6 MISCELLANEOUS METAL WORKS

6.1 GENERAL

6.1.1 Scope

1 This part includes the specifications for the design, fabrication and erection of ladders, staircase assemblies, open mesh flooring, chequer plate, gratings, handrailing, step irons, supports, anchors, and other appurtenances.

2 Related Sections and Parts are as follows

This Section

Part 1	General
Part 3	Pipes and Fittings Materials
Part 7	Miscellaneous GRP Works
Part 8	Protective Coatings and Painting

Section 1	General
Section 16	Structural Metalwork
Section 17	Metalwork.

6.1.2 Reference

1 The following standards or revised/updated versions are referred to in this Part:

BS 970.....Wrought steels for mechanical and allied engineering purposes

BS 1470 .....Wrought aluminium and aluminium alloys for general engineering purposes; plate, sheet and strips

BS 1471 .....Wrought aluminium and aluminium alloys for general engineering purposes; Drawn Tube

BS 1472 .....Wrought aluminium and aluminium alloys for general engineering purposes; forging stock

BS 1474 .....Wrought aluminium and aluminium alloys for general engineering purposes - bars, extruded round tube and sections

BS 4211 .....Specifications for permanent fixed ladders

BS 4592 .....Industrial type metal flooring, walkways and stair treads.

BS 5395 .....Stairs, ladders and walkways

BS 5493 .....Code of practice for protective coating of iron and steel structures against corrosion

EN 1561 .....Founding Gray Cast Iron

EN 1563 .....Found spheroidal graphite cast iron

EN 1993 .....EURO code 3, Design of steel structures

EN 13101 .....Steps for underground man entry chambers - Requirements, marking, testing and evaluation of conformity

EN 124 .....Gully tops and manhole tops for vehicular and pedestrian areas – Design requirements, type testing, marking, quality control

ISO 2560 .....Welding consumables - Covered electrodes for manual metal arc welding of non-alloy and fine grained steels

ISO 9000 .....Quality System

6.1.3 Submittals

1 The Contractor shall submit complete data as described below.

2 Product Data:

(a) the Contractor shall provide manufacturers' specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in the manufacture of metal fabrications.

3 Design Calculations and Shop Drawings:

(a) the Contractor shall provide design calculations and shop drawings for the fabrication and erection of all assemblies of metal fabrication work which are not completely shown by manufacturers' data sheets, including anchorage and accessory items. Plans and elevations at metric scales not less than 1:10 scale, and details of sections and connections at not less than 1:5 scale shall be included.

(b) detailed drawings shall show material type, thickness grade/class dimensions, and construction scheme. The submittal shall include catalogue pages, erection description, manufacturers' data/instructions, and templates.

4 Where structural steelwork is to be provided the Contractor shall submit duplicate copies of dimensioned shop drawings for approval by the Engineer's Representative. If drawings are not approved, one copy shall be returned to the Contractor marked up indicating the alterations required. Upon final approval one copy of the drawing, stamped 'Approved' by the Engineer's Representative, shall be returned to the Contractor. Four further copies of the approved drawings shall then be submitted to the Engineer's Representative. No shop fabrication may commence before receipt of the relevant shop drawings.

5 The shop drawings shall become record drawings on the completion of steelwork erection and the original drawing and one ISO size A2 (495 & 420) negative of each shall be supplied to the Engineer. If there were any changes to the steelwork during erection these should be supplied together with the original and the size A2 signed negative.

6 WPS and PQR

6.1.4 Quality Assurance

1 Fabricated metal products and materials shall be provided by experienced and approved manufacturers and fabricators as designated in the Contract document to the written approval of the Engineer.

2 Where welding/brazing is required the Contractor shall:

(a) submit for approval welding procedure specification (WPS) and procedure qualification record (PQR) in conformance with AWS D1.1(steel structures), ASME IX (piping and pressure vessels) and EN 288 part 4 (Aluminium) and EN 1011-8 (Iron) as appropriate;

(b) submit for approval welder qualifications which shall be in conformance with the above codes and or ISO 9606-2 (aluminium alloys),

(c) assign a CSWIP 3.1 or AWS QC qualified welding inspector, who shall be subject to the Engineer's approval, to witness all welding.

