition to allow manufacturing to recommence if required. The period of such storage is expected to be until practical completion but do not destroy MOLDs until authorized.

WEIGHING

The weighing equipment must have an accuracy of 0.1% or less. Depending on the quantity of material used a balance of 100 kg and a balance of 1000g (-/+0.05 gram) is the minimum, which is necessary for production.

FABRICATION OF FRP ELEMENTS

GELCOAT(S) TO EXTERNAL SURFACES

Mix resins thoroughly. All units of one color to have gel coats from the same color batch of resin. Apply evenly to give an overall nominal thickness of 500 microns. Check the wet film thickness of the gel coat(s) of all units in accordance with BS 3900: Part C5, Method 7, four readings per sq m per coat over the external surface area.

If single gel coating is used, no reading to be less than 400 microns nor more than 600 microns and average of readings for each unit to be within the range of 450550- microns.

If double gel coating is to be used, submit proposals for coat thickness limits based on the resin manufacturer›s recommendations, and obtain approval.

HAND LAY-UP

The next step in the contact molding process is the lay-up of the glass fiber reinforcement with polyester resin. Lying up can be started as soon as the gel coat has hardened sufficiently to withstand solvent attack from the laminating resin. Chopped strand glass fiber mat is the most usual reinforcement for contact molding. The amount of resin required can be calculated by weighing the glass fiber to be used for the molding. For chopped strand mat the resin: glass ratio should be between 2.5:1 and 2:1 weight (2933%- glass by weight).

SPRAYING

Simultaneous depositing of polyester resin and chopped glass fiber by spray molding equipment. Although much of the manual labor of hand lay-up is eliminated by using a spray process, thorough rolling is still necessary not only to consolidate the deposited glass/resin mixture, but also to ensure that the accelerated and catalyzed portions of resins are adequately mixed. Considerable skill is required to control the thickness of the laminate when using a glass/resin depositor and to maintain a consistent glass/resin ratio.

The spraying of gel coats can be carried out either by catalyst injection system or the one pot system. When the volume of production is large enough to keep the equipment in constant use, spray techniques are fully justified. Spraying is now widely used throughout the world and in the hands of an experienced operator most types of spray equipment will significantly increase output compared with application by brushing.

INSERTS AND EMBEDMENT

Ensure that all core materials, ties, ribs, fixings and accessories are fully bonded to the GRP skin(s) over the full contact surface area. Fixings to be of a suitable type of stainless steel, nonferrous metal or GRP and to be such as to avoid bimetallic corrosion.

And For best results, ensure that:

- Each GRP skin contains not less than 900 g/sq m of glass fiber, in not less than two layers.
- Random reinforcement is distributed uniformly, and non random reinforcement is correctly positioned and aligned.
- Each layer of woven fabric reinforcement has a layer of chopped strand mat on both sides.
- The glass is fully wetted out by the resin, with a resin/glass ratio of not less than 2:1 higher as appropriate.
- There is a good overall bond between all gel coats and all layers of laminate.
- The GRP is well consolidated and free from air voids.

SEALING OF UNITS

Apply a flow coat to all surfaces of the finished units which are not gel coated. Thoroughly seal all cut edges, holes etc., to protect the glass fiber from penetration of moisture.

CURING

All units must be adequately cured at @ 50° C (higher as necessary) for not less than 8 hours (longer as necessary). Ensure that units are not distorted whilst being cured.

TRIMMING AND FINISHING

Trim the laminate while the resin is still in the “green” stage. This can be carried out with a sharp trimming knife held at right angles to the laminate. Great care should be taken not to disturb or distort the molding at this stage.

Fully Cured FRP is not an easy material to Cut or machine, since it will quickly blunt most ordinary steel tools. Abrasive discs or wheels are recommended for cutting wherever possible. Portable hand tools are often used for awkwardly shaped laminates, and portable reciprocating electric saws have proved useful for trimming and slotting, especially if high grade saw blades are used. It is essential that the resin is fully cured before any finishing operations are undertaken.

Even when the pigmented gel coat has been used and subsequent painting is not required. The molding can then be buffed or polished with any of the normal cutting compounds.

If the molding is to be painted, extra care must be taken to ensure that all traces of release agent are removed from the molding. The surface to be clean and dry and it is advisable to first rub the surface with a fine abrasive to obtain efficient keying. Most paint systems can be used on FRP laminates.

PROTECTION

- Prevent mechanical damage and disfigurement. Separate units during transport and storage to prevent chaffing. Pad all slings, ropes, bearers, ladders etc.

Support units as necessary so they do not bow, twist or distort.

- Adequately protect units from the weather. Surfaces not having a weathering gel coat must not have prolonged exposure to direct sunlight or water.
- Do not cover units with plastics sheeting or stick adhesive tape on exposed surfaces.
- Store fixing and jointing materials indoors.
- Do not deliver to site any units which cannot be erected immediately or unloaded into a suitable well protected storage area.

QUALITY ASSURANCE

Manufacture GRP units carefully to ensure compliance with design and performance requirements, using materials and workmanship appropriate for the purpose.

All materials must be compatible with each other, and must be stored and used in accordance with the manufacturer›s recommendations. Resins must be used as supplied and not mixed. Fillers and admixtures may be used only where authorized.

The standard of finish must be appropriate to the end use and position in the building. Ensure that defects such as wrinkles, spotting, striations, fiber patterning, fish eyes, blisters, crazing, cracking, dry patches and uneven or inconsistent color do not occur.

PRODUCTION CONTROL (UNIT)

The first unit produced of each of the types is to be inspected and, if its appearance is approved, clearly marked and kept safely at the shop as a control standard for appearance of subsequently produced units. Control units to be delivered to site last.

The first unit of each type and size produced is to be thoroughly checked for compliance with the design and specification, and the weight recorded. All subsequent units must then be weighed, and must not deviate from the weight of the first identical unit by more than +/- 10%. Inform.

INSPECTION

All completed units must be carefully inspected and checked by the manufacturer for match with approved sample(s) or control unit(s) and compliance with specification before dispatch to site.

RECORDS

Keep completed records for each unit including the following information:

- Unique identification number.
- Full details of composition.
- Date of each stage of manufacture.
- Dates and results of all tests, checks and inspections.
- Dimensions related to specified levels of accuracy.
- Specific location in the finished work.
- Details of any damage and making good.
- Any other pertinent data, e.g. If the unit is an approved production control unit.

TRANSPORT

Lifting equipment may be necessary for the removal of larger-size panels from the mold. Also, after demolding in-plant transport facilities may be required (trucks, etc.).

When loading for transport to the building site, direct contact of the FRP with iron chains, etc., should be avoided. FRP products should be kept free of one another during transport; this can be done using rubber or plastic sheeting. The same applies to unloading on the site and to erection.

FRP products should be stored properly on the jobsite, for instance under cover, protected, and out of standing water until erected.

INSTALLATION METHOD

Sequence and schedule of installation will be submitted before installation. Review of shop drawings and familiarization with all dimensions is a must before starting. Verify that piece dimensions match the shop drawings.

SETTING OUT

Level and proper alignments are required at the exterior face of the FRP panel. To achieve this, markings will be done prior to the commencement of installation. The concrete/masonry substrate or steel structure to which the FRP panels to be fixed will be within the tolerance limits (for line, level, sureness, smoothness of curves) as per the general industrial standards to facilitate template preparation and fabrication of panel.
Large profiles (ceiling panels, etc.) will be somewhat flexible, allowing for some adjustment and also some difficulty in measuring. Use clamps or other methods to fix to correct shape if necessary. Any discrepancies or confusion with shop drawings must be brought to the designer and project Engineer's attention before installing the product.

INSTALLATION

- The support structure and/or framing to accept FRP parts and fabrications shall be installed level, straight and true within 3mm in 2500mm.
- The substrate shall be free of obstructions and interference that prevents the correct positioning and attachment of the FRP parts. Structural framing and substrate materials shall be of the proper size and design for the intended use and shall be sufficient to properly support the installed FRP parts.
- Refer to the shop drawings for specific details to install the FRP parts and/or fabrications.
- Part thicknesses may vary. Allow for shim spaces between the FRP and the substrate.
- Attach the FRP parts using corrosion resistant screws, bolts or other fasteners as shown on the shop drawings. Additional bracing, or fastening points etc. not shown on the shop drawings, may be required to ensure a proper installation.
- Wherever possible, FRP parts are to be installed with concealed fastening methods.
- Monolithic Joints used to make two or more parts appear as one continuous piece are generally NOT recommended except for specific applications as detailed on the drawings.
- All FRP joints must be caulked. A color matched or paintable one-compound elastomeric, low modulus, polyurethane sealant or equivalent is recommended-caulk supplied by others (e.g. Sonolastic Ultra or equivalent).
- Apply low tack masking tape on either side of the joint and avoid smearing caulk beyond the joint-remove any excess immediately
- Use spacers to maintain a uniform gap between parts and install a bond breaker tape inside the joint over top of the fasteners.
- **HORIZON** supplies a gelcoat putty for hole patching of the same color as the parts supplied.

CUTTING

Cutting dust represents a nuisance dust when exposed to low concentrations from occasional cutting and grinding operations associated with the installation of METARA FRP parts that may cause irritation to the eyes, skin or respiratory tract. Take precautions to minimize exposure. Wherever possible; cut/grind/sand outdoors or in a well ventilated area. Always wear goggles, a dust mask, and protective clothing to minimize any irritation.
Use the most applicable method listed below for the type of cut required:

- A reciprocating saw with a medium composite type blade.
- A hand held disc grinder with a 4" diameter medium composite or Diamond blade.
- A chop saw with a medium composite or Diamond blade for cutting small moldings or batten strips etc.

