TROPICAL

BUILDING THE FUTURE

TROPICAL

TROPICAL FIBER GLASS PRODUCTS INDUSTRY LLC

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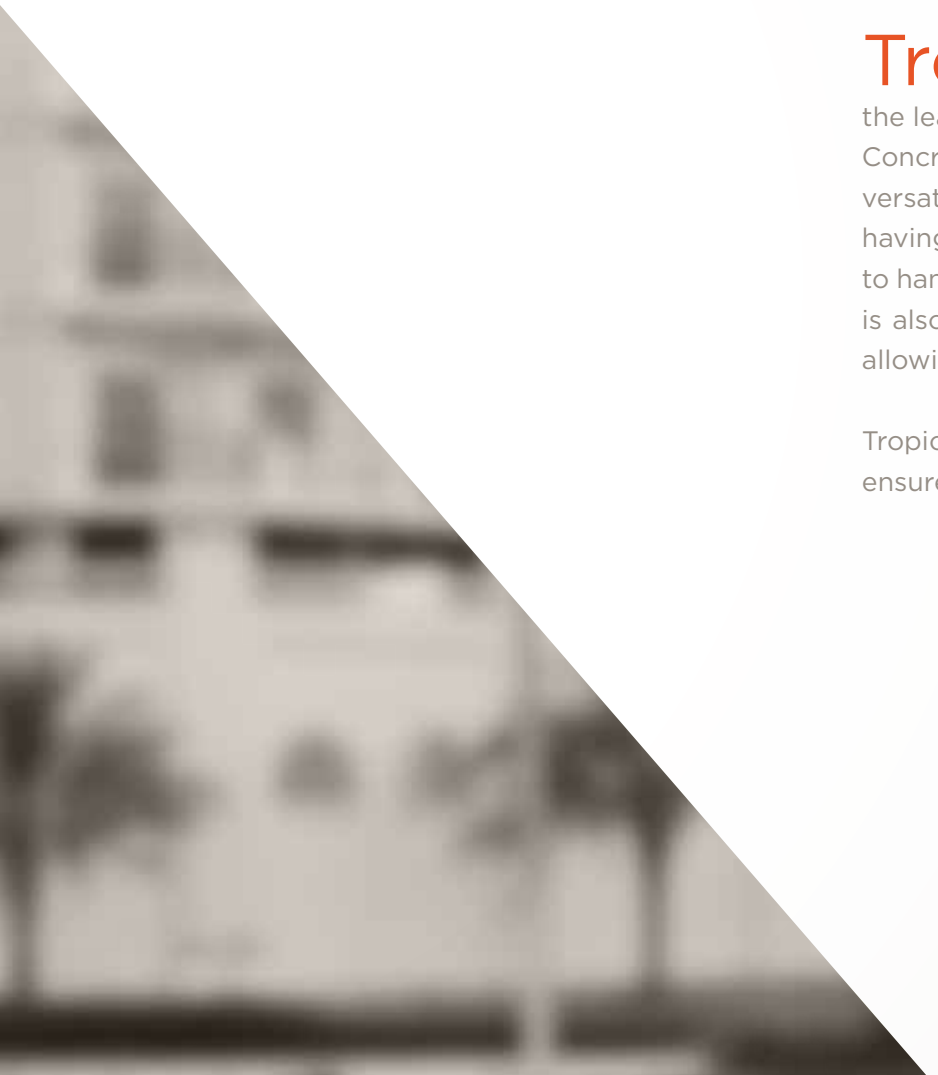
Activities:
Specializing in

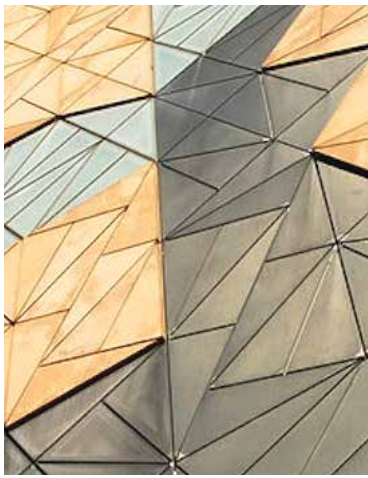
GRC
GRP
GRG



Tropical

Fiber Glass Products Industry LLC is one of the leading suppliers of high grade Glass Fiber Reinforced Concrete (GRC). Glass Fiber Reinforced Concrete is one of the most versatile building materials available to architects and engineers having only 20% of the weight of pre cast concrete, making it easier to handle on site and reducing loads on structures when in use. GRC is also strong with a higher tensile strength than precast concrete allowing thinner wall sections to be produced.

Tropical offers unrivalled levels of service and professionalism to ensure complete client satisfaction.

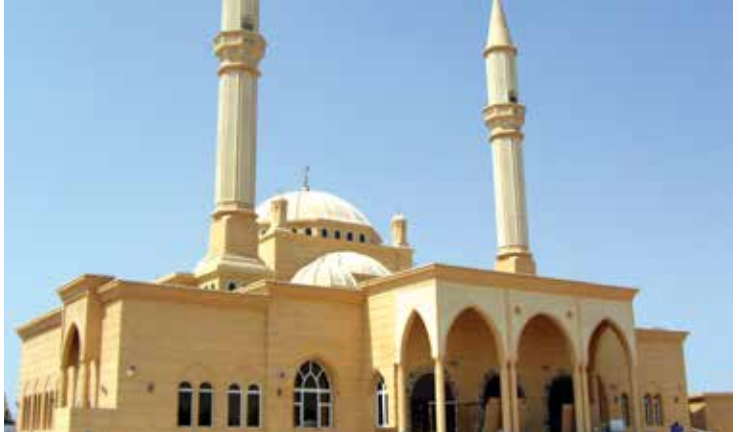


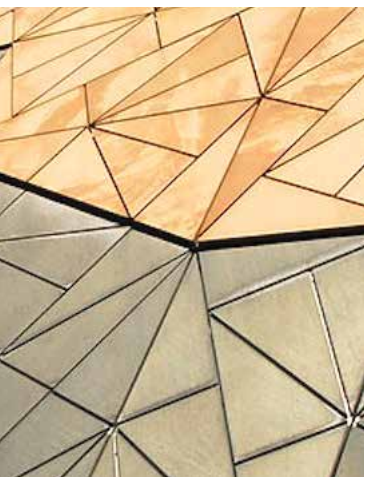
Our Approach

We have a simple approach at Tropical. Excellence is everything we do.

Tropical Fiber glass Products Industry is a leading manufacturer of glass reinforced products within the Middle East region. All our products have been specifically designed, to suit our clients varying needs and requirements.

Supported by our excellent network of production and installation teams, we can supply a complete start to finish turnkey solution for your project. Our aim is to provide a high quality professional service using the most appropriate materials for each project at the lowest cost to our customers.