6.1.5 Delivery, Storage and Handling

1 Metal works shall be stored off the ground, protected from moisture, until ready for use or installation.

2 Metal works shall be stored and handled in such a manner to protect finishes.

3 Metal works shall be stored and handled to prevent bending under its own weight and superimposed loads.

6.2 MATERIALS

6.2.1 Steel

1 Steel rolled shapes, plates and bars shall conform to the requirements of Section 16 unless otherwise specified in this Part.

2 Bolts and nuts shall be of standard commercial quality steel conforming to Section 16, and shall be galvanised when used with galvanised work.

AWS D 1.1 - Steel Structure Welding Code
ASME VIII Div. 1 - Pressure Vessel welding
ASME IX - Boiler & Pressure Vessel Code - Section IX Welding & Brazing
ASME B31.3 - Process Pipe

6.2.2 Stainless Steel

1 Stainless steel shall conform to BS 970 and shall be Grade 316 S31 unless otherwise designated.

2 Stainless steel bolts, hexagonal cap screws, and studs shall be BS 970 Grade 316 S31 unless otherwise designated.

3 All stainless steel to be welded shall be BS 970 Grade 316L.

6.2.3 Aluminium

1 All aluminium plate, pipe and structural shapes shall conform to EN 12020, and BS 1472 with EN 485 Grades 6036-T6 or 6082-T6 or such other chemically resistant alloy that the manufacturer can demonstrate to be suitable for use in aggressive atmospheres likely to be encountered in sewage pumping stations. All aluminium items embedded in concrete shall have two coats of bituminous paint. Where aluminium surfaces are in contact with concrete surfaces or with dissimilar metals, PVC-U gaskets shall be used to isolate the aluminium.

6.2.4 Iron

1 Ductile Iron. Ductile iron shall be in accordance with EN 1563.

2 Grey Cast Iron. Cast iron shall be in accordance with EN 1561.

3 Malleable Iron. Malleable iron shall be in accordance with EN 13101.

6.2.5 Welded Anchor Studs

1 Headed anchor studs (HAS) or threaded anchor studs (TAS), as indicated on the Contract Drawings:

(a) Carbon Steel: ISO 898, either semi-killed or killed aluminium or silicon dioxidation, unless indicated otherwise.

(b) Stainless Steel: ISO 3506, Grade SS 316, Condition CW, where indicated.

6.2.6 U Channel Concrete Inserts

1 Rolled: ISO 9445 Type 316 stainless steel, 2.7 mm thickness, 40 mm width by 35 millimetres depth, with stainless steel anchors at 250 mm maximum spacing, Styrofoam fillers, and end cap.

2 Nut and Bolt Hardware: Type 316 stainless steel, 16 mm minimum diameter, unless indicated otherwise. Manufacturer's standard to match insert.

6.2.7 Concrete Anchors

1 For concrete anchor spacing less than 12 anchor diameters and edge distances less than six anchor diameters, make reduction in allowable pullout and shear values.

2 Allow for thermal movement resulting from the maximum range in ambient temperature in design, fabrication, and installation of handrails to prevent buckling, opening up of joints, over stressing of components, connections and other detrimental effects. Base design calculation on actual surface temperatures of materials due to both solar heat gain and night time sky heat loss. Temperature change is difference between high or low temperature and installation temperature.

3 Use approved service load allowable values for size, length, embedment, spacing, and edge distance to match required loads shown in calculations.

6.3 COATINGS

6.3.1 Galvanising

1 Galvanising shall be executed after all fabrication has been completed and shall be carried out in accordance with BS 5493:1977. The articles shall be pickled in dilute sulphuric or hydrochloric acid followed by rinsing in water and pickling in phosphoric acid. They shall be thoroughly washed, stoved and dipped in molten zinc and brushed so that the whole of the metal shall be evenly covered and the coating thickness after dipping shall not be less than the BS 5493 System Reference Number recommended for the particular conditions and in any case not less than 85 microns.

2 Unless otherwise specified, all ferrous metals shall be galvanised in conformance with reference standards according to the nature of the work. Factory fabrication shall be complete before galvanising. Galvanised coatings that have been marred or damaged during erection or fabrication shall be repaired using designated touch-up material.