METHOD

To prevent chipping the Gel coat surface, apply painter's tape over the cut line and cut through the tape.
Perform a test cut(s) first to validate the saw and blades effectiveness.

ATTACHMENT

CONCEALED FASTENING

Wherever possible, FRP parts are to be installed with concealed fastening methods such as beneath flashings or behind caulked joints. Parts should have pre-drilled oversize clearance holes for fasteners and neoprene shims (or equivalent) installed behind the panel edges being fastened to facilitate movement due to expansion and contraction. A bond breaker tape should be applied inside the joint over the top of the fasteners prior to caulking the joint. Refer to Figs.1 and 2 below.

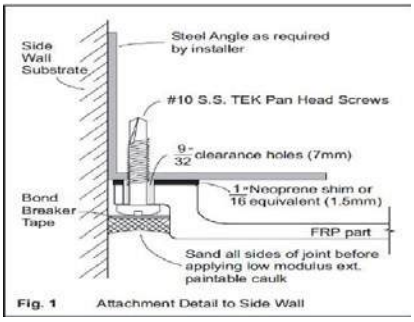


Fig. 1 Attachment Detail to Side Wall

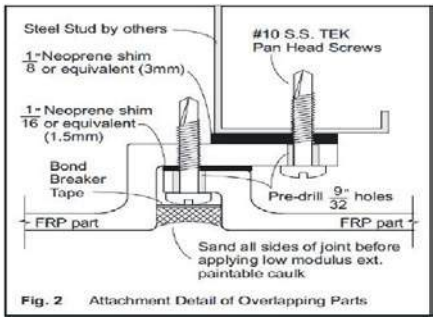


Fig. 2 Attachment Detail of Overlapping Parts

FACE FASTENING

Where face fastening is called up on the shop drawings for attachment to the structure the FRP components should be pre-drilled and counter bored to accept No.10 self-tapping screws with their length and thread style to suit the condition (stainless steel fasteners are recommended).
Screw holes should be filled afterwards with color-matched gelcoat putty and sanded or polished to match factory finish (Gelcoat materials supplied by **HORIZON**).

PRE-MITERED CORNERS

Where fiberglass moldings are supplied with pre-mitered flanged ends it is best to pre-fabricate the corner before attaching it to the structure. To do this, align the moldings and clamp the flanges together. Then drill bolt holes through the flanges 75mm to receive a 516/ hex head bolt. Unclamp the moldings, mix and apply MMA adhesive or fiber filled polyester adhesive to the flange of one part, assemble, and bolt tightly together (Polyester adhesive supplied by **HORIZON**).

FIELD CUTTING

Where shop drawings call for the component to be field cut to suit site conditions, the fiberglass part can be cut using a reciprocating saw with a medium composite type blade. To prevent chipping the gelcoat it helps to apply masking tape along the cut line, then cut through the tape. If after field cutting, two parts of similar profile are to be joined together the preferred method is with Batten strips. Alternatively, it is recommended that both parts be face fastened to the support structure, then if access permits, fiberglass the parts together on the backside using polyester resin and fiberglass mat. The joint on the show face can be filled using gel coat putty supplied by **HORIZON** then sanded and finished to match the factory finish of the parts.

BATTEN STRIPS

In situations where an intermediate part's length must be cut shorter to meet job site conditions and attached to other overlapping parts, the use of "Batten" strips for attachment purposes is recommended. **HORIZON,** can supply Batten strips for attaching to the backs of cut FRP parts. The Batten strips for attached to the cut FRP parts with the use of a polyester adhesive supplied or recommended by **HORIZON,** for this purpose. After the batten strips have been securely bonded to the cut FRP parts, install them to the adjoining FRP parts and framing or substrate .

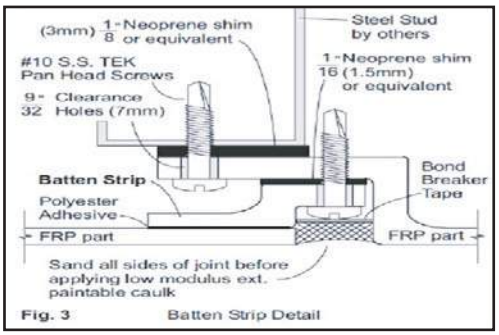


Fig. 3 Batten Strip Detail

JOINTS TREATMENT

TYPICAL MONOTHOLIC JOINTS

Monolithic joints are NOT generally recommended. Use only when indicated on approved drawings.

JOINT PREPARATION

- Install the first component as per shop drawings.
- Dry fit the next component to the installed component to insure the joint fits and aligns:

 For a bolt flange detail; align the joint, clamp the flanges together, and drill the clearance holes for the bolts. This will allow the bolts to align the joint when the components are fastened together.

 For overlap details; after the joint is fit together, remove the part and drill and countersink the clearance holes for the screws through the tape joint bevel.

- With 150 - 180 grit sandpaper sand the joint where components will be contacting each other, the tape joint bevel, and the face of the components extending ~50mm out from the center of the joint. This will ensure the surface is cleaned of any dirt, oils or waxes.

JOINT ASSEMBLY

- Apply a continuous bead of adhesive to the mating faces of the installed component. For this application, **HORIZON,** recommends a Methacrylate adhesive system or a fiber filled polyester adhesive with an extended 'gel time'.
- Assemble the prepared component to the installed component, fastening the part to the framing and mechanically fastening the joint flanges together. Refer to Fig.4.
- Wipe off excess adhesives and allow adhesive to cure.

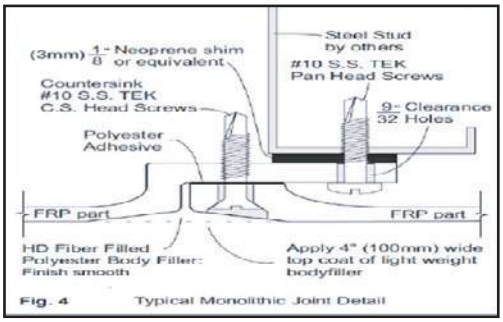


Fig. 4 Typical Monolithic Joint Detail

JOINT FILLING

- Using a heavy duty, fiber filled polyester body filler; fill the joint, allow curing and sanding the filler smooth to the face of the FRP components. Finish sand with 120 -150 grit sandpaper.
- Using A light weight polyester body filler of fairing putty, apply a thin layer over the first fill extending out ~50mm from the center of the joint. Allow to cure and sand, tapering the patch from the center of the joint to where it meets the face of the FRP component. Finish with 150180- grit sandpaper.

PAINTING

- Lightly sand the complete assembly of components.
- Ensure all of the body filler used for hole filling, patching or repairs is primed before painting. Use a primer that is compatible with the finishing paint.
- Finishing paint: check with the paint supplier for recommended paints. METARA suggests 'high solids polyurethane' for exterior applications and acrylic, polyurethane, or oil based enamel for interior applications.

PATCHING, FINISHING and REPAIRING

INSTRUCTIONS FOR MIXING AND APPLYING POLYESTER ADHESIVE

The working time for polyester adhesive is 15- 20 minutes depending on the ambient temperature. Best results are obtained when temperatures are 18°C - 30°C. Do not mix more material than can be used within the working time.

MIXING:

Measure out the amount of #60- 16 adhesive required into an 240 ml container and catalyze at a rate of 1 to 1½ % by weight. Mix thoroughly with a small putty knife until the mixture turns into consist thick paste.

APPLICATION

The catalyzed adhesive is applied by a putty knife to the bonding surface of one of the parts. Components should be clamped or bolted together and excess adhesive removed. The assembly should be left undisturbed for 3 -4 hours for the adhesive to fully cure (dependant on temperature).

CLEAN-UP

Prior to curing, the polyester adhesive can be removed by Acetone. Once cured the adhesive must be removed by using a grinder or power sander. It is best to clean up the excess adhesive before it is fully cured.

INSTRUCTIONS FOR MIXING & APPLYING GELCOAT PUTTY

The gelcoat putty supplied is the same color and batch number used in production of the parts. The working time for the gelcoat putty will be 15 -20 minutes depending upon the ambient temperature. Best results are obtained when temperatures are 18°C - 30°C. Do not mix more material than can be used within the working time.

PREPARATION

Sand the surface where the gelcoat putty is to be applied to ensure that all surface oils or mold release agents are removed. Clean the surface with acetone.

MIXING

Measure out the amount of gelcoat putty required into a 240ml container and add catalyst at a rate of 1 to 1½% by weight. Mix thoroughly with a small putty knife.

APPLICATION

The catalyzed gelcoat putty can be applied by a putty knife to the void or screw hole to be filled. Putty should be left undisturbed for 3 to 4 hours to cure depending on temperature. All polyester materials including gelcoat putty will shrink during cure therefore over fill the void or a second filling may be required.

FINISHING

It is best to allow 3 -4 hours for the putty to cure before sanding. This time will vary with temperature. Wet sand the putty patch until the desired finish is obtained starting with 180> 240> 320> 400>600> 1200 grit wet sandpaper then polish with a polishing compound if high-gloss is required. When sanding the putty, be careful not to sand through the original gelcoat surface, use a block and sand lightly. If factory finish is sanded through gelcoat resurfacing will be required (Refer to ‹Instructions for Gelcoat Resurfacing›).

Clean-Up

Prior to curing, the gelcoat putty can be removed using acetone.

INSTRUCTIONS FOR PERFORMING GELCOAT

RESURFACING

The gelcoat supplied is of the same color and batch number used to produce your order. Properly catalyzed this will allow a working time of 15 -20 minutes (30 -40 minutes with spray formula). Best results will be obtained when temperatures are between 18°C - 30°C. Do not mix more material then can be used within the working time.