Glass Reinforced Concrete (GRC) applications including:

- Architectural cladding
- Moulding and landscaping
- Roofing, walls and windows
- Building renovation
- Foundations and flooring
- Modular building
- Permanent formwork
- Rail cable channeling
- Acoustic barriers and screens
- Bridge and tunnel lining panels
- Water and drainage


Kempinski

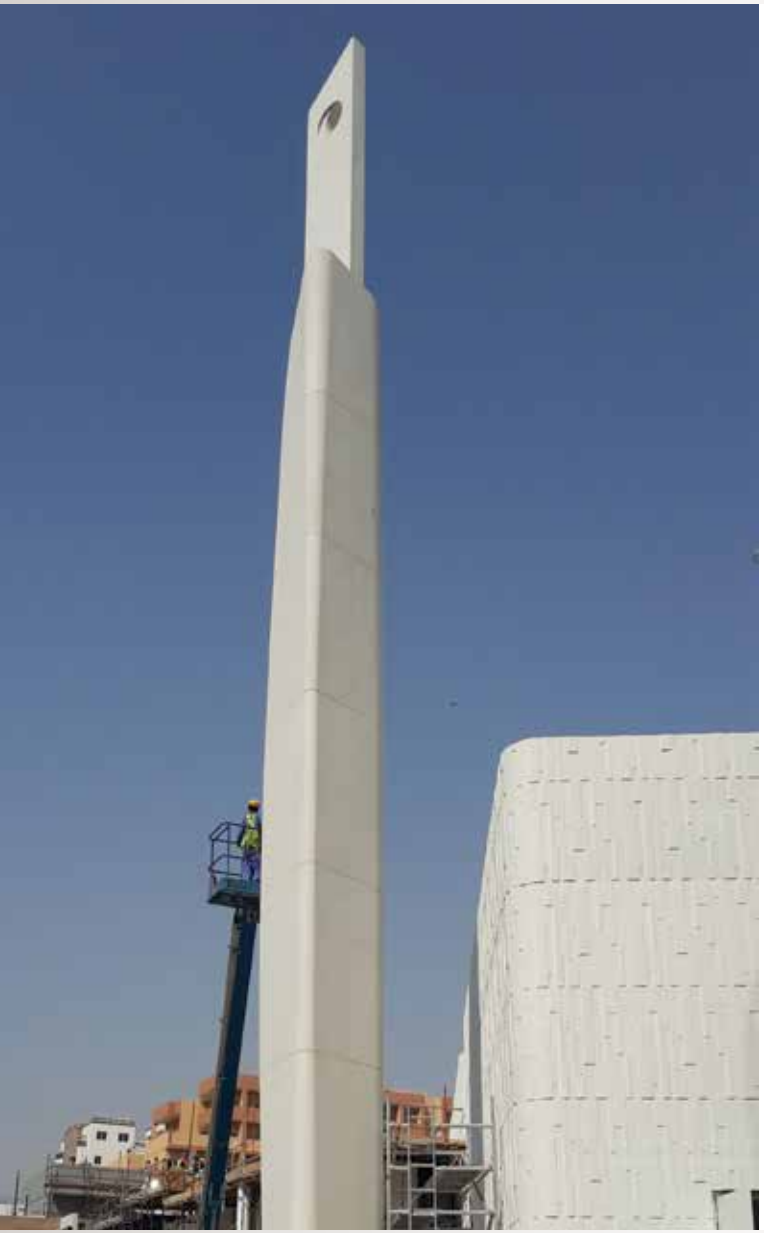
Glass Reinforced Concrete (GRC) is one of the most innovative construction materials available today. GRC is typically made of Portland cement, fine aggregate, water, alkali-resistant glass fibers and additives. GRC achieves physical properties that allow it to be used for numerous cladding applications, especially those where weight is a significant factor in the design, when mixed in certain proportions and manufactured under controlled conditions with appropriate equipment.

Although mix proportions can vary widely the most typical GRC mix, consisting of 1 part cement, 1 part sand, a 5% by weight of total mix glass fiber content, a water/cement ratio of and a 5% by volume acrylic co-polymer additive, can produce a composite with significant flexural, tensile and impact strength, provided it is mixed, sprayed, compacted and cured properly.

This environmentally friendly composite, with its low consumption of energy and natural raw materials, is being formed into a great variety of products, and has grown in popularity amongst designers, architects, engineers and end users for its flexible ability to meet performance, appearance and cost requirements.

GRC has many benefits including the following:

- Lighter than concrete
- Product texture is consistent, smooth finish and requires no painting
- Environmentally friendly, maintenance free and easily cleaned
- Texture surface is more consistent than stone or concrete
- Water sealant is not required, as material does not absorb water
- Long-term technical composition
- Decorative, naturally weathering exterior façade solution
- Durable, resistant to atmospheric pollution
- High flexural and compressive strength with excellent resistance to rain penetration
- Outstanding tensile strength
- High resistance to impact and abrasion
- Ideal aspect ratio between glass diameter and length provides early optimum performance
- Suitable for on site application and pre-casting
- Incorporates alkali resistant glass fiber technology with a high modulus of elasticity for effective reinforcement
- No minimum cement cover required for the glass fiber
- Excellent fire retardant properties



The low weight of the GRC decreases the loads on the building's structural frame, therefore making opportunities for creative architectural design limitless for the following: Cladding work, Decorative columns, Decorative parapets, Water fountains, Artificial rock, Garden furniture and many more applications.

GRC allows architects great flexibility in designing the most visible element of the structure. GRC panels can be produced in many colors or textures. It can be easily produced to match granite or lime stone facing.

GRC is commonly used where weight is factor. GRC is about 50% to 60% lighter than Pre-cast concrete. It is much stronger than Pre-cast concrete and has a beautiful smooth finish. Because of its weight, GRC can be cast in longer than standard lengths, making installation faster and easier than Pre-cast concrete.

GRC replaces conventional large aggregate and steel rebar with a network of little strands of glass in a mixture of cement and sand. Concrete is used as building material primarily because of its resistance to aging and its compressive strength. By using glass fibers as the matrix bound by a cement based adhesion, substantial increases in flexural, tensile and impact strengths are achieved without losing the superb aging properties of concrete.

Products made from GRC generally weigh only 10% as much as conventional Pre-cast concrete products.

The benefit of utilizing GRC panels for the exterior façade of buildings is natural extension of the trend in the building industry toward erecting pre-fabricated parts rather than "cutting and fitting" on site. The result is reduced labor costs. Finally, there is an opportunity to increase the architectural alternatives by utilizing the "mold ability" of GRC: composites, parts can take any shape: deep reveals and complex rectilinear or curvilinear shapes.

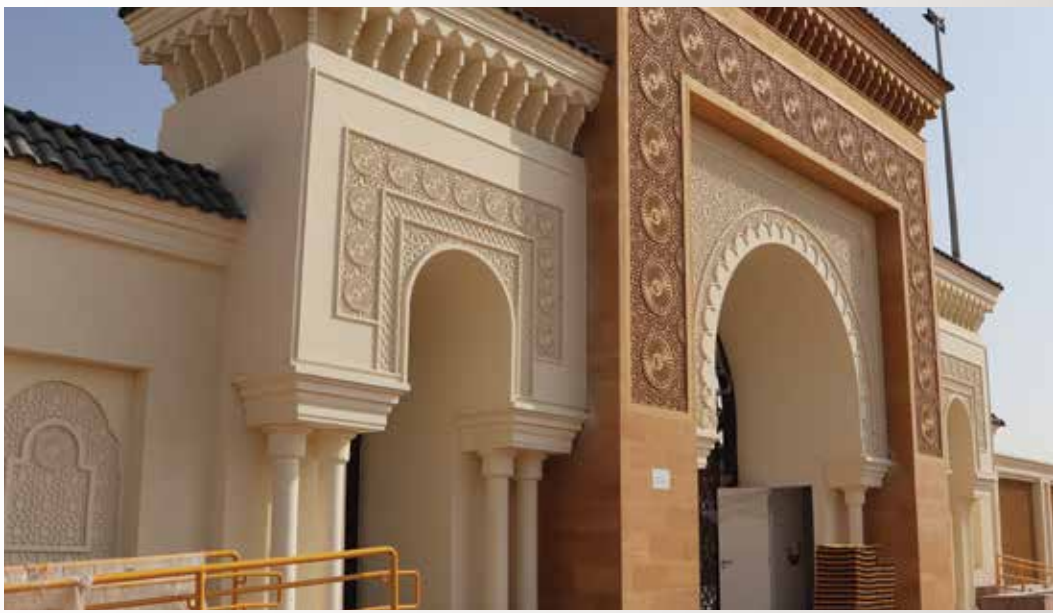
Consultants, designers and property developers in U.A.E. are now choosing GRC for their building elevations. GRC is much suitable to Middle East weather conditions and easy to adopt and make traditional Islamic designs than any material in the construction industry.