3 Surfaces of exterior units which have been galvanised after fabrication and are intended for bolted or screwed field connections shall not be welded, cut or abraded.

4 Galvanised coatings marred or damaged during erection or fabrication shall be repaired conforming to BS 5493 and in accordance with the coating manufacturer's instructions.

5 Unpainted galvanized surfaces shall not be used in an immersed condition within three months of hot dip galvanizing and/or before an adequate protective patina has formed.

6 All mild steel parts unless otherwise stated, are to be heavily galvanised by the "hot dip" process, or other methods as agreed by the Engineer, after fabrication. Where large units are concerned, an approved metal spraying process to BS specifications may be used subject to the approval of the Engineer. With the exception of the metal flooring to be supplied unpainted, the whole of the galvanised mild steel parts and metal sprayed parts are to be treated with a zinc phosphate primer before leaving the place of manufacture. (No lead oxide or iron may be used in priming the galvanised parts.) Painting shall be in accordance with the Schedule A [Work Requirements], Part 5 [Warranted Project Data], 5.1 [Drawings] or as selected by the Engineer.

7 All steel and ironwork of whatever kind to be galvanised shall be thoroughly de-scaled by shot blasting to clear metal to BS 4232 second quality, to clean the surfaces of all dirt, weld spelter, grease, slag, oil-paint or other deleterious materials, and immediately after is to be galvanised by a hot dip process, followed by quenching in water. The molten zinc in the galvanising bath shall contain not less than 98.5 percent of zinc by weight. All articles are to be immersed in the bath only for a time sufficient for them to attain the temperature of the bath and they are to be withdrawn at such a speed that a coating of 90 microns thickness is achieved, or such other practicable maximum thickness for the article defined in BS 729, Part "Hot dip galvanised coating on iron and steel." The galvanising is to be done in all cases after machine work, chipping, trimming, filling, fitting, drilling or bending is completed. Every article is to be covered evenly on all sides.

8 The zinc coating shall consist of a uniform layer of zinc free from abrasions, creeks, blisters, chemical spots or other imperfections, and so applied that it will adhere firmly to the surface of the steel.

9 The galvanising shall be applied in such a manner that the spelter will not peel off. The coating of the finished product shall be even, smooth and uniform throughout. Machine work, dye work, cutting, punching, bending, welding, drilling, thread cutting and other fabrication shall all be done, as far as practicable, before galvanising.

10 The galvanising shall have no adverse effect on the mechanical properties of the articles so treated. Variations in dimensional properties shall be kept to a minimum.

11 The work of surface preparation and galvanising shall be carried out, for any one article, on the same working day.

12 Galvanising on steelwork where required is to be carried out after fabrication and assembly.

13 Light gauge metal work is to be galvanised by the hot dip process as specified in BS 3083 or BS 2989.

14 Contact between galvanised steel members and aluminium surface is to be prevented by means of a layer of "Densochrome" or similar approved tape.

15 All necessary care and precautions are to be taken in shipping and transporting the galvanised or metal sprayed units to avoid damage to the coating. Where damage proves to be extensive in the opinion of the Engineer, the whole unit shall be recoated.

16 Where galvanised parts are to be bolted or riveted together, the joint shall be made with an approved barium or zinc chromate paste.

17 Where the metal parts are too big to be hot dip galvanised, approval of the Engineer shall be sought for the steel parts to be shot blasted to BS 4232 second quality and then immediately zinc sprayed to a minimum thickness of 0.1 mm in accordance with BS 2569 Part 1.

6.3.2 Anodising

1 All aluminium members shall be anodised after fabrication in accordance with Sections 16 and 17.

2 All aluminium and aluminium alloy materials shall be anodised after fabrication to a thickness of grade AA 20 and subsequently sealed against corrosion. After anodising, the aluminium surfaces shall not be painted but left self-finish. Anodising of aluminium shall comply with the requirements of BS 1615.

6.3.3 Factory Painting

1 All protective coatings and painting shall be carried out as specified in Part 8 of this Section.

2 Before leaving the factory, ferrous metals not designated to be galvanised shall be given one coat of primer as specified in Clause 8.2 of Part 8. Portions to be embedded in concrete or masonry shall not be painted.