PREPARATION

Sand the area to be resurfaced with 180 grit sand paper and wipe with clean acetone. This ensures that all surface oils and mold release agents are removed.

MIXING & APPLICATION

BRUSH

Measure out the required amount of gelcoat into a paper cup. Add catalyst at a rate of 12%- by weight.

DO NOT OVER CATALYZE OR THE GELCOAT WILL NOT CURE. Mix thoroughly with a stir stick. Using a soft brush apply an even layer of gelcoat over the area to be resurfaced. If gelcoat starts to thicken (gel); stop, clean brush and mix a new batch of gelcoat.

SPRAY

Mix material as detailed in “BRUSH” and thin with acetone (up to 25%) to achieve spray able viscosity. Apply in 3 -4 thin layers allowing 5 -10 minutes between layers for solvents to evaporate.

FINISHING

It is best to allow 8 -12 hours for the gelcoat to cure before sanding. This time will vary with temperature. Wet sand the gelcoat patch until the desired finish is obtained starting with 240> 320> 400>600>1200 grit wet sandpaper then polish with a polishing compound if high-gloss is required. Matt finish is achieved at a 240 level with no polishing required.

CLEAN-UP :

Prior to curing, the gelcoat can be removed using acetone.

REPAIRING : The following repair method is used for damage which penetrates completely through or deeply into the entire laminate.

REPAIRS FROM THE LAMINATE SIDE OR INSIDE

- Prepare the affected area by cutting away the fractured portion of the laminate to the solid part of the laminate. A keyhole or saber saw works well to cut away these ragged edges.
- Roughen up the inside edges of the affected area, using a power grinder. Feather out the backside at least 50mm beyond the diameter of the hole to be patched.
- Clean the surface and remove all paint or foreign substances. Use a template to give ‹shape› following the show face to the part. Tape cellophane (or wax paper) in place over a piece of cardboard (or aluminum) large enough to completely cover the affected areas with the cellophane against the show face of the part. (Aluminum is used when contour is present).
- Cut glass fabric and mat to the shape and size of the hole. Cut another set of reinforcement 50mm larger in diameter than the hole. The materials and total thickness of each set should approximate that of the part being repaired. A set of reinforcement should consist of multiple layers of glass fiber mat followed by a layer of glass cloth.
- Mix an ample amount of resin (approximately one pint per m2) and catalyst (4cc/240ml.) thoroughly. Using the hole-sized set of reinforcement, daub catalyzed resin onto the glass mat to thoroughly wet it out. Wet out the glass cloth in a similar manner. Apply the mat against the surface inside the hole. Then apply the cloth.
- Roll out or squeegee out all air bubbles. Allow the area to cure well. Build this laminate up to the same thickness or greater than the thickness of the original laminate.
- Apply catalyzed resin and the larger reinforcement over the hole patch and the surrounding surface.
- After the laminate has cured. Remove the cellophane and backing from the outside of the hole. Rough up this surface from outside, feathering the edge with a power grinder. Fill any
- Voids with polyester body filler and sand smooth to the show face using 180 grit sand paper
- Now follow procedures detailed in “Instructions for Performing Gelcoat Resurfacing”.

REPAIRS FROM THE SHOW FACE SIDE

- If it is not possible to access the backside (blind hole) of the part, a template will not be used. Cut a piece of cardboard half again the size of the hole. Then cut the fiberglass mat and cloth along the same outline as the cardboard insert. Cut a second set of fiberglass mat to fit the hole and a thickness equal to the part. Thread a wire or wires through the center of the cardboard insert and then through the sets of fiberglass.
- Rough up the inside edges of the hole to at least half again the diameter of the hole. If a power grinder cannot be used, thoroughly sand by hand with coarse sand paper.
- Mask the area around the repair with paper and tape to protect the show face.
- Wet out the fiberglass with catalyzed resin. Force the plug through the hole. (Don›t worry about neatness, the first concern is a structurally sound repair) Use the wire to pull back and secure the plug until the resin cures. When cured, check adhesion of the plug and proceed.
- Grind and sand down the patch and feather the surface to the show face. Fill any voids using polyester body filler. Using 80 grit sandpaper then 180, smooth and blend the surface to be coated into the surrounding show face surface.

CARE & MAINTENANCE

GELCOAT FINISH

The colored show face on your FRP product consists of a 1520- mil thickness of an NPG polyester gelcoat with integral color. This is a hybrid gelcoat formulated to provide color stability and weather ability for many years.

NORMAL MAINTENANCE

To maintain the surface finish, clean with soap and water or household liquid dishwasher detergent. More stubborn stains, minor cigarette burns and scratches can be removed by wet sanding the mark out and renewing the gelcoat to the desired finish. Start with 180>320 >400 >600 >1200 grit wet sand paper then polish with a polishing compound if high gloss is required.

GELCOAT REPAIR

Should the panel be fractured during installation or use and the damage is to the gelcoat only (gouge or scratch) that is deep enough to penetrate through the gelcoat but not deep enough to penetrate through the fiberglass laminate, follow the repair procedures detailed in: “Instructions For Mixing & Applying Gelcoat Putty” followed by “Instructions For Gelcoat Resurfacing”.

FRP STRUCTURAL REPAIR

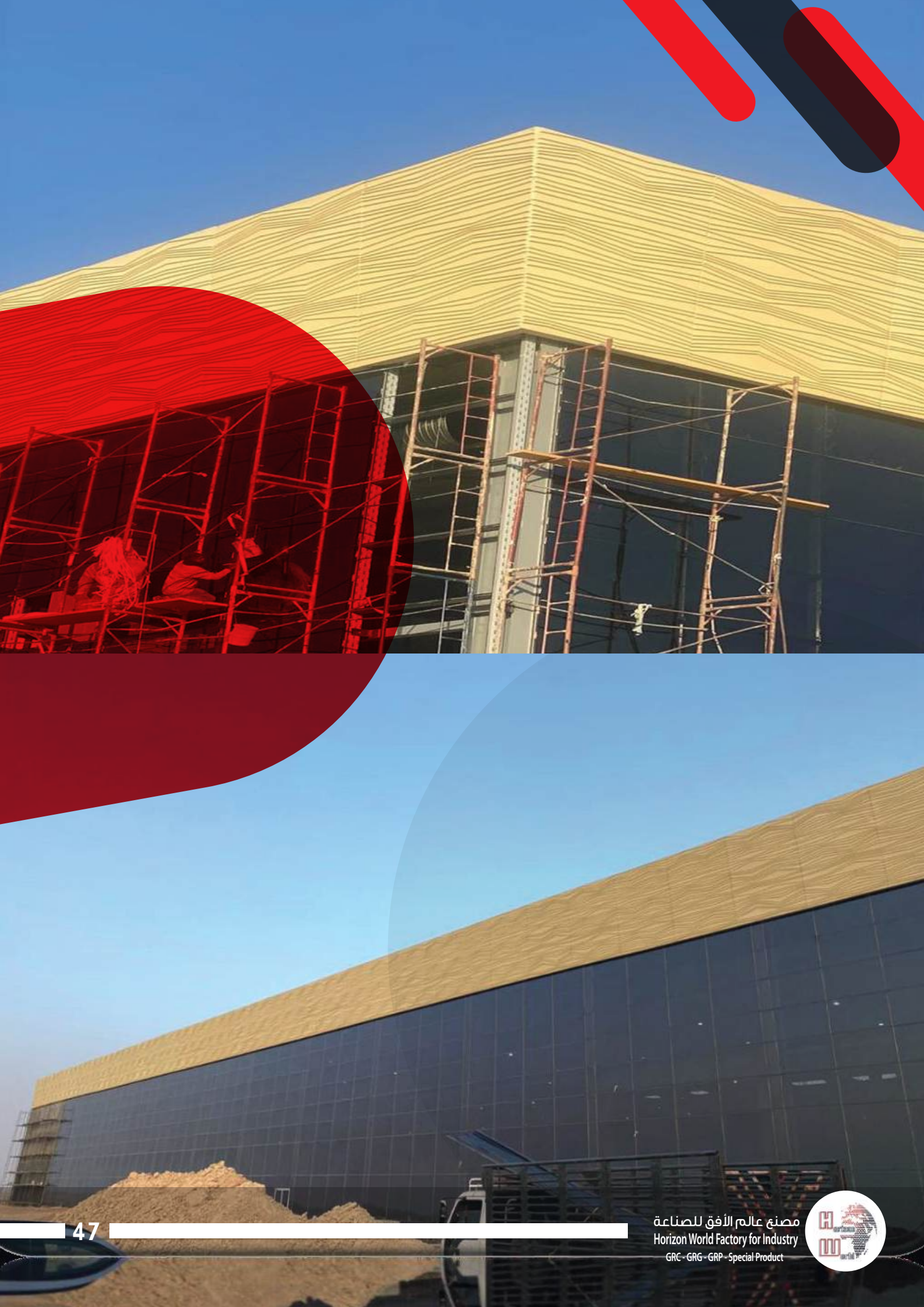
Should the product be damaged to a point where the fracture penetrates completely through the structural fiberglass laminate, follow the repair procedures detailed in “Instructions for Repairing FRP Laminate Fractures” followed by “Instructions for Performing Gelcoat Resurfacing”.