GRC Manufacturing Types

Glass Reinforced Concrete (GRC) also known as Glass Fiber Reinforced Concrete (GFRC) is generally manufactured by either the "sprayed" process or the "premix" process. Premix GRC can either be vibration compacted, or manufactured using a self-compacting GRC mix. The method chosen is normally dictated by factors such as strength requirements, size of mould, architects specification etc.

What Tropical offers:

- Site Inspection & Survey
- Preparation of shop drawing
- Approval of shop drawing
- Mock-ups
- Approval Texture, color and finishes
- Approval fixing components
- Quality control of raw material and production method
- Packing and shipping with unloading method
- Lifting method
- Full time site supervision
- Quality inspection of fixings, erection and finishing
- Handing over



GRC

Typical Formulation

Raw materials	Spray (kg)	Casting (kg)
Cement	50	50
Fine aggregate	50	50
Platicizer	0.5	0.5
Polymer	7.0 optional*	7.0 optional*
AR Glass Fiber	4-6%	2-3.5%
Water	16-17	Raw materials

Typical Mechanical properties of Cem-Fil GRC (at 28 days)

Property	Unit	Spray	Premix
Addition of Cem –FIL fiber	Weight %	5	3
Bending:			
Ultimate strength [MOR]	MPa	20-30	10-14
Tensile			
Ultimate strength [UTS]	MPa	8-11	4-7
Elastic Limit [BOP]	MPa	5-7	4-6
Shear:			
Inter-laminar Strength	MPa	3-5	NA
In-plane 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
Impact Strength	T/M3	1.9-2.1	1.9-2.1

* Dependent on type of fiber and property requirements.
* The water/admixture/polymer content will need to be adjusted according to materials

Tropical provides all labor, material, equipment and services necessary or incidental to completion of molded glass fiber reinforced concrete composites (GRC) and associated work in accordance with the contract documents and all applicable building codes.

Scope & Procedures

A. Site survey
B. Shop Drawing & Production Drawings
C. Molds and pattern Preparation
D. Mock -up
E. Manufacturing
F. Transportation
G. Framing and suspension
H. Site installation
I. Finishing
J. Joint treatments.

Submittals

A. Samples: We will submit three samples showing all joints, fixing, texture, color and finish section.

B. We will submit shop-drawings for approval showing plans, sections, details, joint treatment, reinforcing fastening devices and relation to adjacent construction as required.

Specifier's option: If the GRC scope and complexity warrant a mock-up, this section should be included and we will provide one full size mock-up.

Materials

A. Our all GRC materials are fabricated with Alkali Resistant Glass fiber (Cem-Fil or equivalent) showing chemical properties of CEM-fil ARG fiber.

B. Anchors and fixtures: GI/SS (Find our MATERIALS & DURABILITY)

C. Cement: Portland cement confirming to ASTM C150. We select the best type of cement on color requirements to confirm compliance with assumed design parameters.

D. Aggregates: We are using the suitable sand which is washed and dried silica or approved equal with a history of successful use in GRC

E. Other extra steel frames: Galvanized or Red oxide primed MS steel frames.

F. All other materials i.e. screws, clips, adhesive, shims, hanger-wire, etc., is as per the shop drawing and job specifications.

G. Admixtures: Commercially available water reducing agents, super plasticizers, accelerators, retarder and air entraining agents for our products in GRC. They confirm to ASTM C494 or C260.

H. Pigments: Pigments confirm to ASTM C979 and is stable, color fast and compatible with the cement.

I. Water: Free from deleterious matter that may interfere with the color, setting, or strength of the concrete.

Delivery, Storage & Protection

A. Delivery and handling: GRC material is transported with specially built crates and that will protect from damage, dirt, and moisture and warp age.

B. The main contractor has to provide all necessary storage area as per the written letter from us. The storage area must be firm, leveled and away from painting, welding etc .. which may damage the GRC materials

Protect GRC material (moldings) and Frame work (if any) from damage and deterioration during remainder of construction period

Inspection

A. Main Contractor shall be responsible for inspecting job conditions and providing lines, centers, grades and marks in sufficient detail for correct installation. The Main Contractor shall provide true, level, clean support surfaces.
B. We will verify all marks and check job-site conditions for clearance, working space and all marks provided before commencement of installation. We will also inspect all pieces prior to installation. We will be responsible for repairing all installed pieces except manufacturing defects. All discrepancies affecting the installation of the GRC members will be brought to the attention of the Main Contractor and resolved before installation begins.

Assembly

A. Safety: We are responsible for handling and installing the GRC material in a safe manner. Report any unsafe conditions immediately to the main contractor.
B. The Main contractor/ Client shall provide adequate traffic control, barricades, warning lights or signs to safeguard traffic in the immediate area of hoisting and handling operations.
C. We will use experienced workmen to install the GRC products. Material will be installed level and plumb and as shown in the approved shop drawings.
D. We will protect the GRC products from damage by other trades during construction and until accepted by the main contractor.

E. After erection and acceptance of finished products, all damage and repair will be the responsibility of the Main Contractor.

Attachment

GRC parts are to be installed with concealed fastening methods. Face fastening will always be visible and should be avoided. Typically, metal mounting plates are factory attached to the backs of panels which extend marginally beyond the part edges into joint spaces where the screws will subsequently be concealed with caulked joints. In some instances, where fastening is along a top edge of a panel, flashing materials can conceal face fasteners.

GRC Fixing Methods

The main functions of fixings for GRC cladding panels are as follows:

A. To secure the cladding panels to the building for the life of the panels and or building.
B. To allow transational and rotational movements to occur between individual panels and between the panels and supporting structure whilst maintaining water proofing at the joints.
C. To provide sufficient adjustment to accommodate normal constructional Inaccuracies in combination with the anticipated movements.
D. To maintain integrity of support and restraint under all conditions of exposure (Impact, vibration, wind, fire, etc.,) by minimizing local concentrations of stress in the GRC.
E. To provide lifting points for the cladding during manufacture, handling and assembly.

F. To ensure that forces transmitted through the fixings are distributed over as wide an area of GRC as possible.

To utilize the full strength properties of the GRC by providing supports at the base of the panels and lateral restraints at both the top and bottom of the panels.

Joint Treatments

Joints between GRC components are typically sealed with silicones, urethanes or polysulfide. Sealants must be able to withstand anticipated joint movement due to volumetric changes within the product and due to building movement.

Spacers to be used (min 3/16") to maintain a uniform gap and apply masking tape on each side of the joint.

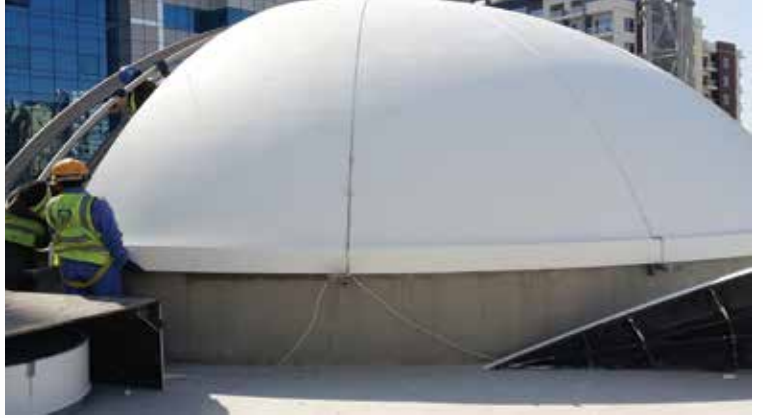
We follow the sealant manufacturer's written instruction/ recommendations for proper preparation of joints with primers, installation of backer rods and application of sealant.

Warranties

Our GRC products are have a one-year warranty against proven defects in material or workmanship, from the date the product has been accepted by the end user, or from a formal notice of completion.

Materials and Durability

Fixings are invariably located in damp environments. Most ferrous metals will corrode in these conditions and this can lead not only to unsightly staining of the building material but also to structural damage. Corroded mild steel will laminate and expand to over four times its original thickness. This expansion would obviously have a devastating effect on GRC panels.
The two most common reasons for any metal fixing to not live up to expectations regarding corrosion resistance are:



A. Incorrect assessment of the environment or exposure to unexpected conditions, e.g. unsuspected contaminations by chloride ions.

