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ARAB ENGINEERING BUREAU

7 GLASS REINFORCED PLASTICS

7.1 GENERAL

7.1.1 Scope

- 1 This part includes the specifications for all work in connection with glass reinforced plastics (GRP) ladders, safety cages, handrails, balustrades, gratings, open-mesh flooring, and linings for pump station wet wells.

7.1.2 Related Sections and Parts

This Section

- Part 1 General
Part 3 Pipes and Fittings Materials
Part 4 Pipe Installation
Part 6 Metal Works

Section 1 - General

7.1.3 References

- 1 The following standards are referred to in this Part:

- ASTM E84 Test Method for Surface Burning Characteristics of Building Materials
BS 3532 Method for specifying unsaturated polyester resin systems.
BS 3749 E glass fibre woven roving fabrics for the reinforcement of polyester and epoxy resin systems.
EN 14118 Reinforcement. Specifications for textile glass mats

7.1.4 Submittals

- 1 Manufacturers' Literature:

- (a) the Contractor shall provide manufacturers' specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in GRP works.

- 2 Design Calculations and Shop Drawings:

- (a) the Contractor shall provide design calculations and shop drawings for the fabrication and erection of all assemblies of GRP which are not completely shown in manufacturers' data sheets, including anchorage and accessory items.
(b) plans and elevations in metric dimensions not less than 1:20 scale, and details of sections and connections at not less than 1:10 scale shall be included. Detailed drawings shall show material type, thickness grade/class dimensions, and construction scheme
(c) the submittal shall include catalogue pages, erection description, manufacturers' data and instructions and templates where appropriate.

7.1.5 Quality Assurance

- 1 Fabricated GRP products and materials shall be provided by experienced approved manufacturers and fabricators as designated in the contract specific documents and manufactured to approved patterns.

7.1.6 Warranty

- 1 The Contractor shall provide the Employer with a 7-year unconditional guarantee against failure of all GRP products whether caused by defective materials or workmanship. The guarantee shall be valid from the date of completion of the installation and must be handed to the Engineer before the issue of the Certificate of Completion.

7.2 MATERIALS

7.2.1 GRP

- 1 GRP material for ladders, safety cages, handrails, balustrades, grating and open-mesh flooring shall be fabricated from structural quality fibreglass shapes with chemical and ultraviolet resistance. Resin shall be all vinyl ester. Glass shall be all ECR and GRP thickness shall be a minimum 5 mm. The top surface shall be provided with a non-slip silica sand finish. The structural components shall have Class I fire retardance, with an ASTM E84 flame spread rating of 25 maximum. Fibreglass components shall have an ultimate tensile strength of 207 MPa, an ultimate compressive strength of 207 MPa, a modulus of elasticity of 20.7 GPa, and a Barcol hardness of 50.
- 2 All cut or trimmed edges of the GRP ladder and braces shall be flow coated with an approved vinyl ester resin. Glass fibres shall not be exposed.

7.3 FABRICATION AND ERECTION

7.3.1 GRP Ladder

- 1 GRP ladders shall be obtained from an approved experienced manufacturer and shall be purpose made to suit the depth of each installation as shown on the drawings. The ladders shall be drilled for wall fixing at both ends and additional intermediate fixing connections shall be provided at centres not greater than 1.5 metres. Rungs shall be at 300mm centres and at a distance of not less than 200mm from the wall. Rungs if tubular shall be no less than 30mm outer diameter, and stringers shall be of a rectangular or channel section no less than 70mm x 25mm in size.
- 2 The wall thickness of the laminate shall be not less than 5 mm at any point and there shall be no sharp edges. The support fixing brackets shall be GRP continuously moulded with the main lamination and they shall be not more than 500 mm apart (every 2 steps/rungs). The rungs shall be 250 mm apart with the upper face finished with a non-slip surface.
- 3 The support fixing brackets shall be put through the liner wall, and be designed to be totally encapsulated by concrete. The ladder brackets shall be laminated to the outside of the liner.
- 4 Each rung shall be able to withstand a point load of 5000 N.
- 5 When supported horizontally over a span of 1.0 m with the climbing face uppermost and with a load of 1000 N applied at the centre of the span the ladder shall not deflect more than 15 mm at the point of application of the load and shall show no permanent deflection after removal of the load. Each ladder fixing shall be capable of withstanding shear and pull-out loads of 5000 N.