PROTECTION OF ERECTED WORKS

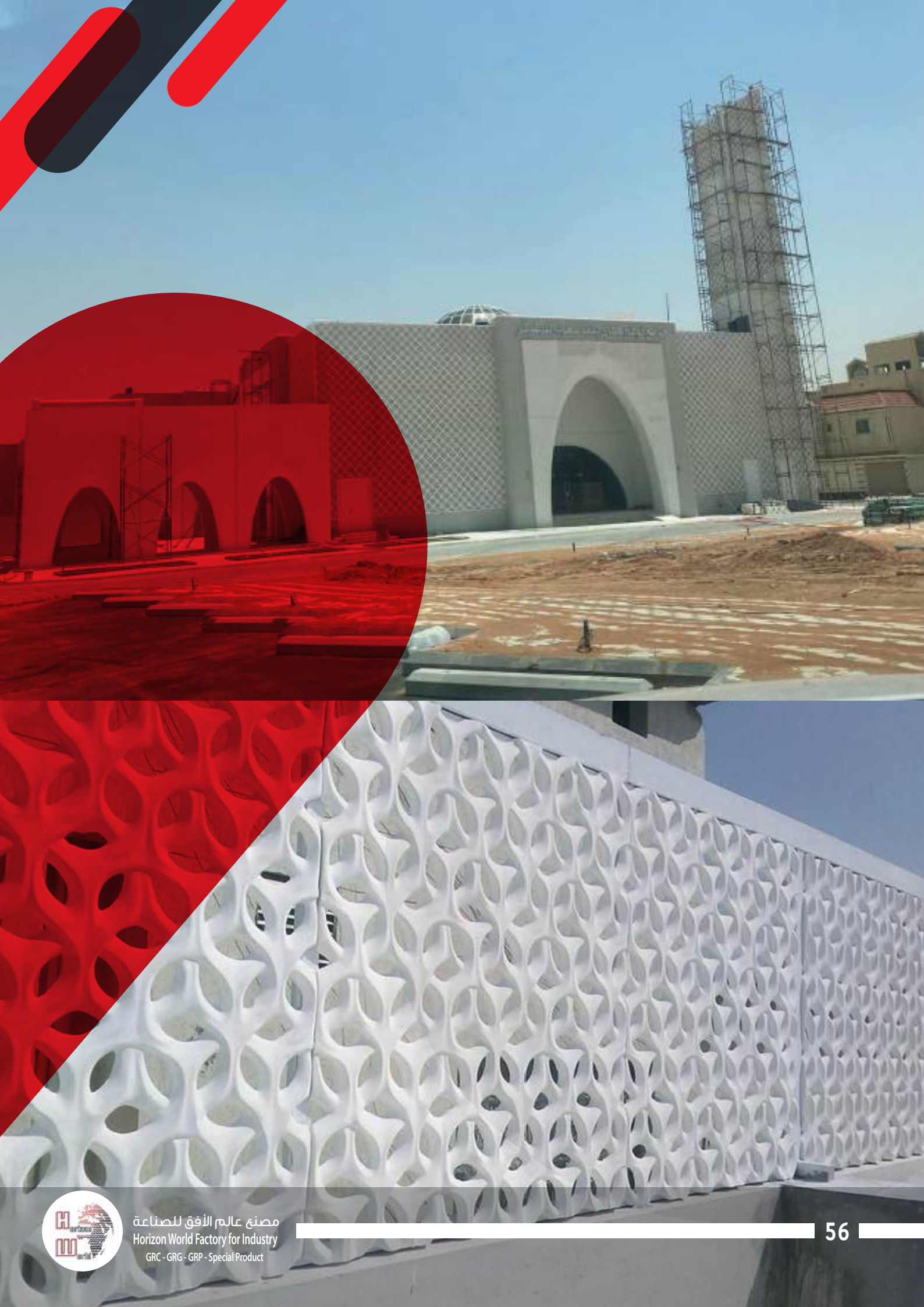
On completion of each elevation, the area will be inspected by **HORIZON** Site Engineer and offered for Main Contractor’s & Consultant’s inspection.
Any comments/snags shall be attended and completed works re-inspected.
If any activities to be carried out after completion of FRP Installation , then the concerned trade has to protect the completed FRP works from Spillage of foreign materials.

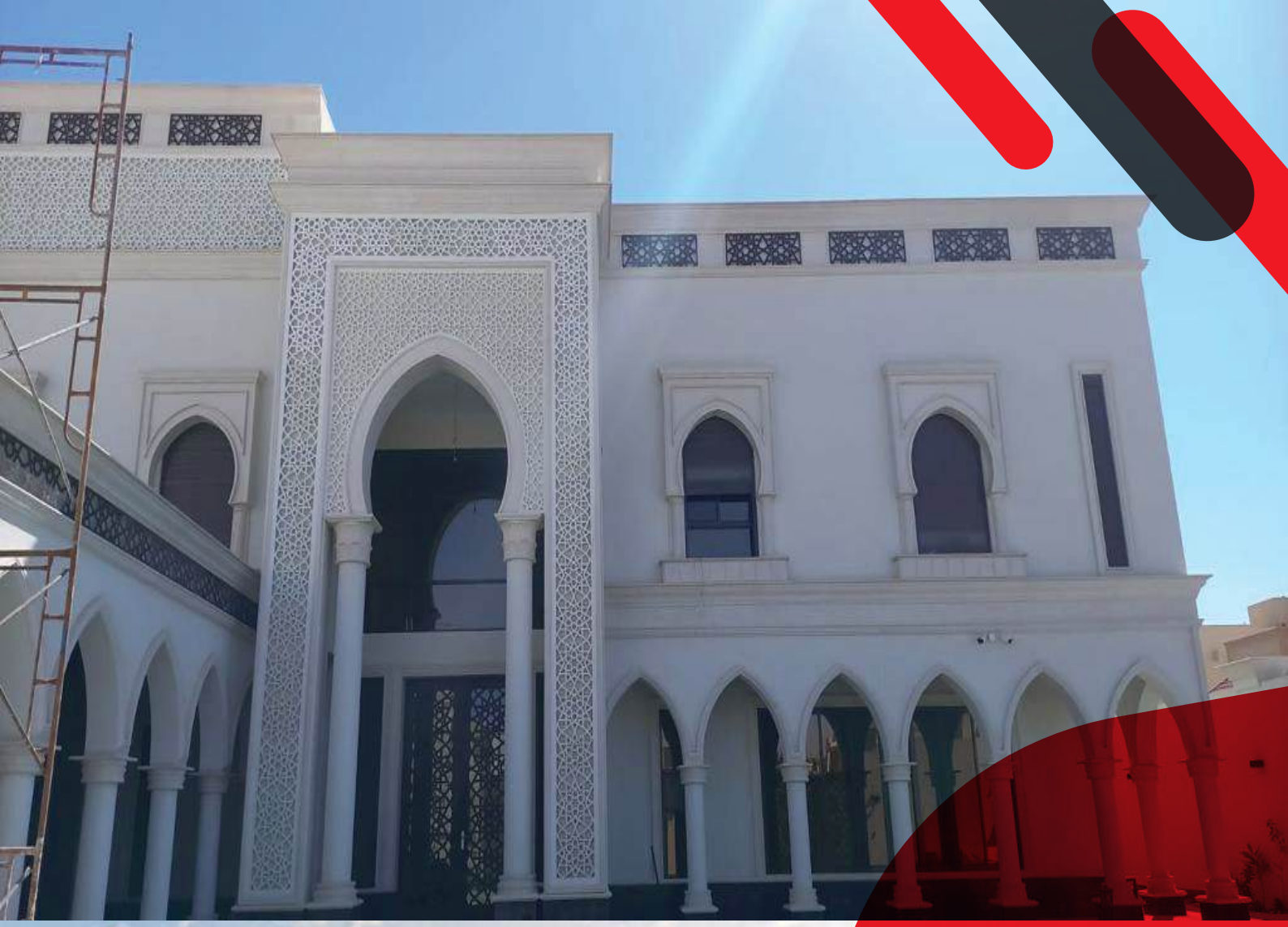
Reference Standards

I ASTM D2992 Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for «Fiberglass» (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings I ASTM D3517 Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe I ASTM D3567 Standard Practice for Determining Dimensions of Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings I ASTM D2996 Standard Specification for Filament Wound Fiberglass(Glass Fiber Reinforced Thermosetting Resin) Pipe.




STORE





CLINT LIST

DALLAH HOSPITLA (YOUSEF MARRON) MARRON)

RASHID MALL (ARTAR)

AHMED AL MOTAIRY (PRIVATE VILLA)

JARIR BOOKSTORE (ARABIAN COMPANY)

ALIYA BULDING

AL-ARRAB - JEDDAH

JIZAN UNIVERSITY

ABDULLAH ALOTHMAN (PRIVATE VILLA)

IRQA MOSQUE (ALMODON ARABIA)

MOHAMMED AL OMRAN (PRIVATE VILLA)

KHALED AL SOFIRAN (PRIVATE VILLA)

MOSQUE JEDDAH (PRIVATE)

ABV ROCK

AL-AFASI (PRIVATE VILLA)


GENERAL MANAGER
EXECUTIVE DIRECTOR
FACTORY MANAGER
(1)
SALES DEPARTMENT
(1)
SITE ENGINEER
(2)
CASTING LABOR
(14)
QUTATION & PRICING
(1)
SITE FORMAN
(3)
MOULD MAKER
(3)
CIVIL ENGINEER
(1)
SITE LABOR
(12)
FINISHING LABOR
(5)
ARCHITECT ENGINEER
(1)
CNC TECHNICAL
(1)

EQUEPMENT AND MACHINARY LIST

Descriptions	Number
CNC Machine Router	1
GRC Spray Machine	2
Carpentry Machines	1
Air Compressor	1
GRC Mixer	1

ورقة البيانات الفنية

JOTUN
Jotun Protects Property

Jotashield Colourlast Matt

وصف المنتج

النوع

يستخدم هذا المنتج الخارجي ذو جودة عالية كوجه نهائي. وهو ذو أساس مائي من الاكريليك الخالص 100%

الصفات والمزايا

تمنح الألوان الفريدة المحمية من الأشعة فوق البنفسجية حماية رائعة ضد التأثير المتلف للأشعة فوق البنفسجية الموجودة بضوء الشمس. مصمم خصيصا لتحمل الظروف المناخية القاسية للشرق الأوسط ويقدم قدرة على التحمل وتشطيب مطفي ذو عمر طويل والتقاط منخفض للأتربة تركيب متفرد يحمي الخرسانة من الكربنة (اختراق ثاني أكسيد الكربون للخرسانة)

الاستخدام الموصى به

مثالي للتحمل وحماية الأسطح الخارجية. يمكن استخدام هذا المنتج في المساحات الداخلية كجراجات السيارات المظلية والأسقف حيث أنة فعال كطبقة مانعة للكربنة

السطح

جص أسمنتي، وخرسانة، والبناء الطوبي، والأسطح الممونة وألواح الجبس وغير ذلك.

