TECHNICAL DATA SHEET

Title: SPECIFICATION FOR SPRAY PROCESS GRC CLADDING
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1.0 GENERAL SPECIFICATION:

1.1 SPECIFICATION FORMAT:

This specification includes the essential criteria for the performance of the external cladding as well as other conditions, requirements, documents and other sections forming the whole of this specification which shall be read in conjunction with it.

1.2 SCOPE OF WORKS:

This specification contains performance and prescriptive clauses for the design, manufacture, testing and delivery to site for the GRC cladding envelope forming the outer face of the perimeter external fabric having all the aesthetic and environmental properties herein described.

The manufacturer shall make due allowance/attendance for co-ordinating, fabricating and supplying interface works with all related building elements and services.

1.3 DESIGN CRITERIA:

The components described or detailed on the relevant drawings, details and specification have been designed to meet the following criteria with manufacture and fabrication having to achieve the stated standards. All sizes and thicknesses stated for components and fixing devices shall be rigidly adhered to. All noted performance or criteria stated below shall be met by the manufacturer and if required the manufacturer shall provide evidence of compliance.

1.4 SHOP DRAWINGS AND DETAILS:

Construction drawings and details shall be specially prepared for the cladding elements of the project and show all information necessary to install each component type. All such drawings should be issued for dimensional approval and checking by the contractor or authorised representative.

Supplementary shop drawings or details required by in-house workshops shall be prepared by the manufacturer. If required, copies should be provided to the contractor and/or architect.

1.5 DESIGN LOAD CONSIDERATIONS:

The cladding system should be designed to resist loads of the following types.

Wind loads shall be calculated in accordance with BS 6399 Part 2 1997. All external components together with their fixing devices shall be designed to withstand wind speeds of up to [Project Specific] per hour without damage or permanent deformation of components.

Other imposed loads such as fittings, windows etc.

The self-weight load imposed during the production process and service life.

Stresses caused by thermal and moisture movement effects within the component arising from its construction or shape. Component design has considered an ambient temperature range of between -5 degrees C to 50 degrees C, a relative humidity range from 50% to 100%.

1.6 MOVEMENT:

The cladding system should be designed and constructed to accommodate movements that occur due to thermal and moisture effects. The designed fixing and jointing system shall take account of movements in both the external cladding and structure such that the components can move adequately without imposed structural movements being imposed on the panels.

1.7 WATER PENETRATION OF COMPONENTS:

The GRC components should not allow water to penetrate through the thickness of the components to the extent that dampness occurs on the inside surfaces.

1.8 FIRE PERFORMANCE:

The GRC components should have a reaction to fire classification equal to or exceeding A2-s1-do in accordance with BS EN 1305-1:2007

1.9 CHEMICAL RESISTANCE:

The components shall meet all normal chemical resistance criteria for the place of manufacture, storage, transportation.

1.10 THERMAL CONDUCTIVITY:

To be established when considering the wall construction.

1.11 SAMPLES:

During the tender period and prior to commencement of manufacture, the manufacturer will submit samples of the proposed finish which is representative of the finished faces and shows the typical range of colour and texture. The minimum sample size is to be approximately 300 mm x 300 mm and of appropriate thickness which is representative of the final product.

1.12 MOCK UP:

Prior to installation of the work associated with this specification a mock-up as may be detailed on the relevant drawing is to be erected at a location directed by the contractor or architect or their authorised representatives using the specified materials.

The mock up shall consist of at least two panels of approximately 1000mmx1000mm. This mock up should be agreed between the parties as being representative of mean colour using the methods detailed in CEN/TR 15739-2008. Texture deviance and a level of repair acceptability should also be determined within the mock up.

2.0 STANDARDS:

The manufacturer shall operate a Quality Management System in accordance with BS EN ISO 9001:2008. The scope of the system will extend to the design, manufacture and testing of GRC products.

The manufacture will be certified under the International Glassfibre Reinforced Concrete Associated Approved Manufacturers Scheme. Certification must cover the production of products by the Spray Process.

Unless otherwise agreed in writing prior to the commencement of the contract all materials and workmanship shall conform to the latest edition of the following British and European Standards except where modified by this specification.

