GENERAL

1.01 SCOPE

Design, supply and erection shall include all labor, equipment, materials and services necessary for or incidental to completion of molded glass-fiber reinforced cement composites (G.R.C.) in accordance with the contract documents and specifications in compliance with local government codes.

1.02 QUALITY ASSURANCE

Manufacturer shall submit data, samples and certified testing reports showing compliance to all guidelines set forth in the G.R.C. QA & QC Plan. Quality control shall be in compliance with BS 1169. Testing of G.R.C. shall be in compliance with BS EN 1170 or GRCA Method of Testing of G.R.C. Material.

1.03 SUBMITTALS by Manufacturer

A. Product data including materials data, mechanical properties, fire rating properties, finishes, coatings, storage, installation and handling requirements and recommendations.
B. Shop drawing showing layout plans, elevations, dimensions, joints, details, subframe as well as the interface details with the adjacent works; include field-measured dimensions.
C. Samples for each custom finishes as specified; submit two samples, minimum size 150x150 mm, representing the actual product, theming, color, texture and patterns.

PRODUCTS

2.01 MATERIALS

A. Glassfiber Reinforced Cement (G.R.C.): High density composite materials made of Ordinary Portland Cement, silica sand, polymers and chopped AR glass fiber reinforcements to specified proportion. Manufactured by mean of premix or spraying in accordance with the design requirements.
   - ▶ Grade 525 OPC: 10% by weight;
   - ▶ #6 Silica Sand (MC < 2%): 40% by weight;
   - ▶ 28~32mm AR-GlassFiber (ZrO_2 Content >16%): 5%
   - ▶ Water: 14.5%;
   - ▶ Admixture & Polymer: 3~4%;

B. Where exposed face fasteners are used, they shall be in stainless steel or; for all other fasteners or connectors shall be galvanized or passivized zinc-plated.
C. All other fixing materials, i.e. bolted anchors, embeds, screws, washers, shimming, clips and adhesives shall refer to the design shopdrawing or specifications.

2.02 PHYSICAL PROPERTIES (G.R.C. Composite)

1.	Glass-fiber Content	= 4~5%	by weight
2.	Dry Density	= 1800~2000	Kg/m^3
3.	Nominal Shell Thickness	= 12~20	mm
4.	Characteristic Limit of Proportionality (LOP)	= 7	MPa (Spray-mix)
5.	Characteristic Modulus of Rupture (MOR)	= 18	MPa (Spray-mix)
6.	In-Plane / Inter-Laminar Shear Strength	= 2.8	MPa (Spray-mix)
7.	MOR top/bottom ratio	= 0.8-1.25	
8.	Modulus of Elasticity	= 20,000	MPa
9.	Coefficient of Thermal Expansion	= 5.5×10^{-6}	mm/mm°C /ASTM C531-00
10.	Flammability	= BS 476 Pt4: 1970 /ASTM E 84:0(Non-Combustible)	

PS: The above strength values are presented from the testing of GRC control samples and the final strength value obtained on the actual products may vary due to geometry variations.

2.03 Manufacturing, fabrication and pre-assembly procedure shall refer to our technical specifications.

EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

A. Delivery: All G.R.C. products are well-packed and labeled with the following measures taken:
- ▶ Pack and otherwise protect each unit during shipping and handling to avoid edge damage.
- ▶ Lift and support pieces only at points indicated on design drawings.
- ▶ Non-staining resilient spacers shall be placed in between product(s).
- ▶ Non-staining materials are placed to support products during shipment.

B. Store and handle G.R.C. products off the ground, under cover, and in a dry and level surface location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, staining, and other causes. Avoid stacking and leaning of pieces as far as possible.

C. Client shall provide sufficient space and access for unloading, hoisting and logistic arrangement.

3.02 INSPECTION

A. G.R.C. product with viewable part surfaces shall be free of noticeable defects (ripples, porosity, chips, scratches)

B. Dimension Tolerance (in general):
- ▶ Dimension to all directions (+/- 3mm)
- ▶ Warpage or bowling (3mm per meter)
- ▶ Shell Thickness (+/- 4mm)
- ▶ Chords, radii and diameter (+/- 5mm)

3.03 ERECTION

A. Client shall be responsible for providing setting out reference lines, centers, levels, gradients and marks in sufficient detail for correct installation.

B. Experienced workmen shall check all reference marks prior to installation. All discrepancies that will affect the G.R.C. installation shall be brought to the attention of the client and resolve before installation commence.

C. G.R.C. pieces shall be installed level and plump as shown in the approved shop drawings. It will be securely anchored, jointed and finished in accordance with the design drawings and method statements.

D. All fixing of G.R.C. pieces shall be in stainless steel or passivated zinc-plated mild steel to BS1706.

E. Control joints or exposed joints in between G.R.C. panel shall be filled with appropriate backer rod and with compatible sealant capable of withstanding +/-25% joint movement.

3.04 PROTECTION

A. Protect installed products until completion of works.

B. Touch-up, repair or replace damaged products and clean before handover to client for substantial completion.

WARRANTY

4.01 UMAGINE warrants our G.R.C. products for one year from the date of acceptance to remain free from cracks, chips and marks by defective material or workmanship.

4.02 This limited warranty does NOT cover any liability to the damages arising out of any other than in inherent workmanship defect, including but not limited to (1) any incidental, consequential or special damages resulting from the use, service or failure; (2) any damages due to misuse, negligence, mishandling, accident, mechanical abuse, fire, abnormal chemical attack or other casualties which are excluded from this warranty.