B. The way in which the materials are joined, stressed or treated may introduce conditions not envisaged in the initial assessment.

Pitting is a localized form of corrosion, which can occur as a result of exposure to specific environments, most notably those containing chlorides. In most structural applications, the extent of pitting is likely to be superficial and the reduction in section thickness of a component is negligible. However, corrosion products can stain architectural features.

1.1 Galvanized fixings

Galvanizing to BS 729 will greatly increase the life span of the fixing. All galvanized components have a finite life, directly proportional to the thickness of the zinc coating. Early corrosion can occur if this coating is damaged during handling. A number of buildings are now being designed with a minimum functional life of 60 years. It is doubtful if galvanizing will provide the necessary protection.

1.2 Stainless Steel Fixings

Stainless steel fixings are widely used for their durability and long life. They are generally very corrosion resistant and will perform satisfactorily in most environments. The corrosion resistance of a given grade of stainless steel depends upon its constituent elements and so each grade exhibits a slightly different response when exposed to the same corrosive environment. Consequently, care is needed to select the most appropriate grade of stainless steel for a given application.

Generally, the higher the level of corrosion resistance required, the greater the cost of the material e.g. Grade 316 steel costs about a third more than grade 304.

1.3 Other Metals

Other corrosion resisting metals from which fixings are generally made with copper, phosphor bronze and aluminium bronze. When choosing one of these metals, due consideration should be given to the following properties:

a. Strength

Safe working stresses used in design should confirm to the relevant standards.

b. Workability

The chosen metal should be readily available and easily formed into the required fixing. If this involves welding, the metal must be of a suitable grade and composition

Non-Staining

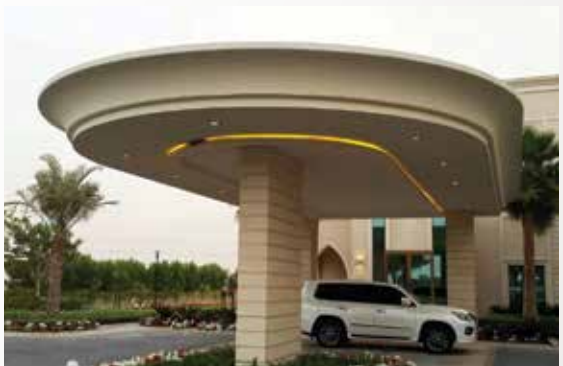
The fixing must not cause staining on the faces of the cladding panels. Copper is a relatively weak material and is only used for restraint fixings. It has a high resistance to corrosion but is liable to surface oxidation if exposed to damp conditions. The relevant British Standards for copper and copper based alloys are BS 1400, BS 2870, BS 2873, BS 2874 and BS 2875.

2. Galvanic Corrosion

Galvanic corrosion may occur when two dissimilar metals are in electrical contract in a common electrolyte (e.g. rain, condensation etc.,). If a current flows between the two, the less noble metal (the anode) corrodes at a faster rate than it would otherwise have done had the metals not been in contact.

3. Crevice Corrosion

Crevice corrosion is a localized form of attack, which is initiated by the extremely low availability of oxygen in a crevice. It is only likely to be a problem in stagnant solutions where a build-up of chlorides can occur. Crevices typically occur between nuts and washers, around the thread of a screw or around the shank of a bolt. Crevices can also occur in welds, which fail to penetrate, under deposits on the steel surface and under iron particles embedded in the surface of the steel.



4. Stress Corrosion Cracking

The development of stress corrosion cracking requires the simultaneous presence of tensile stresses and specific environmental factors unlikely to be encountered in normal building atmospheres. The stresses do not need to be very high in relation to the proof stress of the material and may be due to loading, residual effects from manufacturing processes (such as welding, bending) or wedging action of corrosion products growing in a crack.

GRC Method Statement

1. Site survey by our installation team and informs main contractor about the physical site condition. required scaffolding to do the survey from the main contractor.
2. Required clear access to start the frame or angle fixings.
3. Preparation of shop drawing.
4. Starts mold preparation once the shop drawing is approved.
5. Inspection and identifying of GRC returns, location of cast in anchors and additional cast in frames.
6. Study of lifting method.
7. Starts production once the mold is ready for production.
8. Curing and washing inspection.
9. Preparation of frames at the factory/site as per the approved shop drawing and identifying the frame or angle fixing points at site to starts the frame/angle fixtures in plump and leveled manner. Required scaffolding and platform from the main contractor. We will take necessary steps for the safety precautions.
10. Arrangement of transportation of GRC/GRG panels.
11. Arrangement of storage area at site.
12. Informs site installation team to unload and relocate to the store or site.
13. Protecting the GRC/GRG panels from other sub agencies work to prevent any damage before commencing installation.
14. Required necessary lifting equipment, scaffolding, platforms and cantilever -to fix pulley for lifting of GRC panels- from the main contractor to start the installation.
15. Starts installation
16. Starts approved mastic fill.
17. Protecting GRC/GRG panels with polythene cover.
18. Inspection and hand over.

GRC Maintenance Manual

Cleaning:

Many GRC panel projects will require only spot cleaning with soap and water in isolated areas while other projects may require a general cleaning. More stubborn dirt may require a commercial cleaning compound or a dilute solution of muriatic acid. Other methods may be used, and all methods should be performed on a small obscure area before proceeding with full-scale work. The GRC surface should be wetted in advance to prevent deep absorption by strong cleaners. A 3 to 5 percent phosphoric acid solution may be more effective on white concrete and also helps to avoid a yellow stain. When using acids, special care is required in masking and protecting adjacent materials to avoid damage. A thorough rinsing with water after use of a strong cleaner is required to neutralize the panel surface.

Patching and repair:

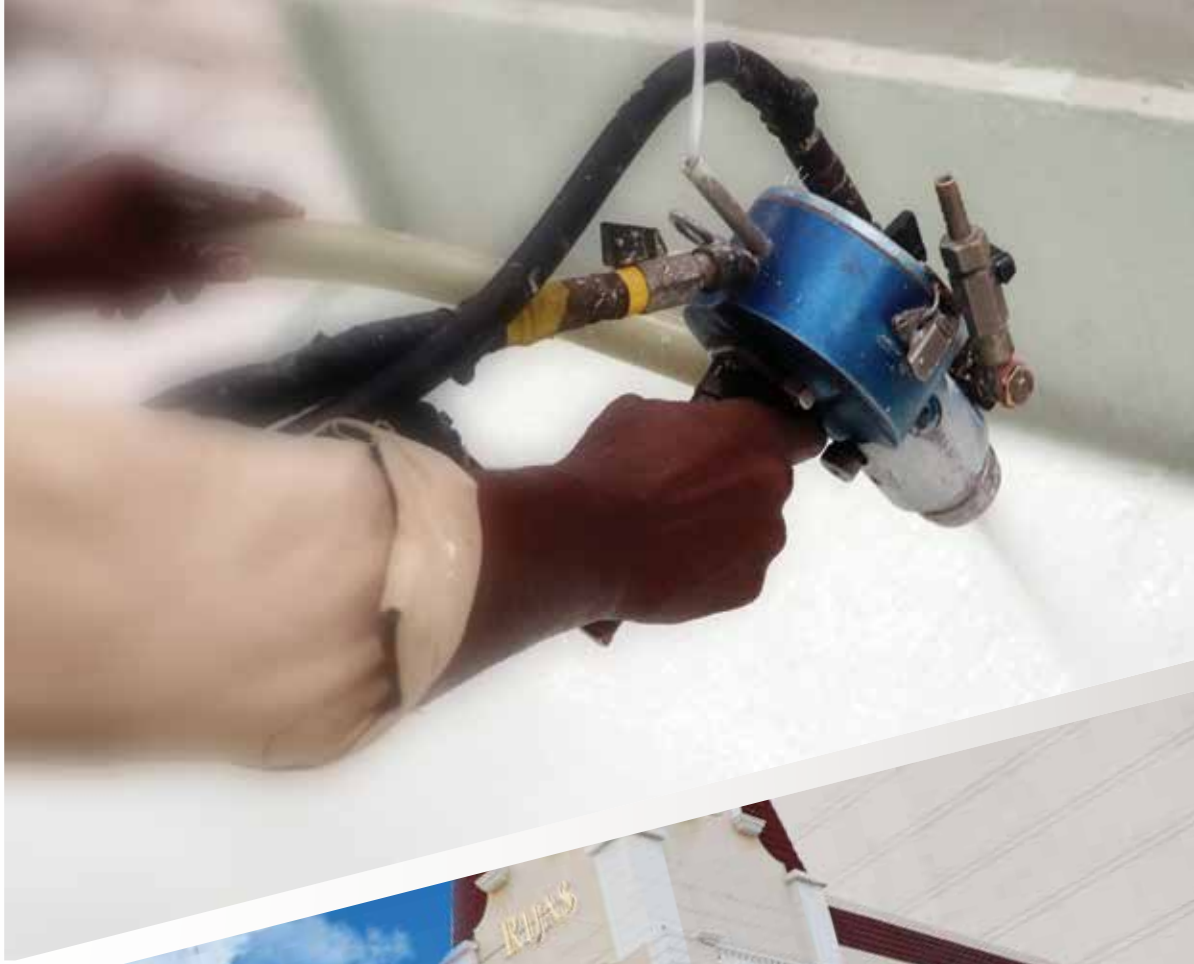
A certain amount of repair of product is to be expected as routine procedure. Production blemishes should have been corrected at the plant. Since patching and repair of GRC is a specialized activity, it is recommended that the manufacturer's personel be used for repair work. They understand the use of bonding agents and shading or texturing techniques. It may even be necessary to prepare a composite patching mix reinforced with glass fibers. Damage that affects the structural capacity should be discussed with the design engineer. In general, the extent of patching and repairing required should be minor.

Aesthetic Defects

Aesthetic defects are considered minor defects. They are usually production related and can be fixed quickly at the plant. Some examples include bug holes, small chips, and crazing cracks. Aesthetic defects do not impact the structural integrity or intended service life of the products

Crazing Cracks

Crazing cracks usually occur very soon after the concrete has been placed. The cracks are shallow and typically do not cause wear resistance or durability issues. Crazing cracks are often attributed to a lack of hydration on the surface of the concrete during the curing process. Crazing cracks are typically not repaired because they are not structural and they are so small (.3-1mm) that it would be nearly impossible to fill them with any material.



Glass Reinforced Plastic (GRP)

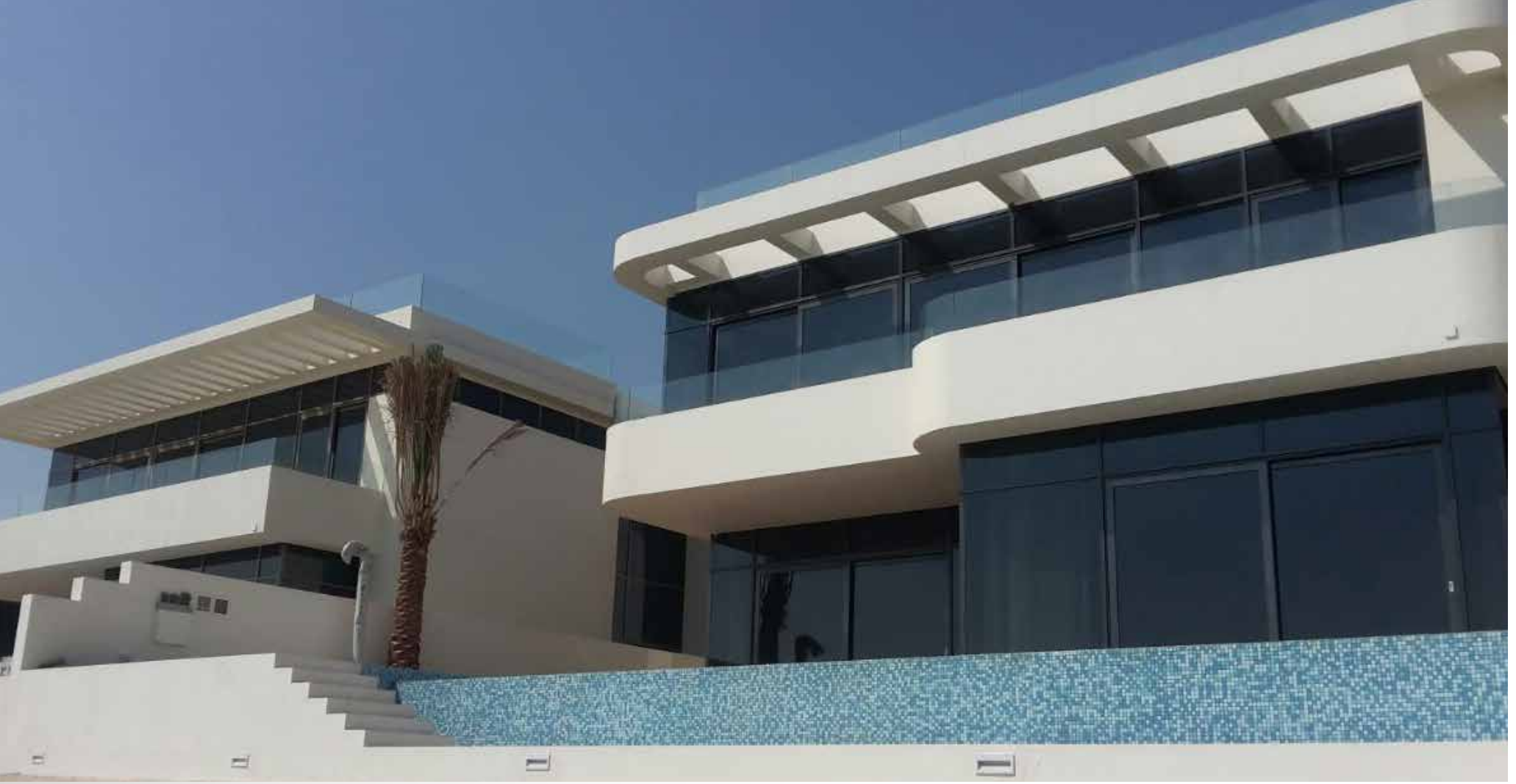
GRP

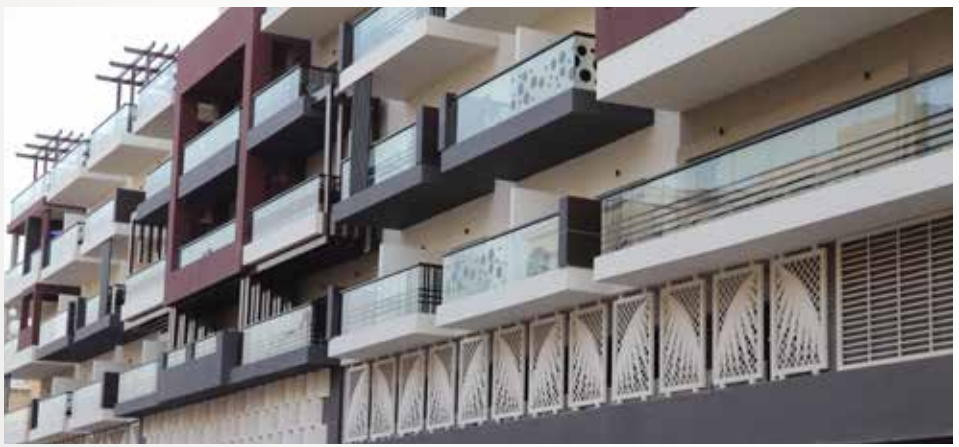
GRP is an acronym for Glass Reinforced Plastic or Glass Reinforced Polymer. It is also often referred to as fiber glass (fiber glass in the US) or glass fiber composite and belongs to a family of products known as FRP or Fiber Reinforced Plastics.