يجب أن يتمتع السطح المنوي طلائه بالقوة الكافية لتحمل الدهان. لذلك يجب معالجة أي نوع من الشقوق أو الثقوب أو النتوءات قبل المباشرة بعملية الدهان. قبل استخدام أي مواد حشو مسامية عن جهة أخرى، يجب التأكد من ملائمتها مع منتجاتنا وذلك عبر سوال جوتن.

بيانات المنتج

حجم التعبئة			L 1، L 4 و L 18 مصر و ليبيا : L 1 و L 10
الألوان			ارجع إلى بطاقة اللون الخارجية لمنتج جوتاشيلد.
المواد الصلبة حسب الحجم	34 ± 2	الحجم%	نظري
الوزن النوعي	1.31		نظري فقط في حالة الأبيض
المواد العضوية الطيارة (VOC)	22	g/l	ISO 11890 EU
المواد العضوية الطيارة (VOC) ملاحظات			هذه القيمة نظرية، وسوف تختلف حسب نوع الإختبار ، دقة المعدات وظروف الإختبار.

بيانات التطبيق

يمكن تطبيق المنتج بواسطة

البكرة : مُوصى بها

عن طريق الرش : استخدم الرش المضغوط أو الرش التقليدي.

فليجو : موصى به لطلاء الزوايا والحوافد.

بيانات إرشادية لاستعمال الرُش

فوهة	0.021–0.027"
زاوية الرُش	65–80°
الضغط في الفوهة	140 - 190 kg/cm² (2100 psi)

تنظيف أدوات الطلاء

ورقة البيانات الفنية

Jotashield Colourlast Matt

JOTUN
Jotun Protects Property

الملاحظات

قد تكون بعض الأنظمة الأخرى محددة حسب منطقة الاستعمال.

شريط الفصل اللاصق فور انتهاء تطبيق الوجه النهائي

يجب خلط محتويات العبوات التي تحمل أرقام تشغيلات مختلفة معًا قبل الاستعمال.

يُرجى الرجوع إلى إدارة المبيعات الإنشائية للاستشارة الفنية.

يتوافر هذا المنتج في: الإمارات العربية المتحدة، البحرين، الكويت، قطر، سعودي، عمان، مصر و ليبيا

التخزين

ينبغي تخزين المنتج طبقًا للقوانين الوطنية. تتمثل شروط التخزين في أن تُحفظ الحاويات في مكان جاف بارد بتهوية جيدة وبعيدًا عن مصادر الحرارة والإشتعال. يجب الاحتفاظ بالحاويات مغلقة بإحكام.

الشهادات

معدل انتقال الماء السائل : مُنخفض (التصنيف طبقًا للمواصفة EN-1062-1.): 99.85 % تقليل امتصاص الماء:center Technology, المملكة المتحدة.

معامل انتشار ثاني أكسيد الكربون : التصنيف طبقًا للمواصفة EN-1062-1. : سُمك طبقة هواء مكافئة : : IBOS

الصحة والسلامة

يرجى مراعاة المحاذير البيئية والوقائية المعروضة على الحاوية.

تم إصدار نشرة بيانات سلامة المادة للمنتج
وتشمل نشرة بيانات السلامة الخاصة بالمنتج على المعلومات المفصلة المتعلقة بأخطار الصحة والسلامة والإجراءات الوقائية المتعلقة باستعمال هذا المنتج.
إجراءات الإسعافات الأولية، ارجع للقسم 4.
المناولة والتخزين، ارجع للقسم 7.
معلومات النقل، ارجع للقسم 14.
المعلومات التنظيمية، ارجع للقسم 15.

إخلاء المسؤولية

تم تقديم المعلومات الواردة في هذا المستند وفقًا لأحدث المعلومات المتوفرة لدى شركة Jotun، وبناءً على الاختبارات المعملية والخبرة العملية. تعتبر منتجات Jotun من السلع شبه الجاهزة، وباعتبارها كذلك، فإن هذه المنتجات دائمًا ما يتم استخدامها وفقًا لشروط معينة تحت رقابة شركة Jotun. ولا تضمن شركة Jotun أي شيء سوى جودة المنتج نفسه. تحتفظ شركة Jotun بالحق في تغيير البيانات المقدمة دون إخطار مسبق. وينبغي على المستخدمين الرجوع إلى شركة Jotun للحصول على الإرشادات الخاصة بمدى ملاءمة هذا المنتج بوجه عام لاحتياجاتهم الخاصة وللاستخدامات المحددة. وفي حالة التضارب بين إصدارات اللغات المختلفة من هذا المستند، فإن النسخة الإنجليزية (المملكة المتحدة) هي التي تكون سارية ويتم العمل بها.

وينبغي على المستخدمين الرجوع إلى شركة Jotun للحصول على الإرشادات الخاصة بمدى ملاءمة هذا المنتج بوجه عام لاحتياجاتهم الخاصة وللاستخدامات المحددة

إصدارات اللغات المختلفة من هذا المستند، فإن النسخة الإنجليزية (المملكة المتحدة) هي التي تكون سارية ويتم العمل بها.

ورقة البيانات الفنية

JOTUN
Jotun Protects Property

Jotashield Colourlast Matt

سمك الطلاء لكل طبقة

مجموعة الموصى نموذجي

سمك طبقة الطلاء الجافة	35	-	50	µm
سمك الطبقة الرطبة	102	-	147	µm

جودن - سوف يختلف سمك الطبقة وسوف لحسب كمعدل متوسط.

معدل الفرد النظري	9.7	-	6.8	m²/l

يعتمد معدل الفرد على سمك طبقة الطلاء المطلوبة، ونوع ملمس السطح، ومسامية السطح، والعيوب ودرجة الحرارة، والفاقد أثناء الطلاء وغير ذلك.

ويتم احتساب الحد الأقصى لمعدل انتشار في معطف في الحد الأدنى سمك الفيلم الجاف والعكس بالعكس.

مخفف

الماء

التخفيف

الحد الأقصى 10%

الظروف أثناء الاستعمال

يجب أن تكون درجة حرارة السطح أقل من 10 درجات مئوية كحد أدنى و3 درجات مئوية على الأقل فوق درجة التكثف الخاصة بالهواء، ودرجة الحرارة والرطوبة النسبية المقيسة بالمحيط المجاور للسطح. لمد التهوية الجيدة مطلقا أيضا في المساحات الضيقة لضمان جفاف مناسب.

زمن الجفاف

رتبط فترات الجفاف بشكل عام بحركة الهواء ودرجة الحرارة وسمك طبقة الطلاء وعدد طبقات الطلاء وسوف تتأثر بها طبقا لذلك.

1. البيانات الموصى بها مخصصة لحالة إعادة الدهان بنفس نوع الطلاء العام.

2. في حالة التطبيق المتعدد للطبقات، تتأثر فترات الجفاف بعدد الطبقات المطلية السابقة وتتابعها وإجمالي سمكها.

3. يجب أن يكون السطح جافا وخاليا من الملوثات قبل دهن طبقة الطلاء اللاحقة.

يتم قياس مدة التجفيف من خلال القيم التالية:

الرطوبة النسبية 50%			
درجة حرارة السطح	10 °C	23 °C	40 °C
جفاف السطح (عند اللمس)	12 h	6 h	2 h
شديد الجفاف	16 h	8 h	4 h
تجفيف الطلاء الزائد، الحد الأدنى	12 h	6 h	2 h

توجيهات الاستخدام

إعداد السطح

يجب أن تكون طبقة السطح سليمة ونقية وجافة وخالية من الغبار والزيت والشحم وقذاء الخرسانة وغير ذلك. ويجب إزالة جميع آثار العوامل التي تفرز الرغوة. ويُنصح بإجراء صنفرة خفيفة بمادة صنفرة مناسبة قبل إجراء الطلاء. ويجب إزالة أي جزيئات غبار/جزيئات هشة ناتجة عن ذلك.