2.1 REFERENCES:

BS EN 1169	Factory production of GRC products
BS EN 15191	Classification of GRC product performance
BS EN 1170 Part 1	Slump test
BS EN 1170 Part 2	Wash out test
BS EN 1170 Part 4	Simplified bending test
BS EN 1170 Part 5	Complete bending test.
BS EN 1170 Part 6	Determination of density and water absorption
BS EN 1170 Part 7	Measurement of extreme dimensional variances
BS EN 1170 Part 8	Cyclic weathering type test
BS EN 197 Part 1	Cement, composition, specification and conformity criteria
BS EN 15422	Specification of glass fibre for the reinforcement of cement and concrete

BS EN 12390 Part 3	Testing hardened concrete for compressive strength
BS EN 12878	Pigments for colouring of building materials
BS EN 480	Admixtures for Concrete
BS EN ISO 9001	Quality Management Systems
BS EN ISO 14001	Environmental Management Systems
CEN/TR 15739:2008	Concrete Finishes - Identification

3.0 MATERIALS:

All materials shall comply with the standards given above and to the requirements of this specification.

3.1 ALKALI RESISTANT GLASS FIBRE:

Glass Fibre shall be Alkali Resistant and shall be specifically manufactured for the use in hydraulic cement environments and shall meet the specified requirement of BS EN 15422

3.2 CEMENTS:

Cements shall be Grey Ordinary Portland Cement (OPC) or White OPC both conforming to the requirements of BS EN 197 Part 1

3.3 WATER:

Water shall be clean, free from deleterious matter and meet the requirements of BS EN 1008

3.4 FINE AGGREGATES:

Fine aggregates shall be silica sand and shall be washed and dried to remove soluble matter to permit accurate control of the water: cement ratio.

Grading of particle sizes shall be a maximum of 1.2mm (i.e. passing 16 sieves) with a silica content greater than 96%.

3.5 POLYMER MODIFICATION:

Polymers shall be in either a liquid or powder form and shall be specifically manufactured and formulated for use in a hydraulic cement environment. The polymer shall be added to the concrete matrix as part of the normal mixing procedure.

3.7 PIGMENTS

All pigments shall comply with the requirements of BS EN 12878

3.6 FACE COATS:

All aggregates used to form the face coat shall be clean, hard, strong, durable, inert and free of deleterious materials and shall be purchased in one batch and in sufficient quantity to complete the contract with an additional percentage allowed for possible component replacement due to damage etc. All aggregates used shall be in accordance with the aggregates used in the approved samples.

3.7 DESIGN MIX RATIOS:

Glass Reinforced Cement Mix Details:

Aggregate/Cement Ratio.	1:1
Water/Cement Ratio.	0.32-0.35
Fibre Percentage	4-5%
Polymer	As manufacturer's instructions

All materials used shall comply with the relevant standards given above and to the specification.

The GRC material must meet the following minimum strength requirements at 28 days.

Compressive Strength	40MPa (tested in accordance with BS EN 12390 Part 3)
Flexural Yield Strength (LOP)	07MPa (tested in accordance with BS EN 1170 Part 5)
Ultimate Flexural Strength (MOR)	18MPa (tested in accordance with BS EN 1170 Part 5)

Facing mixes shall achieve a minimum compressive strength of 30MPa when tested at 28 days and in accordance with BS EN 12390 Part 3

Facing mixes shall also be designed to reproduce the colour and finishing treatments agreed to on samples provided by the manufacturer and selected by the Architect or his authorised representative.

3.8 ADMIXTURES:

Admixtures shall be permitted in the design mix to suit particular factory conditions and shall be used in accordance with the manufacturer's recommendations.

3.9 PIGMENTS:

Where tinted finishes are specified or samples containing tinted finishes are approved all pigments used to obtain the specified tint shall be dry organic powder pigments and shall be used in accordance with BS EN 12878.

3.10 FILLERS:

Other fillers such as Micosilica, Crushed Aggregates, PFA etc. are not permitted.

3.11 INFILL AND VOID FORMING MATERIALS:

Infill and void forming materials to enable internal stiffening ribs to be formed shall be Polystyrene closed cell foam or equal approved and shall be as detailed and located in the positions indicated on the relevant drawings or details.

Such material shall be adequate for the purpose intended to enable the performance criteria to be attained.

3.12 MOULD RELEASE AGENTS:

Mould release agents suitable and compatible with the required finishes shall be permitted. It shall be established in writing to the contractor or his authorised representative prior to manufacture that the mould release agent to be used is compatible with any coatings or sealants which may subsequently be applied to the finished component. Any residue of mould release agent present on the component following the finishing process shall be thoroughly cleaned off.

3.13 CAST IN FIXINGS:

Cast in fixings shall be cast into the component during manufacture for the purpose of lifting and attaching the finished components to the structure via loose fixings.