6.4 FABRICATION AND ERECTION

6.4.1 General

1 Stairs, ladders and walkways provided shall conform to BS 4211 and BS 5395.

2 Fabrication and erection shall be performed by approved specialist subcontractors experienced in work of equivalent magnitude. Shop drawings shall be prepared by the Contractor based on the details shown on the Drawings. The Contractor shall

(a) verify all measurements and shall take all site measurements necessary before fabrication

(b) be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members

(c) not substitute sections

(d) not modify connections.

Members and connections, for any part of the structure, not shown on the Drawings shall be the Contractor's responsibility.

3 The Contractor shall use materials of the size and thickness shown on the Drawings, or if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use.

4 All work at the factory shall be preassembled to the greatest extent possible to minimise field splicing and assembly of units at the Site. Units shall be disassembled only to the extent necessary to comply with transportation limitations and shall be clearly marked for reassembly and proper installation. Ladders shall be supplied as preassembled units.

5 For the manufacture of metal fabrications which will be exposed to view, only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness shall be used. Any such blemishes shall be removed by grinding, or by welding and grinding, before cleaning, treating and application of finishes including anodising and galvanising. Smoothness shall be required all round for handrails and ladders.

6 Exposed work shall be formed true to line and level with accurate angles and surfaces and straight sharp edges. Exposed edges shall be rounded to a radius of approximately 1 mm unless otherwise designated.

7 Exposed connections with hairline joints which are flush and smooth shall be formed using concealed fasteners wherever possible. Exposed fasteners shall be flat-head (countersunk) screws or bolts. Bolt and screw holes shall be predrilled for attachment of metal fabrication work and for the attachment of adjacent materials.

8 Welding shall be carried out by experienced tradesmen, and made with designated electrodes or submerged arc conforming to ISO 2560. The following procedures shall be carried out:

(a) before fabrication, all steel shall be thoroughly wire brushed, clean of all scale and rust, and thoroughly straightened by approved methods that will not injure the materials being worked on

(b) welding shall be continuous along the entire line of contact except where tack or intermittent welding is permitted

(c) where exposed, welds shall be cleaned of slag and ground smooth.

(d) All stainless steel welding shall be gas tungsten arc welding (GTAW)or shield metal arc welding (SMAW) processes using stainless steel type 316L consumables conforming to the requirements of the under-mentioned codes / AWS A5.9 (GTAW) or AWS A5.4 (SMAW).

(e) All aluminium welding shall be undertaken using GTAW process using consumables under 5356 classification of AWS A5.10.

(f) Welding to be undertaken in accordance with the applicable code as follows:

General guidance for arc welding	EN 1011 –1
Arc welding of ferritic steels	EN 1011– 2
Arc welding of stainless steels	EN 1011–3
Arc welding of aluminium	EN 1011-4
Welding of cast iron	EN 1011-8
Steel Structures	AWS D1.1
Pressure vessels	ASME VIII Div 1
Piping	ASME B31.3

9 Fixing shall be carried out as follows:

(a) the Contractor shall fabricate and install anchoring devices with spacing as required to provide adequate support for the intended use of the work

(b) fastenings to wooden plugs will not be permitted

(c) All nuts and bolts shall be threaded in accordance with BS 3643 “Isometric series threads” part 2 “Limits and tolerances for coarse pitch threads” and fitted with 3mm thick washers beneath bolt and nut.

(d) Regardless of the materials being fixed all bolts, nuts, washers and anchor plates shall be of stainless steel Grade 316 S31 to BS 970 and shall remain unpainted. PTFE washers shall be fitted beneath stainless steel washers for both bolthead and nut.

(e) Drilled anchor fixings for use on concrete structure shall be of a type approved by the Engineer’s Representative. The positions of all drilled anchors shall be approved by the Engineer’s Representative and any Contractor proposing to use such fixings shall be deemed to have undertaken to supply, mark off, drill and fit.

(f) All exposed bolt heads and nuts shall be hexagonal and the length of all bolts shall be such that when fitted with a nut and tightened down, the threaded portion shall fill the nut and not protrude from the face thereof by more then half the diameter of the bolt.