نظام الطلاء الموصى به

المبادئ

FIBERLINK INC.

www.fiberglassfiberlink.com

Product data

Product Name		AR Fiberglass Mesh Cloth
Product Code		H2-045-38J
Woven Structure		LENO
Input Yarn (TEX)	**Warp**	134*1*2
	Weft	280
Density (ends/in)	**Warp**	6 ± 0.5
	Weft	6 ± 0.5
Unit Weight (gsm)	**Greige**	130 ± 6
	Finished product	152 ± 8
Tensile Strength (N/50mm)	**Warp**	≥ 1200
	Weft	≥ 1200
Binder Content (%)		16 ± 2
Coating Type		Fire Resistant
Moisture Content (%)		≤ 1
Roll Width (inch)		38
Roll Length (feet)		150

Disclaimer of Liability

This data is offered solely as a guide in the selection of a reinforcement. The information contained in this publication is based on actual laboratory data and field test experience. We believe this information to be reliable, but do not guarantee its applicability to the user's process or assume any liability arising out of its use or performance. The user, by accepting the products described herein, agrees to be responsible for thoroughly testing any application to determine its suitability before committing to production. It is important for the user to determine the properties of its own commercial compounds when using this or any other reinforcement. Because of numerous factors affecting results, we make no warranty of any kind, express or implied, including those of merchantablility and fitness for a particular purpose. Statements in this data sheet shall not be construed as representations of warranties or as inducements to infringe any patent or violate any law, safety code or insurance regulation.

FIBERLINK INC.

www.fiberglassfiberlink.com

Technical Data

Alkali Resistant Mesh

Product Introduction

Fiberglass Alkali Resistant mesh is made from C-glass woven fabric then coated by acrylic acid copolymer liquid. This alkali-resistant mesh has excellent properties including water resistance, flexibility, softness, resistance to aging and attack from breakdown. It is widely used for waterproofing in roofing applications, reinforcement for natural marble, plasterboard, and Exterior Insulation Finishing Systems (EIFS).

Product Description

The fiberglass alkali resistant mesh fabric is an ideal engineering material in construction with the following applications:

Exterior Insulation Finishing Systems (EIFS): Fiberglass alkali resistant mesh is an integral part of the structure in EIFS. The fiberglass mesh has high strength, good cohesion, and can combine with EPS board firmly. Moreover, it can resist alkaline properties of cement and other structural compounds.

Roofing: As the waterproof medium (bitumen) is weak itself, the roofing system is easily cracked due to temperature changes, sunlight and wind. When fiberglass mesh is added to the system it can strengthen the ability to resist this influence because of its properties of high tensile strength and alkali resistance.

Concrete Cement: Fiberglass mesh is ideal to reinforce concrete cement because of its high strength, corrosion resistant, strong elastic modulus, fracture strength and balanced structure.

Packaging

The Alkali Resistant Mesh is wound into a roll on a cardboard inner tube with an inside diameter of 5cm (2"). Each roll is wrapped with a plastic bag and four (4) rolls are placed in a cardboard box. 12 boxes are placed

horizontally with 4 boxes x 3 layers on a pallet, which is stretch wrapped.

Stacking

To ensure safety and avoid damage to the product, skids should not be stacked more than two high. When stacking two pallets high, care should be taken to correctly and smoothly place the top pallet.

There are 3 common processes for the manufacture of GRC façade panels, and the choice of the process will depend upon the size of panel to be produced, the applied loadings, and the panel complexity. In all cases the materials used for the matrix are similar, but different Cem-FIL® fibre types may be used as indicated below.

The basis of a typical GRC matrix is:

Cement	1 part
Sand	1 part
Water	0.3 – 0.35 parts
Cem-FIL® fibres	(quantities indicated below for each process)

This basic formulation can be adapted with the use of admixtures and additives to enhance the processing, appearance and performance of the GRC:

- Plasticisers – to improve workability and reduce water
- Accelerators or retarders to regulate the setting time
- Acrylic Polymer – to ensure that the thin panel gets an adequate cure and does not dry prematurely
- Metakaolin, Silica Fume or other pozzolans to enhance long term ductility
- Oxide pigments if an integral colour is required

	Simultaneous Spray	Premix-Spray	Vibration-Cast Premix
Typical fibre content	5% by weight	3 – 4% by weight	3% by weight
Typical fibre type	Cem-FIL® 54 or 61 Series Spray Roving	Cem-FIL® 60 Series Chopped Strands	Cem-FIL® 60 Series Chopped Strands
Description	Cem-FIL® GRC façade panels are most commonly produced by the Simultaneous Spray process. In this process the spray gun is supplied with both a Cem-FIL® Spray Roving and the premixed mortar. The gun uses compressed air to atomise the mortar and chop the roving into strands typically 30 - 40mm in length, and sprays both materials simultaneously onto the mould surface where it is compacted with rollers. (For comprehensive details of the simultaneous spray process, refer to "Guide to Spray Manufacture").	Premix-Spray is a process which is becoming increasingly popular for the manufacture of smaller elements used in building facades (e.g. cornices and column facias). In this process the Cem-FIL® high-integrity chopped strands are mixed with the mortar and supplied to the spray gun through a peristaltic pump. Compressed air is used to spray the fibrous mortar onto the mould. (For comprehensive details of the premix-spray process, refer to "Guide to Premix Manufacture").	This process is the most similar to the manufacture of precast concrete. All materials are mixed together (with the Cem-FIL® chopped strands being added to the mix last) and poured into a mould, with the use of vibration to aid compaction. This process is not commonly used for façade panels, as the quantity of reinforcement is less than in the spray process, but it is used in producing mouldings which may complement the panels on a façade. (For comprehensive details of the premix process, refer to "Guide to Premix Manufacture").

APPLICATION SHEET

CEM-FIL® AR-GLASS FIBER SOLUTIONS FOR GRC

FAÇADE CLADDING

Soccer City Stadium, South Africa: 30,000 m² Cem-FIL® fibre panels

Masdar Institute, Abu Dhabi: pigmented and acid-etched GRC façade

Shepard Hall, City College of New York: 75,000 GRC elements replacing weathered glazed terracotta

DESCRIPTION

Cem-FIL® AR-glass fiber solutions for GRC gives architects and engineers a material from which the most ambitious designs can be created. Its versatility of shape, colour and texture enable it to be used to create complex modern forms or to replace traditional materials.

For the past 45 years Cem-FIL® GRC has been used to produce architectural facades on many of the world's most prestigious buildings in more than 120 countries.

BENEFITS

GRC has many characteristics which make it ideally suited for use as a façade cladding material:

- **Thin and light-weight**: rapid erection without heavy lifting equipment. Reduced load allows savings to foundation and structure costs, economical transport
- **Durable**: GRC will not rot or corrode, and is resistant to biological attack. No embedded steel, so no spalling or staining. Matrices can be modified to further enhance long-term ductility, reduce shrinkage, etc.
- **High quality matrix**: low permeability and a hard dense surface. Carbonation 1/10th the rate of regular concrete. High compressive and flexural strength. Low maintenance
- **Attractive and versatile**: can be formed with complex shapes, colours and textures. Can be used to accurately simulate natural materials (timber, rock, stone, etc.). Makes aesthetic solutions possible
- **Non-combustible**
- **Excellent acoustic performance**: The good transmission loss qualities of solid GRC can be further enhanced by incorporating acoustic insulation into the panel, or using shape to control the direction of reflected noise

CEM-FIL® AR-GLASS FIBER SOLUTIONS FOR GRC

ÇADE CLADDING

PECIFICATIONS

number of Guide Specifications are available to simplify the specification and use of GRC and to give confidence to the user. hese include: "Cem-FIL® GRC Typical Cladding Specification – Sprayed GRC"; "Specification for the Manufacture, Curing and esting of GRC Products" (GRCA); "Recommended Specification for Manufacture, Curing and Testing of GRC Products" (NPCAA, ustralia); "Guide Specification for GFRC" (PCI, USA).

DDITIONAL CHARACTERISTICS OF CEM-FIL® AR-GLASS FIBER SOLUTIONS FOR GRC

Typical mechanical properties of Cem-FIL® GRC at 28 days

Property		Unit	Simultaneous Spray	Premix Spray	Vibration-Cast Premix
Fibre Content		Weight (%)	5	2.5 – 4.2	3
Bending Strength	MOR	MPa	22 – 32	12 – 14	10 – 12
	LOP	MPa	7 – 13	7 – 10	6 – 9
Tensile Strength	UTS	MPa	8 – 12	5 – 9	4 – 7
	BOP	MPa	5 – 7	4 – 6	4 – 6
Compressive Strength		MPa	50 – 80	40 – 60	40 – 60
Shear Strength	Inter-laminar	MPa	3 – 5	N/A	N/A
	In-Plane	MPa	8 – 12	4 – 7	4 – 7
Impact Strength		kJ/m²	10 – 25	10 – 15	10 – 15
Elastic Strength		GPa	10 – 20	10 – 20	10 – 20
Strain to Failure		%	0.6 – 1.2	0.2 – 0.3	0.1 – 0.2
Dry Density		t/m³	1.9 – 2.1	1.8 – 2.0	1.8 – 2.0

em-FIL® AR glass fibres are manufactured under a quality management system approved to ISO 9001. Cem-FIL® fibres are not assified as dangerous by the regulation 1272/2008/EC.

nformation about any aspect of the use of Cem-FIL® fibres and/or performance of GRC may be obtained from the regional epresentative of Owens Corning or their local distributor.

For further info please send a email to: cem-fil@owenscorning.com / www.cem-fil.com

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APPEARANCE / FINISHES

In architectural applications the appearance of the façade panels is of great importance, and this is an area where GRC excels. GRC can be painted, faced with fine aggregates, coloured with pigments or stains, or it can reproduce any desired texture from the mould.

Durability of the finish is also very important. Because of the high cement content and impermeability of the matrix, GRC is less prone to carbonation than precast concrete, and has better resistance to aggressive environments (chemical exposure, freeze-thaw, etc).

Acid etching, sand blasting or surface retarders may be used to add texture to the surface of a GRC panel. If a GRC face coat needs to be reinforced, to reduce the risk of crazing, but the fibres should not be visible after the surface is etched, mono-filament Cem-FIL® fibres may be used (e.g. Anti-CRAK® HD).