The type and location of cast in sockets for lifting and storage shall be as detailed and located in the positions indicated on the relevant drawings or details. All sockets for lifting and storage shall be stainless steel to a minimum grade of 1.4301 to BS EN 10088 Part 2

Sockets for attaching the finished component to the structure shall be as detailed and located in the positions indicated on the relevant drawings or details and shall all be stainless steel to a minimum grade of 1.4301 to BS EN 10088 Part 2

All fixings incorporated into GRC have been designed to appropriate safe working loads and the manufacturer shall achieve a safety factor of three times the safe working load provided in the calculations for pull out and shear. The GRC manufacturer shall conduct such tests on incorporated fixings into GRC to prove the design criteria and shall submit the results to the Architect or his authorised representative.

Fixings shall withstand without fracture or permanent deflection all dead and superimposed loadings. Fixings shall accommodate differential movement of components relative to the structure.

3.14 STUD FRAMES

All stud frames may be fabricated from light gauge steel which has been galvanized to inhibit corrosion. Hop dip galvanizing after fabrication is not recommended due to panel distortion.

All galvanized steel used in the fabrication of frame and associated flex and gravity anchors to must comply with BS EN ISO 1461. Any cut ends and weld seams must be treated with a suitable paint to prevent corrosion.

All gravity and flex anchors must be isolated from the concrete bonding bad using a suitable de-bonding isolation material.

3.15 LOOSE FIXINGS:

All loose fixings and fittings such as fabricated steel brackets or plates shall be stainless steel to conform to a minimum grade 1.4301 to BS EN 10088 Part 2 or galvanized mild steel to BS EN ISO 1461 as indicated and shall be as detailed and located in the positions indicated on the relevant drawings or details.

All loose fittings such as bolts, screws, threaded bars and steel washers shall be stainless steel to conform to BS EN ISO 3506 Parts 1&2, minimum grade A1 and shall be of the type indicated on the relevant drawings or details.

All plastics washers and isolation tubes shall be of PTFE or a suitable engineering plastics material such as high density nylon and shall be as detailed and located in the positions indicated on the relevant drawings or details. .

All shims and packers shall be of a suitable material, i.e. stainless steel, plastics or composite and shall not fracture or permanently deform under the working load and shall be as detailed and located in the positions indicated on the relevant drawings or details.

3.16 JOINT OR SEALING MATERIALS:

All sealing materials used between components or between components and structure shall accommodate the manufacturing tolerances, thermal and shrinkage movements of the components and the construction tolerances together with the service movements within the total structure.

All jointing materials shall be Arborsil 1090 unless otherwise stated and shall be to a colour selected by the Architect or his authorised representative. The sealant shall be used in accordance the sealant manufacturer's system with regard to primer and choice of backing material.

3.17 INSULATION:

Insulation if required, shall be placed in the areas indicated on the relevant drawings and shall be as specified by others.

4.0 MOULDS:

4.1 PATTERNS, MOULDS AND OTHER TOOLS AND JIGS:

The materials and construction of patterns and moulds shall be consistent with the type and quality of the surface finishes or treatments required for the components and with the tolerances given in this specification. All timber shall also be free from such faults as insect or fungus attack, woolly texture, soft heart, sapwood, splits or shakes. Loose knots and knot holes are not acceptable.

Patterns and moulds shall be constructed to ensure that flat surfaces remain plain throughout the life of such patterns and moulds.

All patterns or moulds shall be regularly inspected and maintained in a clean and sound condition so that there is no progressive deterioration of the finished surface and shall be inspected for accuracy each time on reassembly prior to re-use.

Any rubber liners used within the moulds shall be manufactured by or with materials supplied by Reckli GbmH

Patterns or moulds shall only be re-used if any damage can be repaired so that the surface of the completed component is not impaired. All patterns or moulds shall be constructed fit for the purpose and shall prevent any grout loss from the component.

All patterns or moulds shall be maintained and kept in good repair and stored in a suitable place when not in use for a period of 90 days after completion of deliveries. The cost of storage, maintenance and disposal shall be included by the manufacturer in the contract sum.

5.0 MANUFACTURE:

5.1 WEIGHING AND BATCHING:

All dry materials shall be batched by weight using calibrated weighing equipment capable of accuracy of ± 2% of the stated batch weight. Liquids shall be weighed or volume batched and the manufacturer shall demonstrate that the method employed for all batching provides the accuracy stated prior to manufacture.