(g) All jointing material shall be provided by the Contractor.

10 Dissimilar materials shall be separated by gaskets.

6.4.2 Staircases

1 Metal staircases shall be constructed to the overall dimensions detailed on the Drawings and shall be prefabricated in marine quality mill finished aluminium alloy or galvanised steel. Staircases shall be designed to span longitudinally from wall to wall and shall be designed to carry a live load of 5 kPa. Stringers shall be of adequate size to support dead and live loads.

2 Treads shall be of non-slip surface and shall have adequate stiffness to carry a point load of 1.8 kN at the centre.

3 Landings shall not exceed 3 m.

4 Kicker plates shall extend to a minimum of 100 mm above flooring and open sides. The risers shall not exceed 200 mm.

5 Chequer plates shall be as specified in Clause 6.4.6 wherein.

6 Unless otherwise shown on the Contract Drawings, furnish flush type abrasive nosing on stairs.

7 Nosing Components:

(a) Homogeneous epoxy abrasive, with minimum 50 percent aluminium oxide content, formed and cured upon an extruded aluminium base.

(b) Epoxy abrasive shall extend over and form curved front edge of nosing.

(c) Base of Nosing: Extruded aluminium alloy, 6063-T5, heat-treated complying with EN 12020.

(d) Anchoring System: Double-set anchors consisting of two rows of integrally extruded anchors.

(e) Size: 75 mm wide by 6 mm to 10 mm thick by length as shown.

(f) Colour: Selected by Engineer from manufacturer's standard colour range.

6.4.3 Ladders

1 Galvanised steel ladders shall be to the form and dimensions shown on the Drawings, and as specified below:

(a) ladders shall comply with BS 5395, Part 3.

(b) ladders greater than 6000 m shall be provided with an intermediate platform

(c) stringers shall be solid flat sections of minimum size 65 mm by 13 mm where extended stringers are provided they shall be radiused over the top for walk-through access and shall be not less than 600mm apart.

(d) fixing brackets shall be at maximum 2500 mm centres

(e) rungs shall be

(i) solid sections of minimum 20 mm diameter

(ii) at 300 mm centres

(iii) minimum 380 mm wide between stringers

(iv) minimum 200 mm from adjacent walls

(v) capable of withstanding a point load of 5000 N applied at the centre of the rung and close to one end

(f) 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

(g) safety cages shall be provided where indicated and where the distance between landings exceeds 3500 mm. These shall be constructed of three vertical flat sections, minimum size 50 mm by 8 mm supported by flat hoops with a diameter of 750 mm. The hoops shall be at a maximum of 900 mm centres and the first hoop shall be 2400 mm above lowest platform level. No single hoop shall be used

(h) all welds shall be ground flush and smoothed and ladders hot-dip galvanised after fabrication. Connections to concrete or masonry walls shall be secure with accurately positioned stainless steel anchor bolts. Ladders shall be mounted to produce a finished appearance that is plumb, straight and true to dimensions.

2 Stainless steel ladders shall generally be of dimensions as designated for galvanised steel ladders except that all materials shall be of stainless steel.

3 Aluminium ladders shall be to the form and specified dimensions shown on the Drawings, and as specified below:

(a) the spacing of stringers, rungs and safety hoops shall be as galvanised steel ladders.

(b) material shall be aluminium alloy to EN 573 grade EN AW-6082.

(c) ladders shall be of all welded construction. Stringers shall be drilled to receive rungs which shall be welded into position from the outside of the stringers. Welds shall not be proud of the outside of the stringers

(d) rungs shall be of substantial section serrated tube to enable sure hand and foot holds

(e) fixings shall be of stainless steel. Gaskets shall be provided to isolate aluminium alloy from other materials

(f) all other requirements shall be as specified for galvanised steel ladders

(g) ladders shall be obtained from approved suppliers.

6.4.4 Step Irons

1 Step ironing rising main valve chambers shall be galvanised malleable cast iron, shall conform to EN 13101, and shall be of general purpose type. The tail length shall be 230 mm unless the well into which the tail is to be cast is less than 290 mm thick.