7.3.2 GRP Handrails and Balustrades

- 1 GRP handrails and balustrades shall be white (or near white) in colour and shall be obtained from an approved experienced manufacturer.
- 2 The resin, glass and synthetic fibres used in the manufacture of handrails shall be chosen to produce a chemically resistant product with a resin-rich surface layer suitable for use in aggressive atmospheres likely to be encountered in sewers and sewage pumping stations.

- 3 Standards shall be no smaller than 45 mm square, and shall be 1100 mm high. Base fixing shall be as shown on the drawings. Where installed on concrete surfaces using expanding anchor bolts, the bases shall be bedded on an approved mastic sealant to prevent ingress of water to the bolt holes.
- 4 Handrails shall be no smaller than 50 mm square, and shall be located 550 and 1100 mm above finished floor level on standards spaced no more than 1500 mm apart. Deflection under vertical loads shall be no greater than deflection under the same horizontal load.
- 5 The complete installation shall be capable of withstanding a horizontal force at top rail level of 740 N/m. The deflection of both rails and standards shall not exceed 2 % of the span/height under a horizontal load of 360 N/m on the top rail.
- 6 At ladders and other openings, two removable stainless steel chains, shall be installed which shall be fixed to handrail standards or ladder stringers using stainless steel (316 S31) hook bolts.

7.3.3 GRP Gratings and Open-Mesh Flooring

- 1 GRP grating and open-mesh flooring shall have the same overall dimensions and design criteria as designated for steel grating and open-mesh flooring in Part 6 of this Section except as modified below.
- 2 The grating shall be of one piece compression moulded continuous fibreglass strand bar type grating and other requirements shall be as designated for GRP ladders. The colour and pattern of the grating and open-mesh flooring will be selected from the available manufacturer's standards and to the approval of the Engineer.

7.3.4 GRP Lining for Pump Station Wet Wells

- 1 GRP linings to pumping station shall consist of a chemically resistant layer comprising vinyl ester resin suitably reinforced with a "C" glass or synthetic tissue veil. This layer shall be no less than 6 mm thick, and shall have a resin content by weight of approximately 90 % at the exposed surface, reducing to 65 % - 75 % at the inner surface. The remainder of the liner shall consist of vinyl ester or isophthalic resins "ECR" glass chopped strand mat. The lining shall be at least 6 mm thick and shall be white (or near white) in colour.
- 2 All linings shall consist of preformed sheets and tubes with moulded on lugs to allow bonding to concrete. Joints between sheets shall be bandaged on the hidden face, with the bandaging extending 150 mm either side of the joint. On the inside (exposed) face the joint shall be filled with vinyl ester paste to produce a smooth finish. Where joints form angles, a 50 mm radius fillet shall be formed using vinyl ester paste prior to bandaging.
- 3 Where the Engineer permits the use of GRP lining to upper surfaces, and other areas where casting in of preformed sheets in inappropriate, lapping of in-situ work onto preformed work, and application of in-situ lining shall be carried out as follows:
 - (a) at the junction between preformed linings and in-situ linings, the preformed lining shall be lightly abraded to a distance of 150 mm from the junction
 - (b) a vinylester paste fillet of 50 mm radius shall be formed at internal angles which are to receive an in-situ lining
 - (c) the in-situ lining shall be built up by applying isophthalic or vinyl ester resin to the whole of the surface to be lined, the fillet and the abraded strip of the preformed lining
 - (d) a layer of "E" or "ECR" mat shall be rolled into the resin using a suitable steel roller to exclude all air and provide complete immersion of glass fibre in the resin

- (e) after a period to allow pre-gel to a tacky state a second coat of resin shall be applied followed by a further layer of glass fibre mat. This process shall be repeated until the total thickness of the lining is approximately 4 mm
 - (f) vinylester resin and "ECR" glass or synthetic tissue veil shall than be applied in layers to complete the lining
 - (g) where linings are applied to inverts of channels subject to high fluid velocities of 5 m/s, the GRP lining shall be mechanically fixed to the substrate using stainless steel screws and washers. After building up approximately 60 % of the required thickness of lining, stainless steel round headed screws 50 mm long and stainless steel washers 25 mm diameter shall be used at 500 mm centres (by drilling and plugging) to fix the lining to the concrete. Particular attention shall be paid to edges of sheets where the flow of sewage will tend to lift the lining. The remaining layers of GRP shall then be built up over the screw heads and washers.
- 4 The top surface of benchings and platforms shall incorporate silica sand to form a non-slip surface.

END OF PART