Although GRC does not require the application of a surface sealer for waterproofing, these can be useful to reduce the accumulation of dirt on an architectural finish. Typical sealers include silane and siloxane.

The range of finishes for GRC can also be enhanced by the use of natural stone veneers (e.g. granite, marble, limestone, etc). In this case particular care should be taken regarding differential expansion and contraction of the two materials due to temperature and moisture changes. (Examples of suitable attachment methods for veneers can be seen in the "PCI Recommended Practice for GFRC Panels").

Samples of finishes

Panel assembly prepared for installation

FIXING AND JOINTING

As with all cement based materials GRC is subject to movement caused by changes in temperature and moisture conditions. The fixing system should make allowance for these movements of the GRC, and also for site and manufacturing tolerances, and movement of the structure. For example, with a 4-point fixing system, one of the lower fixings can be used to locate the panel while the others allow movement relative to it.

Where possible it is preferable for the weight of panels to be carried by lower fixings, so that the panel is in compression and is able to use its full flexural / tensile strength to resist applied loads.

In all cases the fixing system should be designed so that the force transmitted through the fixing is transferred to a sufficiently large area of GRC to ensure that the load is spread.

A popular system of fixing GRC façade panels uses a steel stud frame attached to the back of the GRC panel during manufacture by flexible steel anchors at 600mm intervals. This allows large and complex profile panels to be produced, handled and installed with ease.

ɔinting systems must also be designed to make allowance for in-service ɘment, and preparation of the GRC surface should follow the guidelines ɔalant supplier.

ɦe typical allowances for movement of GRC, and also examples of methods are shown in the "Cem-FIL® GRC Technical Data Guide to Fixings for GRC Cladding". and the "PCI

Typical stud frame fixing assembly

APPLICATION INFORMATION

Recommended Dosage	Sikament® NN can be used at the dose rate 0.30% - 2.30% by total weight of cementitious material depending on requirements concerning workability and strength. It is recommended that trial mixes be conducted to determine the exact dosage rate required. Note : • Typical dosage rate for use with silica sand is 0.60% - 1.8% by weight of cementitious material for normal precast concrete application. • Typical dosage rate for use with combination of manufactured sand / volcanic sand is 0.8% - 2.3% by weight of cementitious material for normal precast concrete application. For more specific requirements, advice is available from our Technical Service Department to determine the usage rate for optimum results.
Compatibility	Sikament® NN may be combined with the following products: • Plastocrete series • Plastiment series • Sika Fume • Sika AER • Sika Pump Pre-trials are recommended if combinations with the above products are required. Please consult our Technical Service Department.

APPLICATION INSTRUCTIONS

DISPENSING

Sikament® NN can be added to the mixing water prior to its addition to the aggregates or as in most cases, it can be added directly to the freshly mixed concrete. When added directly to the freshly mixed concrete, the plasticizing effect is more pronounced.
For ready-mix concrete, Sikament® NN is added to the concrete immediately prior to discharge and after further mixing has taken place for about three to five minutes.

BASIS OF PRODUCT DATA

All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

LOCAL RESTRICTIONS

Please note that as a result of specific local regulations the declared data and recommended uses for this product may vary from country to country. Please consult the local Product Data Sheet for the exact product data and uses.

ECOLOGY, HEALTH AND SAFETY

For information and advice on the safe handling, storage and disposal of chemical products, users shall refer to the most recent Safety Data Sheet (SDS) containing physical, ecological, toxicological and other safety-related data.

	240 kg drum
Colour	Dark brown
	1 year from the date of production in store properly in unopened original container
itions	Store in dry, cool, shaded place
	1.17 – 1.19 kg/ L

Packaging
Appearance /
Shelf Life
Storage Condi
Density

BUILDING TRUST

DATA SHEET

nt® NN

TER REDUCING

PRODUCT

Sikamer

HIGH RANGE WA

ION

tive dual action liquid superplasticizer
ction of free flowing concrete or as a
ater-reducing agent for promoting high
nate strengths. Chloride free.

l is used as a super plasticizer in the
free flowing concrete for use in:
oundations
mns and piers.
mponents with densely packed
ent.
rface finishes
as a water-reducing agent leading to
ength concrete for use in:
ncrete elements
d concrete
d cantilever structures
ncrete where formwork must be
uickly or early load will be applied.

CHARACTERISTICS / ADVANTAGES

Sikament® NN provides the following properties :

As a Superplasticizer :
- Workability is greatly improved. Increased placeability in slender components with packed reinforcement.
- Decreases the amount of vibration required. Normal set without retardation.
- Decreases the amount of vibration required. Normal set without retardation.

As a Water reducer :
- Up to 20% reduction of water will produce 40% increase in 28 days compressive strength.
- High strength after 12 hours.

APPROVALS / STANDARDS

Complies with A.S.T.M. C 494-92 Type F

DESCRIPT

A highly effect
for the produc
substantial wa
early and ultir

USES

Sikament® NN
production of
- Slabs and fo
- Walls, colu
- Slender cor
reinforcem
- Textured su

It is also used
high early stre
- Pre-cast co
- Pre-stresse
- Bridges and
- Areas of co
removed qu

INFORMATION

e	Naphthalene Formaldehyde Sulfonate

PRODUCT

Chemical Base

Technical Data

Density	Approximately 1.00 kg/lt.
Chloride content	Nil (EN 934-2)

Application Details

Substrate Preparation	Concrete surfaces should be clean, sound and free from oil, grease, cement laitance and all loosely adhering particles. The surface should be in a saturated surface dry condition.
Dispensin	Pre-mix **Sika Latex®** and clean water, then add cement and sand until desired consistency is achieved. Mix for at least 3 minutes until a homogeneous mixture is achieved.

Application
For all applications apart from sprayed on renders, a bonding bridge should be brushed into the prepared surface.

1. Bonding Bridge
Cement : Sand : Liquid (1 part Sika Latex® + 1 part Water) = 1 : 1 : 1 (by volume) or
Cement : Sand : Liquid (1 part Sika Latex® + 1 part Water) = 1.5 : 2 : 1 (by weight)
Apply the Slurry onto the pre-wetted substrate in 1-2 mm thickness and apply the subsequent mortar renders immediately (wet onto wet application).

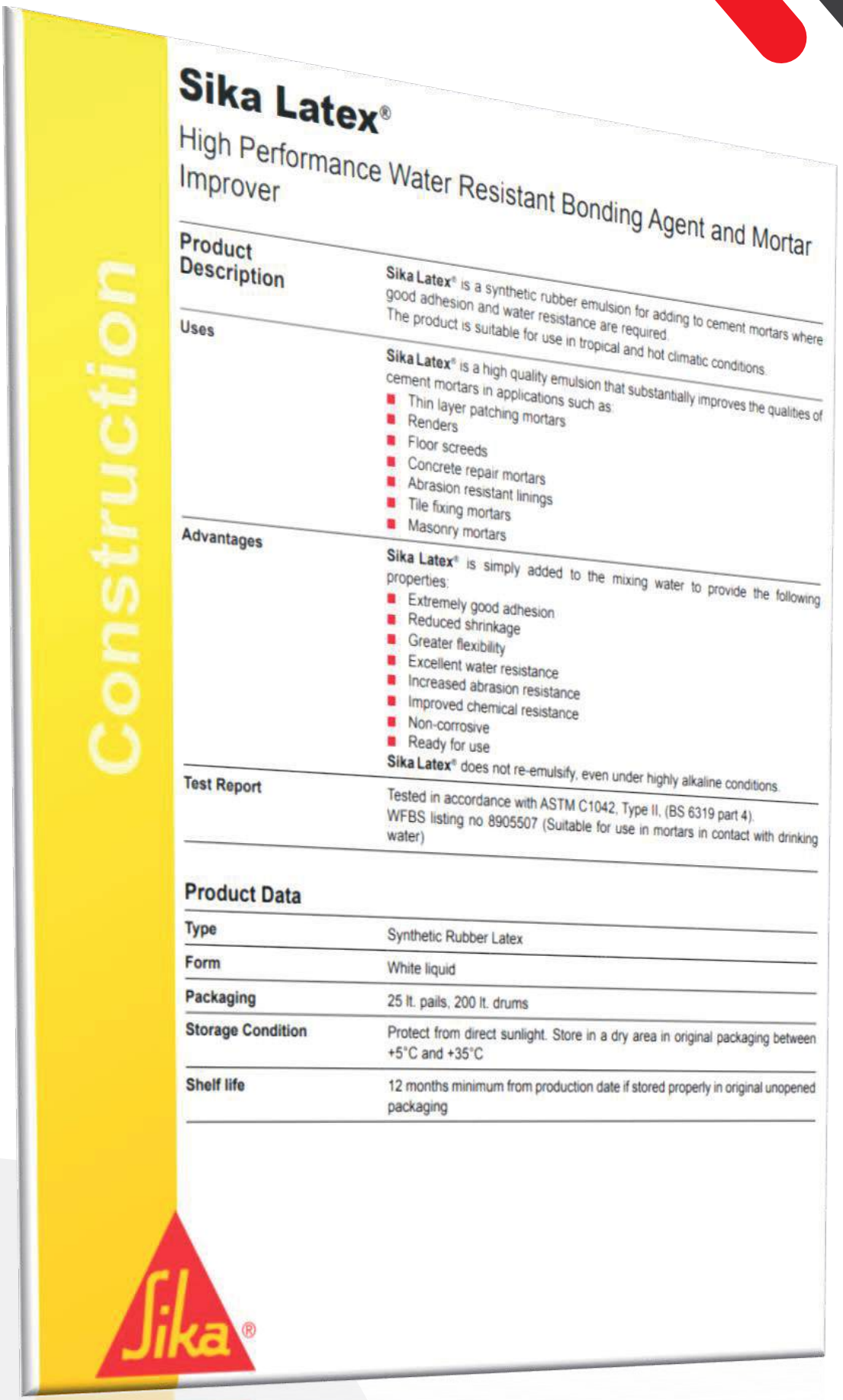
2. Repair Mortars

Portland cement Sand **Sika Latex®** Water Admixture	50 kg 125 kg (+25 kg) 7 lt 12 lt -	50 kg 125 kg (+25 kg) 9 lt 9 lt -	50 kg 125 kg 7-9 lt 9 lt 2 lt Sika Rapid-1
Yield	approx. 90 lt	approx. 90 lt	approx. 100 lt
Remarks	Up to 25 kg of Sikadur Aggregates should be added where the thickness per layer exceeds 12 mm		Apply within 10-20 minutes at 25°C. Sika Rapid-1 is chloride free and does not attack the reinforcement.