2 Step irons in house connection chambers shall comply with EN 13101 and be the general-purpose type manufactured of galvanised malleable cast iron. The tail length shall be 115mm. The step irons shall be epoxy coated with a material compatible with a galvanised surface and finished with a two part, acrylic polyurethane topcoat as detailed below and applied in accordance with the manufacturer's instructions.

Epoxy Coating	50 ∓DFT
Two Part Acrylic Finish	50 ∓DFT

6.4.5 Handrails and Railings

1 Handrailing shall be obtained from an approved experienced manufacturer and shall be GRP, circular hollow section, marine quality mill finished aluminium alloy (EN 573 grade EN AW-6082) in pre-fabricated lengths complete with fixings or shall be stainless steel circular hollow section (BS970 Grade316S31). Site welding will not be accepted. All welded parts to be completed during manufacturing fabrication with approved WPS by Engineer in accordance with Clause 6.1.4 of this Part. Handrails and railings fabricated from mild steel, stainless steel, or aluminium as shown on the Drawings and meet the following requirements:

(a) brackets, bolts and fastening devices shall be provided as required for complete installation

(b) handrailing and railings shall be provided with smooth bends and welded joints ground smooth and flush

(c) installed railings and supports shall withstand a 1100 N load applied at any point, downward or horizontally or 740 N/m along the top rail, whichever is greater

(d) the deflection of both rails and standards shall to exceed 2 % of the span/height under a horizontal load of 360 N/m on the top rail.

2 Galvanised steel handrailing shall be provided in accordance with the following requirements:

(a) stanchions shall have a nominal bore of 40 mm and a minimum wall thickness of 3.25 mm

(b) stanchions on steel stringers shall have base plates or angles welded to bottom of pipe and bolted to stringer

(c) rails shall have a nominal bore of 32 mm and minimum wall thickness of 4 mm

(d) horizontal handrails shall be 1,100 mm high with an intermediate rail 550 mm high

(e) railings shall be

(i) mounted so as to produce a finished appearance that is plumb, straight, and true to dimension, free from kinks, twists, and abrasions

(ii) curves, where indicated on the Drawings or necessary, shall be bent to a radius of not less than 100 mm. Where shown on the Drawings, or directed by the Engineer, removable sections shall be provided

(f) toe plates shall be provided where railings are not mounted on stanchions

(g) welds shall be ground flush and smooth and handrailing hot-dip galvanised after fabrication

(h) sleeves shall be provided for setting by other trades where embedded

(i) connections to concrete or masonry wall surfaces shall be secure with accurately positioned stainless steel anchor bolts, or with cinch anchors and bolts

(j) where expanding anchor bolts are used on concrete surfaces, the bases shall be bedded on a mastic sealant as approved by the Engineer to prevent ingress of water

(k) at ladders and other openings, 12 mm minimum galvanised steel safety chains with eyebolt and harness type snap attachments shall be installed.

3 Stainless steel handrailing shall generally be as designated for galvanised steel handrailing except that all materials shall be of stainless steel Grade 316 S 31, including stainless steel safety chains and attachments.

4 Aluminium handrailing shall generally be as designated for galvanised steel handrailing except as modified below:

(a) handrailing shall comprise double line handrails made from minimum 43 mm outside diameter 9 SWG tube to BS 1474 Grades 6036-T6, 6082-T6 unless otherwise designated

(b) fixings shall be of stainless steel

(c) at ladders and other openings, two stainless chains shall be installed which shall be fixed to hand rail standards or ladder stringers using suitable aluminium alloy hooks.

5 All joints shall be made within standards and shall consist of a dowel to provide rigidity fixed within the handrailing using countersunk stainless steel grub screws. Where removable lengths of handrails are detailed half lap joints shall be used.

6 Make provisions for handrails in the exterior and interior installations subject to high humidity to drain water from railing system.

7 Posts mounted handrails in concrete, bends and elbows occurring at low points, drill weep holes of 6 mm diameter at lowest possible elevations, one hole per post or rail. Drill hole in the plane of the rail.

6.4.6 Chequer Plate

1 General

(a) all chequer plate shall be designed to support uniformly distributed loads of 7.5 kN/m^2. The loading shall be considered a minimum requirement. Where an item of equipment demands larger loading, the loading shall be increased accordingly.