GRP products are made from Glass fiber reinforced polymers, typically with a polyester or vinylester thermoset resin matrix. Thermoset polymers are formed by a chemical reaction, initiated by adding a catalyst, which causes an irreversible hardening of the resin. This is coupled with reinforcement, achieved by the incorporation of glass fibers during the production process. The fibers may be in the form of fine long strands, chopped stands or woven mats. The production techniques by which this is achieved varied and can range from a simple manual process to one which is highly automated, utilizing robotic machinery.

Advantages of GRP

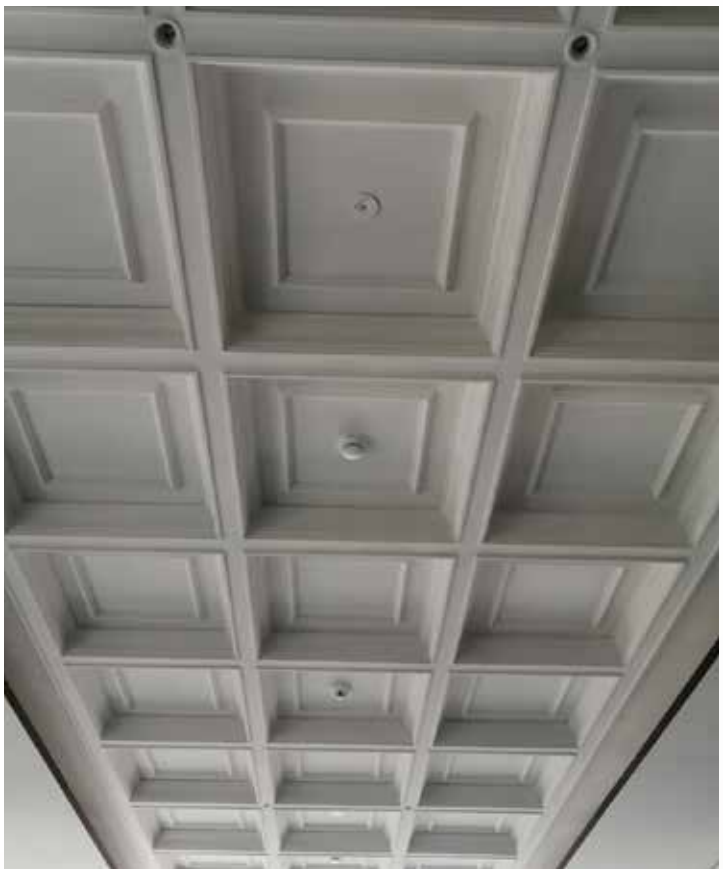
- Little or no maintenance required
- Warm to the touch
- Good resistance to a wide range of chemicals
- Long service life
- Easy fabrication and machining – no hot works required when constructing using composites
- Flame retardant versions available
- Wide operating temperature range
- Sustainable – low energy manufacturing processes
- Resistant to insect infestation – a reliable alternative to wood, where boring insects may ultimately undermine structural strength
- Recycling – GRP waste can be reprocessed to provide energy and raw material for cement production





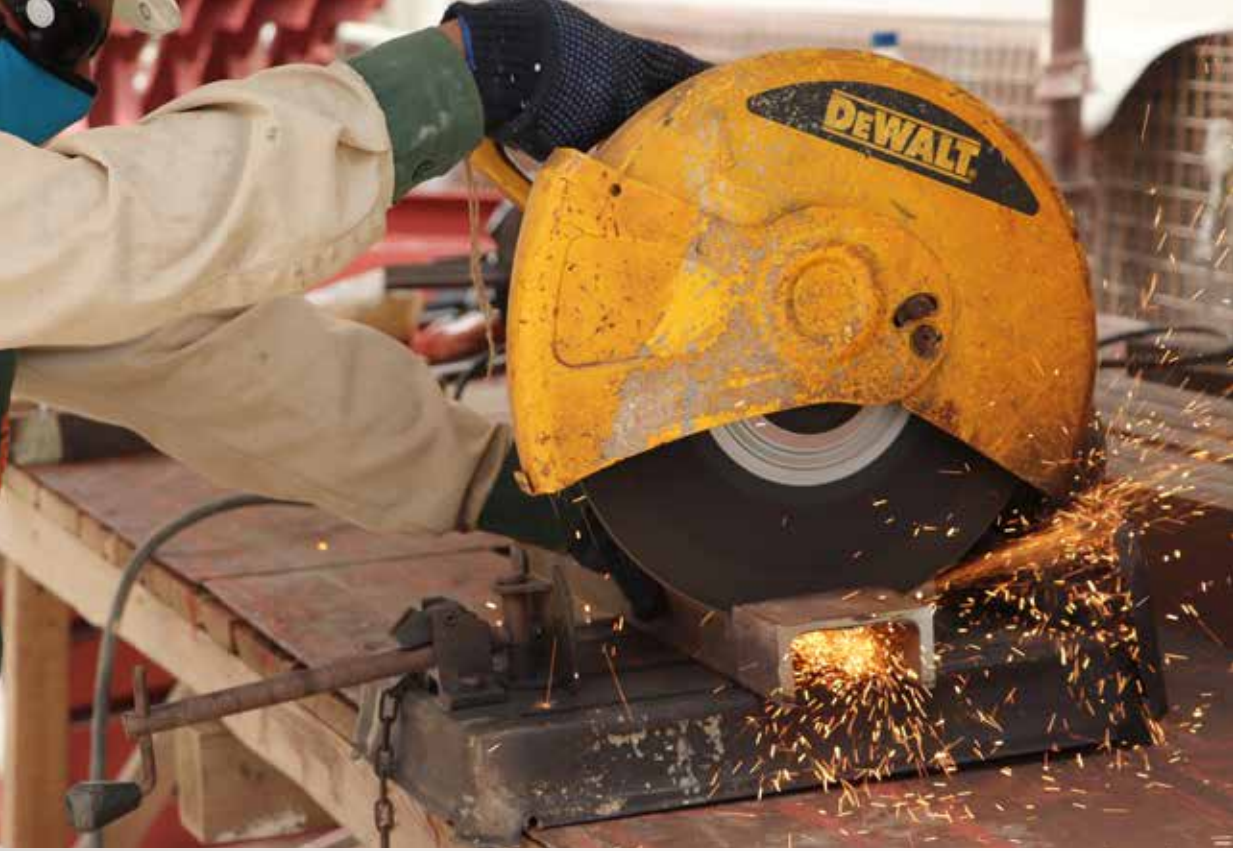
GRG

Glass Reinforced Gypsum (GRG)



GRG (Glass Reinforced Gypsum) is a molded product with a high strength to weight ratio that is used in construction to replace the disappearing art of plaster. In the past, “Master Plasterers” would reproduce stunning run-in-place architectural columns, domes, vaults, arches, cornices, etc... Today, there are very few “Masters” left. “GRG” produces these results in a pre-molded, light weight, time tested composite for far less the cost. It has been used on probably millions of projects all over the world to continue the “charm” of both traditional or classical architecture and to create the free flowing forms of modern design.