5.2 MIXING:

The cementitious batched slurry shall be mixed in a 'High Shear Mixer' in accordance with the equipment manufacturer's instructions using the stated design mixes. Facing mixes shall be mixed in accordance with the manufacturer’s requirements to achieve the finish approved by sample.

5.3 FACING MIX:

The facing mix shall be placed or sprayed into the mould in the areas indicated and to the thickness stated on the relevant drawings or details**.** Where necessary the facing mix shall be vibrated or compacted by hand to produce a void free composite.

5.4 SPRAYING:

The hand spray technique shall be used for all component manufacture using specialist equipment which allows the simultaneous deposition of known quantities of cementitious slurry and chopped strand glass fibres. Spraying of GRC shall be bi-directional to produce a satisfactory matrix/fibre distribution. Prior to manufacture the spray equipment shall be calibrated to ensure that the specified glass fibre percentage is achieved. See testing below.

Spraying of the GRC material shall be carried out as soon as practically possible onto the placed facing mix or mould surface but in all cases spraying shall be carried out before initial set of the facing mix takes place in order to ensure a monolithic construction is achieved. The GRC shall be sprayed to the thickness stated on the relevant drawings or details in layers varying from 4 mm to 5mm until the designed thickness is achieved. Each layer is to be compacted by hand roller to provide a void free composite prior to the spraying of the next layer.

The incorporation of preformed sections, hand formed details or infill materials to form stiffening ribs or blocks and the subsequent over spraying of GRC shall be carried out before the parent skin of GRC has achieved its initial set to ensure a complete bond of materials.

Control of material thickness for both the main parent skin or the over spraying shall be achieved using a template or pin gauge.

No spraying of GRC shall be commenced unless the component can be completed within the working day. If spraying is interrupted the manufacturer shall ensure that the GRC/GFRC has not taken an initial set before re-commencing spraying.

5.5 CURING:

Components shall be de-moulded not less than 18 hours or not more than 48 hours after manufacture and upon de-moulding shall be stored and not allowed to be exposed to temperatures exceeding 30°C or below 5°C for a period of 2 days. During this period components should not be exposed to drying winds.

5.6 UNIT IDENTIFICATION:

Each component shall be marked with the reference number shown for the individual components on the relevant elevation layout drawing plus any necessary manufacturer's reference which shall also include the date of manufacture, component weight and provide full traceability to the production and testing process

5.7 STORAGE AND HANDLING:

Units shall be handled and stored in such a manner that no damage or marking of the architectural surface occurs and so that the components are not subject to undue stress.

5.8 FINISHING:

When components have been sufficiently cured and are adequately hard set the surface shall be treated to achieve the finish represented on the approved samples in the area indicated on the relevant drawings or details.

On non-architectural surfaces of the component such as side returns, stiffening ribs and around fixing supports these areas shall be made good by way of filling voids and areas of exposed glass fibres by

using a slurry cement mix compatible with the design mix. All rear surfaces of the components shall be well compacted by roller to produce a regular finish. All mould flash lines or trimmed edges which allow glass fibres to be exposed shall be trimmed smooth and free of glass fibres.

5.9 REPAIRS / PATCHING:

5.9.1 Repairs to the finished surfaces will be accepted provided the repairs are made using the material specified above and provided such repairs fall within the agreed acceptance levels of the mock up (refer 1.12). Observation distance for repairs is recommended as 5 metres.

5.9.2 Repairs or patching will only be permitted provided the structural adequacy of the component is not impaired.

6.0 MANUFACTURING TOLERANCES:

All components shall be manufactured to the tolerances.

Length and Height (Major Dimensions of Component)

Up to 3m	± 3 mm
3m to 6m	± 5 mm
6m to 9m	± 8 mm

Width (Thickness)

Up to 0.5m	± 3 mm
0.5m to 0.75m	± 5 mm

Straightness or bow (deviation from

Intended line)

Up to 3m	6 mm
3m to 6m	9 mm
6m to 12m	12 mm

Squareness (difference in length of the two diagonals)

3mm per 2m diagonal up to a maximum of 9mm

Twist (any corner should not be more than dimension stated from the plane containing the other three corners)

Up to 3m	6mm

3m to 6m	9mm
6m to 12m	12mm

7.0 MATERIALS TESTING AND RECORDS:

Records and details of the following tests shall be maintained in writing and retained for a period of at least 10 years so that they can be made available to the contractor or his authorised representative on request. The contractor or his authorised representative shall have access at all reasonable times to the manufacturer's testing facility.