(b) maximum deflection shall be 0.2 % of the span under maximum loading conditions for steel flooring and one per cent for Aluminium

(c) plate sections shall

(i) have a minimum thickness of 6 mm, excluding the raised pattern

(ii) Plates shall be reinforced with angle sections of the same material to meet the above loading and deflection requirements.

(iii) be of diamond shaped pattern at the top and have an angled and opposed pattern which shall be non-slip type

(d) joints shall be provided at the centre of all openings unless otherwise shown on the Drawings

(e) joints and openings shall be reinforced with additional stiffeners where necessary to provide the required load carrying capacity and deflection criterion.

2 Galvanised steel chequer plate and frames shall be hot dip galvanised after fabrication, and all fasteners shall be stainless steel. Where specified on the drawings galvanised chequer plate flooring shall in addition be epoxy coated.

3 Aluminium chequer plate and frames shall be fabricated from aluminium alloy to EN 755-9, Grade 6082-T6, and all fasteners shall be stainless steel A4. Gaskets shall be provided to isolate aluminium alloy from other materials.

4 Flooring shall be provided in sizes suitable for removal by one man and with the appropriate cutouts to permit its removal without disturbing or dismantling spindles, supporting brackets or pipe work. Intermediate supporting members shall be provided and fixed, the cost of which shall be deemed to be included in the cost of the flooring.

5 Chequer plate flooring covering openings in concrete or brickwork shall be set flush in frames of the same material fixed as shown on the drawings.

6.4.7 Gratings and Open Mesh Flooring

1 General

(a) all flooring and walkways shall be designed to support uniformly distributed loads of 7.5 kN/m^2

(b) gratings and open mesh flooring shall be welded, rectangular opening type, bar gratings with seat angles, anchors and supports of the same material

(c) grating up to and including 1.0 m shall be furnished in pieces approximately 1.0 m in width and all gratings for pans greater than 1 m shall be furnished in pieces 0.8 m in width

(d) openings required in gratings shall be banded where openings are provided and shall be strengthened as necessary

(e) installed units shall be true to plane and free of warps and irregularities

(f) units shall be divided for ease of installation and removal

(g) bearing bars shall be serrated and have a minimum size of 45 mm deep by 5 mm thick

(h) the edges of all flooring and platforms shall be finished with approved kerbs, which shall be provided by the flooring supplier and shall be fitted with fish tail lugs for building into the concrete work

(i) the pattern, design thickness and finish shall be approved by the Engineer. The pattern of open type flooring shall be rectangular and shall match between adjacent panels

(j) flooring and walkway supports shall be independent of bearing supports to prevent the setting up of oscillations and noisy vibrations

(k) all clips and bolts shall be stainless steel

(l) all supporting metal work shall be provided on large area openings to provide support for the flooring

(m) the faces of flooring which come into contact with cement mortar concrete shall have two coats of bituminous paint before installation of the frame.

2 Galvanised steel gratings and open mesh flooring shall be hot dipped galvanised after fabrication.

3 Aluminium gratings and open mesh flooring shall be manufactured in approved structural aluminium BS 1471, BS 1472 or BS 1474, Grade 6063-T6 or 6082-T6 unless otherwise designated and all fastens shall be stainless steel. Gaskets shall be provided to isolate aluminium alloy from other materials.

4 Stainless steel gratings and open mesh flooring shall be manufactured of Grade 316S31 to BS 970.

5 Flooring shall be removable and set flush in frames of the same material. Frames shall be fixed as shown on the drawings.

6 The deflection under maximum load shall not exceed 0.2 per cent of the span for steel flooring and one per cent for aluminium.

7 Flooring shall be provided in sizes suitable for removal by one man and with the appropriate cut-outs to permit its removal without disturbing or dismantling spindles, supporting brackets or pipe work. Intermediate supporting members shall be provided and fixed, the cost of which shall be deemed to be included in the cost of the flooring.

8 Steel angle support frames to be embedded in concrete shall be stainless steel, BS EN 10272:2000 Type 316, unless indicated otherwise.

9 Welded anchors for stainless steel support frames shall also be stainless steel.

END OF PART