“GRG” is a multi-layered composite using only two basic raw materials: continuous strand fiber glass mats in a matrix of high density “alpha” gypsum cement plaster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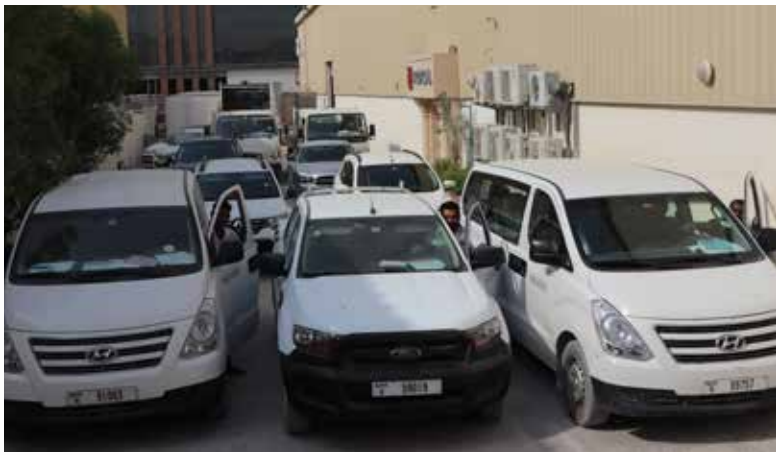

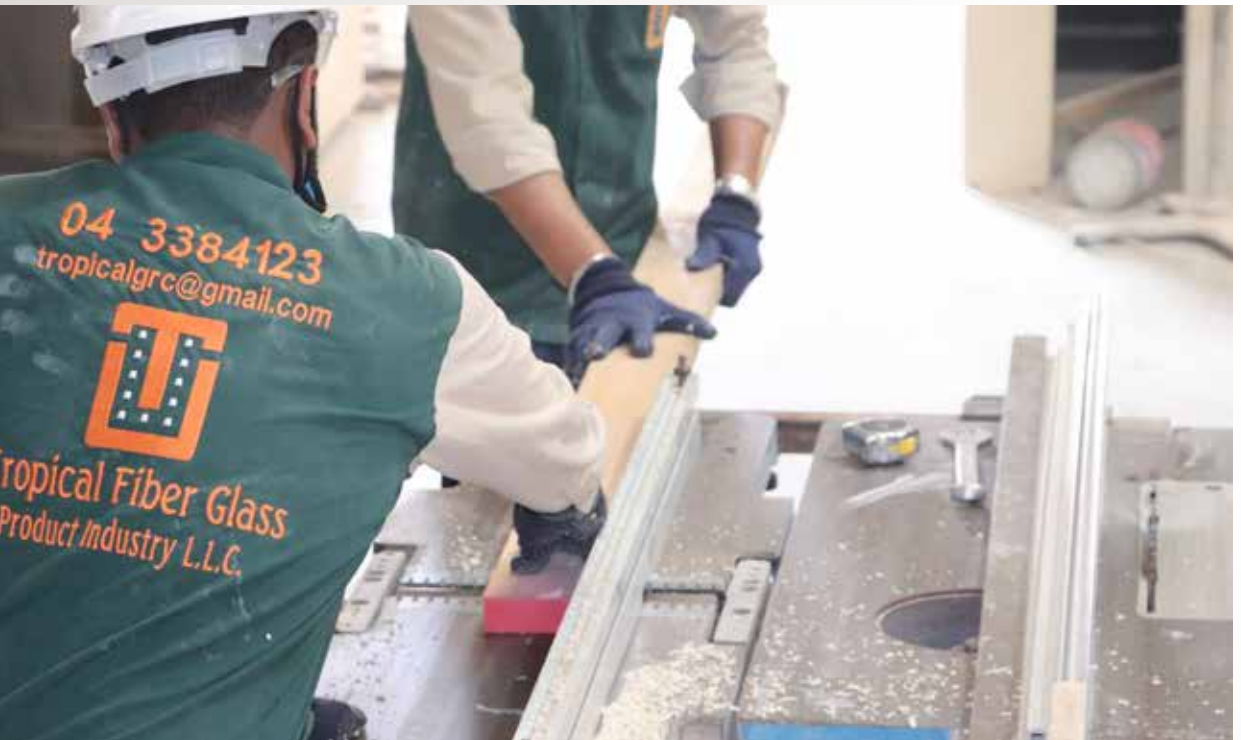
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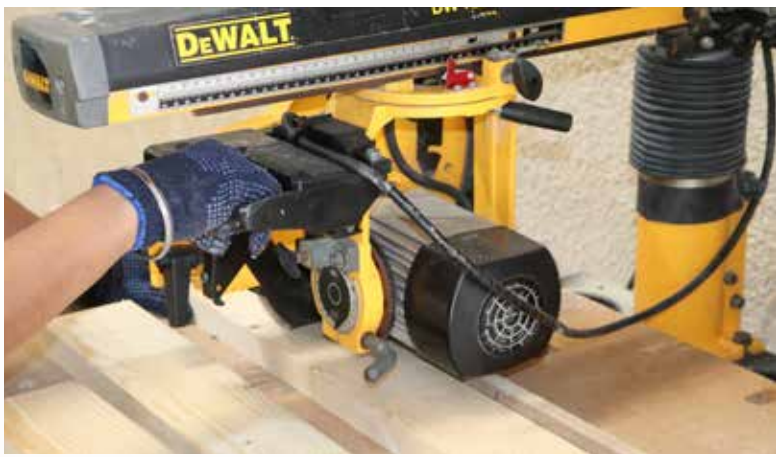
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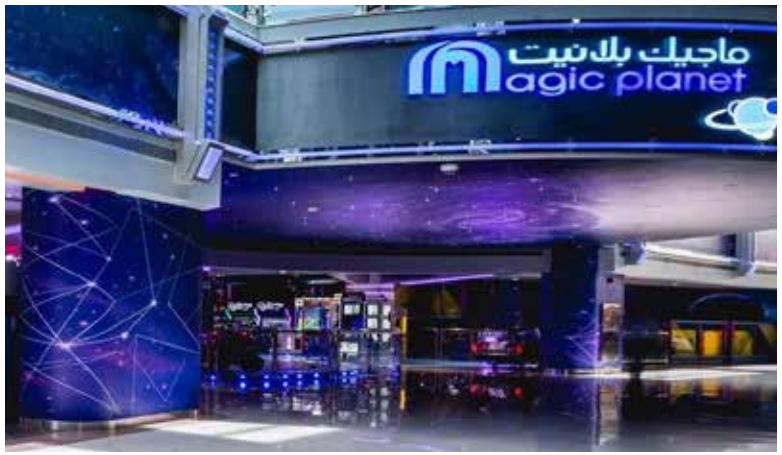
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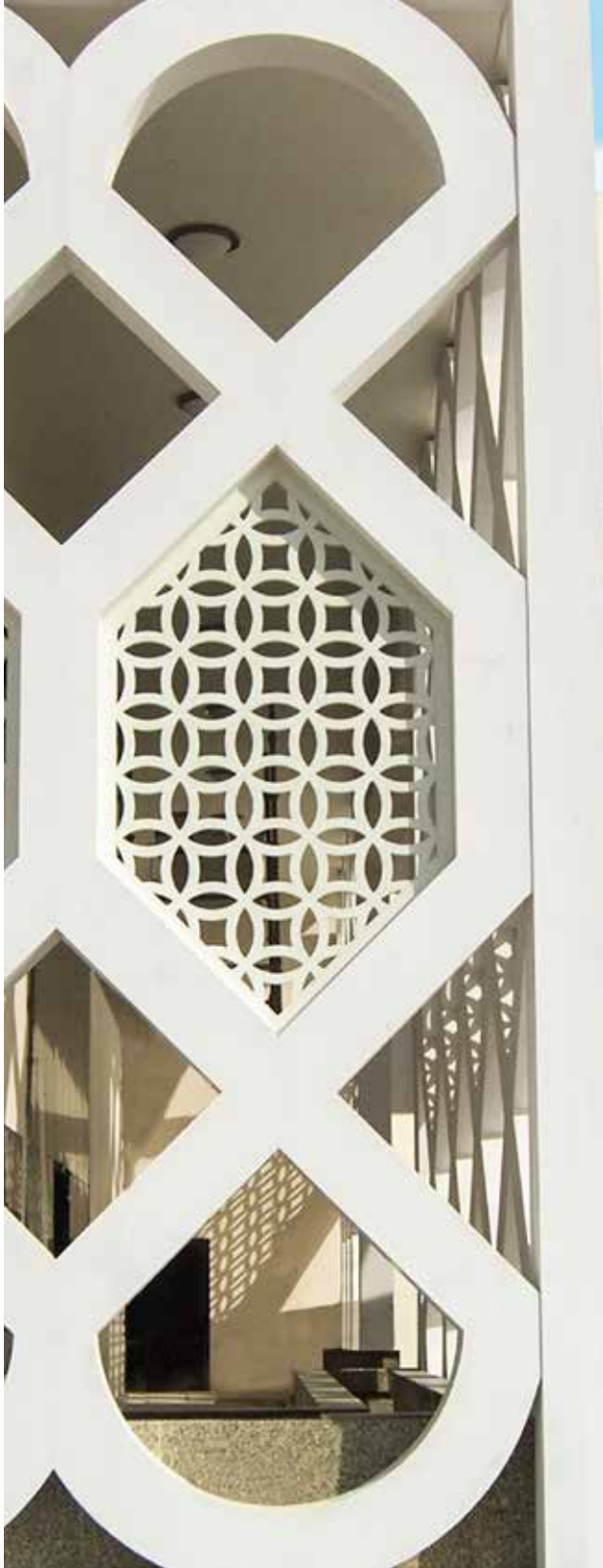