3. Flooring, Adhesive and Grouting Mortars

Mix / Application	Heavy duty floor, patch repair mortar for industrial floors.	Adhesive mortar for bonding tiles, slip bricks, coping stones, kerbs, etc	SBR modified grout. Sealing cracks and stabilizing unbonded screeds.
Portland cement Sand Aggregate **Sika Latex®** Water Others	50 kg 75 kg 75 kg (2.3 - 5 mm) 4-6 lt 12 lt -	50 kg 125 kg - 9 lt 9 lt -	50 kg 125 kg - 7-9 lt 9 lt 0.25 kg Intraplast
Yield	approx. 100 lt	approx. 90 lt	approx. 95 lt
Remarks	Screeds with increasing thickness require a lower consumption of **Sika Latex®**.	For thin sections use zone 4 sand. Keep water content at a minimum.	May be pumped. Use promptly. Where ever possible saturate surfaces.

Important Note
- The above mixes are for guidance and based on the use of sharp, well graded aggregates and dry sand. Trials with the materials to be used are recommended.
- For optimum results, always ensure that the correct **Sika Latex®**: Water ratio is used as shown in the tables above.
- Depending on the application and performance required, **Sika Latex®** may be added to the clean mixing water within the range of 1:1 to 1:4.


Construction
Sika Latex®
High Performance Water Resistant Bonding Agent and Mortar Improver
Product Description
Sika Latex® is a synthetic rubber emulsion for adding to cement mortars where good adhesion and water resistance are required.
The product is suitable for use in tropical and hot climatic conditions.
Uses
Sika Latex® is a high quality emulsion that substantially improves the qualities of cement mortars in applications such as:
Thin layer patching mortars
Renders
Floor screeds
Concrete repair mortars
Abrasion resistant linings
Tile fixing mortars
Masonry mortars
Advantages
Sika Latex® is simply added to the mixing water to provide the following properties:
Extremely good adhesion
Reduced shrinkage
Greater flexibility
Excellent water resistance
Increased abrasion resistance
Improved chemical resistance
Non-corrosive
Ready for use
Sika Latex® does not re-emulsify, even under highly alkaline conditions.
Test Report
Tested in accordance with ASTM C1042, Type II, (BS 6319 part 4).
WFBS listing no 8905507 (Suitable for use in mortars in contact with drinking water)
Product Data
Type
Synthetic Rubber Latex
Form
White liquid
Packaging
25 lt. pails, 200 lt. drums
Storage Condition
Protect from direct sunlight. Store in a dry area in original packaging between +5°C and +35°C
Shelf life
12 months minimum from production date if stored properly in original unopened packaging
Sika®

SDS	Silica Sand / Silica Flour	Adwan Chemical Industries Co. Ltd.
Issuing Date	29 April 2018	

Safety Data Sheet

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name	Silica Sand H.S. Code: 281122
Chemical Name	Silicon Dioxide
Synonyms	Silica Sand, Silica Flour, Glass Sand, Ground Silica, Quartz, Flint, Foundry Sand, Filtration Sand Fracturing Sand, Gravel Sand.
Manufactured By	Adwan Chemical Industries Co. Ltd. Riyadh 2nd Industrial City – Al Kharj Road PO Box 355128 Riyadh 11383 Kingdom of Saudi Arabia
Website	www.adwanchem.com
Phone	+966-11-265-0041
Fax	+966-11-265-0023

2. HAZARDS IDENTIFICATION

GHS classification Eye Irrit. 2B H320, STOT SE 3 H335, Carc. 1A H350, STOT RE 2 H373

Hazard Pictogram (GHS)

Signal Word (GHS) Danger

Construction

Aggregate Grading	Aggregates should be sharp, well graded and thoroughly washed. Sand particle sizes should correspond to the thickness of mortar to be applied and required surface finish. **Thickness/Application** — **Grading** < 2 mm — 0 - 0.5 mm 2 - 10 mm — 0 - 1.0 mm 10 - 25 mm — 0 - 2.3 mm > 25 mm — 0 - 5.0 mm
Curing	Standard curing practices must be followed.
Cleaning	Clean all equipment and tools with water immediately after use.
Remarks	Renderings and floor toppings should be allowed to cure correctly. Avoid excessive air-entrainment through over mixing. Do not use neat **Sika Latex®** or **Sika Latex®**/Water as a bonding agent, always add cement and sand. Normal "concrete" mixers are not suitable for Sika Latex mortars; the higher performance 'creteangle' or forced action paddle type mixers are recommended. Always keep the water/cement ratio to a minimum to enable correct working and compaction. A w/c ratio of less than 0.4 is advisable. Mortar toppings should be finished by wood float or steel trowel. Care should be taken to prevent rapid drying of **Sika Latex®** mortars by the use of polythene, damp hessian or concrete curing compounds. Maximum layer thickness per application should not exceed 40 mm Ensure hardened layers are mechanically "keyed", wetted and grouted
Notes	All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.
Safety	For information and advice on the safe handling, storage and disposal of chemical products, users should refer to the most recent Material Safety Data Sheet containing physical, ecological, toxicological and other safety-related data.

Legal Notes

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Limit:

	OSHA PEL	ACGIH TLV	NIOSH REL
Silica (mg/m^3)	$\frac{10}{\%SiO_2 + 2}$ TWA	0.05	0.05

The exposure limits are time weighted average concentrations for an 8-hour workday and a 40- hour workweek.

Silica exists in several forms, the most common of which is quartz. If silica is heated to more than 870°C, it can change to a form of silica known as trydimite, and if silica is heated to more than 1470°C, it can change to a form of silica known as cristobalite. The OSHA PEL for silica as trydimite and cristobalite is one-half of the OSHA PEL for silica.

Respiratory Protection: The following chart specifies the types of respirators which may provide respiratory protection for crystalline silica.

Particulate Concentration	Minimum respiratory protection
5 x PEL or less	Any dust respirator
10 x PEL or less	Any dust respirator, except single-use or quarter-mask respirator. Any fume respirator of high efficiency particulate filter respirator Any supplied-air respirator. Any self-contained breathing apparatus.
50 x PEL or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
500 x PEL or less	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 500 x PEL or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

*Use only NIOSH-approved or MSHA-approved equipment. See 29 CFR §1910.134 and 42 CFR §84. See also ANSI standard Z88.2 (latest revision) "American National Standard for Respiratory Protection".

Eye Protection:

Employee must wear splash-proof or dust-resistant goggles to prevent eye contact with these substances. Contact lenses should not be worn when working with this chemical.

Gloves:

Employee must wear appropriate protective gloves to prevent contact with this substance.

Clothing:

As appropriate for the work environment. Dusty clothing should be laundered

3. COMPOSITION / INFORMATION INGREDIENTS

Ingredients:	Chemical Formula	Typical % By Weight
Silicon Dioxide	SiO_2	> 98
CAS-No.	14808-60-7	

4. FIRST AID MEASURES

Inhalation:
No specific first-aid is necessary since the adverse health effects associated with exposure to silica result from chronic exposures. If there is a gross inhalation of silica ,remove the person immediately to fresh air, give artificial respiration as needed, seek medical attention as needed.

Eye Contact:
Wash immediately with large amount of water. If irritation persists, seek medical attention.

Skin Contact:
No known effects. However, it is recommended to remove contaminated clothing and shoes. Wash affected area with large amount of water.

Ingestion:
No known effects. Recommended to treat symptomatically and supportively. If vomiting occurs, keep head lower than hips to prevent aspiration.

5. FIRE-FIGHTING MEASURES

Silica is not flammable, combustible or explosive.

6. ACCIDENTAL RELEASE MEASURES

Spills: Use dustless methods (vacuum) and place into closable container for disposal, or flush with water. Do not dry sweep. Wear protective equipment specified (see section 8).

Waste Disposal Method: see section 13

7. HANDLING AND STORAGE

Precautions during Handling and Use: Do not breathe dust. Use adequate ventilation and dust collection. Keep airborne dust concentrations below PEL. Do not rely on your sight to determine if dust is in the air. Silica may be in the air without a visible dust cloud. If dust cannot be kept below permissible limits, wear a respirator approved for silica dust when using, handling, storing or disposing of this product or bag. Practice good housekeeping do not permit dust to collect on walls, floors, sills, ledges, machinery, or equipment. Maintain, clean, and fit test respirators in accordance with OSHA regulations. Maintain and test ventilation and dust collection equipment. Wash or vacuum clothing that has become dusty. See also control measures in Section 8.

Precautions during Storage: Avoid breakage of bagged material or spills of bulk material. See control measures in Section 8.

مصنع عالم الأفق للصناعة

Horizon World Factory for Industry

GRC - GRG - GRP - Special P roduct

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