7.1 RAW MATERIAL CONTROLS

7.1.1 All cement delivery batches must be accompanied by a declaration document detailing the type of cement and strength class. Approximately 5Kg of cement from each delivery batch must be taken and retained for 1 month

7.1.2 All silica sand delivery batches must be accompanied by a declaration document detailing the grain size analysis, the cleanliness, water content and chemical analysis. Grain size must be verified by the manufacturer. Approximately 5Kg from each delivery batch must be taken and retained for 1 month

7.1.3 All polymer deliveries must be accompanied by a declaration by the supplier of the family of polymers, dry extract and limit of use date. Approximately 1 Kg from each delivery batch must be taken and retained for 6 months

7.1.4 All fibre deliveries must be accompanied by documentation from the supplier detailing quality of glass, diameter of filaments, definition of strand and loss on ignition. Approximately 0.5Kg from each delivery batch must be taken and retained for 6 months.

7.1.5 All raw materials must be stored in a protected environment, in such a way they do not mix with each other and are protected against contamination. Kiln dried sands must be kept in a dry internal location in order not to effect water/cement ratios. All materials must be stored to allow correct stock rotation always using oldest material first.

7.2 TESTING:

7.2.1 The slump test in accordance with BS EN 1170 Part 1 must be carried out at least once per day for each mixing plant to ensure consistency of the matrix.

7.2.2 All concentric spray guns and mixer pumps must be calibrated before the start of production and after any plant breakdowns or interruptions to ensure the correct ratio of slurry and fibres. The method used can either be in accordance with BS EN 1170 Part 3 or the GRCA/PCI “Bag and Bucket Test”.

7.2.3 As flexural bending tests to verify material performance cannot be carried out for a minimum of 7 days a wash out test must be carried out every day for each batching/spray

station to verify fibre content. The method of test shall be in accordance with BS EN 1170 Part 2.

7.2.4 Flexural tests should be carried out every day for each batching/spray plant on 7 day old samples in accordance with BS EN 1170 Part 4. In addition to the measurement of ultimate strength (MOR) as required by the standard a measurement of yield strength (LOP) should be taken.

7.2.5 Flexural tests should be carried out at least every week on both 7 day and 28 day samples in accordance with BS EN 1170 Part 5. It is not necessary to carry out the water absorption aspect of the test as part of a quality control process.

7.2.6 Density and water absorption tests should be carried out at least once per week in accordance with BS EN 1170 Part 6

7.2.7 The manufacturer must arrange for the test for measurement of extremes of dimensional variation due to moisture content in accordance with BS EN 1170 Part 7 to be carried out for each formulation

7.2.8 The manufacturer must arrange for the cyclic weathering test in accordance with BS EN 1170 Part 8 to be carried out for each formulation

7.3 LOADING AND DELIVERY:

All components shall be securely loaded onto suitable transport using all necessary timbers and packings to make the load secure for transportation by the manufacturer to site. The use of such timbers or packing shall not allow staining or damage to occur to the components.

Account shall be taken of the requirements of the site programmes so the components are delivered in a sequence to suit the general contractor's construction schedule, site storage facilities and the component installation programme.

Minor damage caused during loading shall be made good by the manufacturer prior to shipping.

7.4 INSPECTION:

All components may be inspected by the contractor or his authorised representative. Access to the manufacturer's works and yard shall be available to the contractor or his authorised representative at all reasonable times subject to reasonable notice being given.

The inspection of components during and following manufacture may take the form of:-

a. Compliance with the specification.

b. Testing of materials.

c. Quality control.

d. Quality of components manufactured.

e. Storage and packing of components

The Inspector's acceptance of any component in no way relieves the Manufacturer of his responsibility to produce components in accordance with the specification, drawings and details or any warranties provided under the contract.

8.0 QUALITY MANAGEMENT SYSTEMS

All design, manufacturing and testing processes shall be complaint to ISO 9001:2009. Such compliance to be certified by a UKAS accredited provider.

9.0 ENVIRONMENTAL

All processes used in the manufacture of the GRC items must be carried out in accordance with BS EN 14001:2004. Compliance to be certified by a UKAS accredited provider.

10.0 UNSUITABILITY:

Should in the opinion of the Manufacturer any details or specifications be unsuitable or undesirable or inconsistent with the Manufacturer's warranties, guarantees or responsibilities under the contract the Manufacturer shall draw such matters to the attention of the contractor or his authorised representative before ordering materials or commencing manufacture and shall present amended or superseded details which do not contravene the Manufacturer's warranties.

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