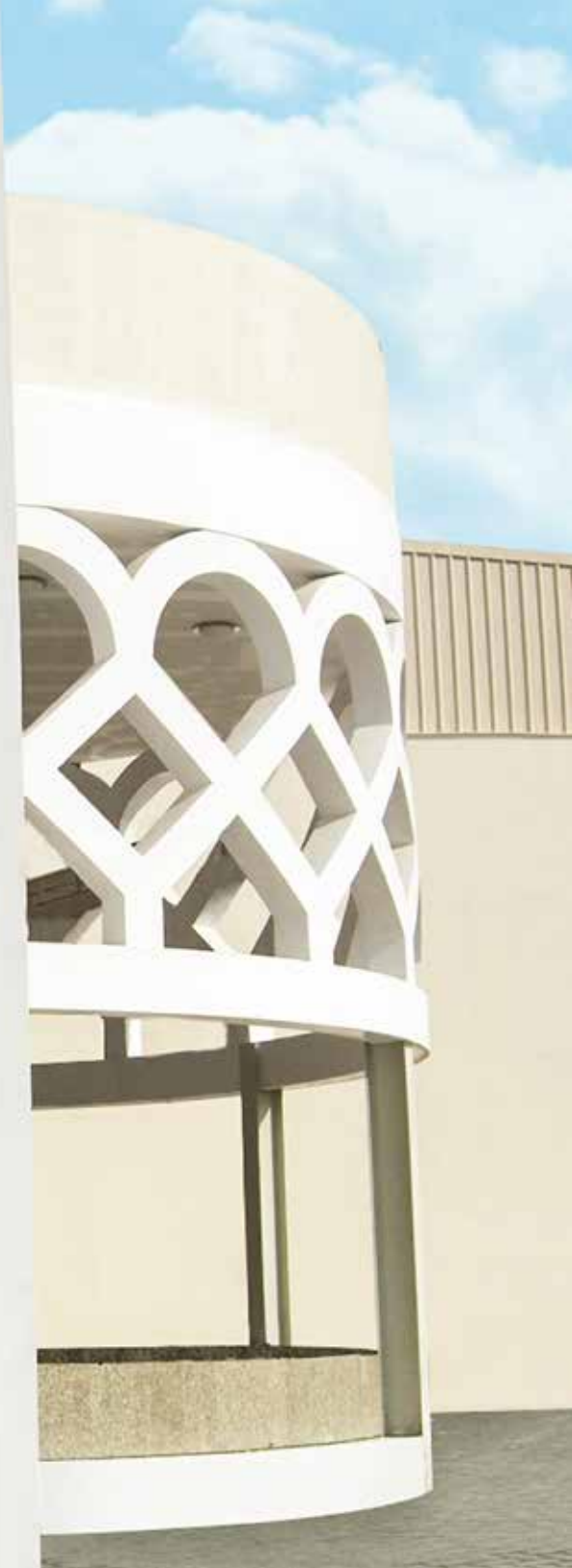

Some of our Consultants

- M/s AECOM Middle East Limited
- M/s RMJM FZ LLC
- M/s Eng. Adnan Saffarini
- M/s Bel-Yoahah Architectural & Eng. Consultants
- M/s Al Asri Engineering Consultant
- M/s Wanders Werner Falasi
- M/s X – Architects Design Consultants
- M/s Al Ajmi Engineering Consultants
- M/s DSA Architects International
- M/s EDP Consultants
- M/s GHD Consultant
- M/s Engineer's Office
- M/s High Art Engineering Consultants
- M/s Al Hutaib Architects
- M/s Design Centre Architects and Engineers Consultants
- M/s Abdul Rahim Architectural Consultants
- M/s JLL Consultants
- M/s ASG Engineering Consultants
- M/s Makan
- M/s Al Wasl Al Jadeed Consultants
- M/s Limelight Architects
- M/s White Space Consultant
- M/s Sustainable Architectural & Engineering
- M/s National Engineering Bureau
- M/s Design Bureau
- M/s German Engineering Consultants
- M/s Dynamic Engineering Consultants
- M/s Datum Engineering Consultants
- M/s Maktab Al Asri Engineering Consultant
- M/s Al Reef Engineering Consultancy
- M/s Erga Progress Engineering Consultant
- M/s GHD Consultant
- M/s Big Bjarke ingels group
- M/s CV Tee Consultants Engrs.
- M/s Port Saeed Engineering Consultant

Some of our clients Interiors / Signs

- M/s Al Shafar Interiors LLC (EXPO 2020)
- M/s Al Tayer Stocks LLC (Interiors)
- M/s Aati Contracts
- M/s City Liner LLC
- M/s Super Sign S.S ADV. Co.LLC
- M/s Sign Works FZ LLC
- M/s Romeo Interiors Factory LLC
- M/s Bond Interiors LLC
- M/s Lamirada Contracting LLC
- M/s Interior International Industries LLC
- M/s Bowyer Wick Interiors LLC
- M/s Karani Construction LLC
- M/s Dutco Interiors LLC

Some of our clients

- M/s Zublin Construction LLC
- M/s Al Tayer Stocks LLC
- M/s Khansaheb Civil Engineering LLC
- M/s Engineering Office LLC
- M/s Delta Al Emarate Building Contracting LLC
- M/s Al Shafar National Contracting LLC
- M/s ISG Middle East LLC
- M/s Najmat Al Fawares General Contracting LLC
- M/s Al Sahel Contracting Company LLC
- M/s Jasaf Building Techology Co. LLC
- M/s Fujairah National Construction Co. LLC
- M/s ARCO Turnkey Solution Cont.LLC
- M/s Baith Al Nokhada Tents & Fabshade
- M/s Al Habtoor Leighton Group
- M/s Techno Steel Construction Co LLC
- M/s Plus Palace General Contracting LLC
- M/s Heilbronn Contracting
- M/s Al Aflaj Building Contracting LLC
- M/s Gold Line Contracting
- M/s Al Ahmadiah Contracting
- M/s Belhabala Contracting LLC
- M/s Hi Build Constuction LLC
- M/s Bin Suroor Contracting LLC
- M/s Horizon Contracting Co.LLC
- M/s Emirates Oasis Contracting LLC
- M/s Proscape LLC
- M/s Highgate Int.Design LLC
- M/s Al Jihan Gulf Horizon General Contracting LLC
- M/s KPS World
- M/s Tefco International Contracting LLC
- M/s AIC Contracting LLC
- M/s Bowyer Wick Building Contracting LLC
- M/s Bridgeway Group Of Companies
- M/s Al Nuaimi Group LLC
- M/s Dutco Styles And Woods

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