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1. PRELIMINARIES

1.1. Standard and Codes

- 1.1.1. The Contractor shall, perform the Works in compliance with all regulations, standard specifications or statutes of the Government of Maldives unless otherwise conform to this specification.
- 1.1.2. The current British Standard Specifications and Codes of Practice shall apply to and form part of these specifications unless otherwise specified in respect of all materials and works to which they have application.

1.2. Drawings and Specifications

- 1.2.1. Drawings and Specifications are intended to complement each other, so that if anything is shown on the Drawings, but not mentioned in the specifications or vice versa, it is to be furnished and built as though specifically set forth in all three. If any discrepancies, errors, ambiguities or omissions occur in the Drawings or Specifications, the same shall be referred to the Consultant before proceeding with the Works, and the Consultant decision on such discrepancies, errors, ambiguities or omissions shall be final.
- 1.2.2. In addition to the Drawings and Specifications attached hereto, the Consultant will during the progress of the Works furnish additional Drawings, Specifications, and instructions as may be necessary, in the opinion of the Consultant for the purpose of the proper and adequate execution and maintenance of the Works, and the Contractor shall make his work conform. Such drawings and instructions shall be deemed to be part of the Contract Documents.

1.3. Transportation to the Site

- 1.3.1. The Contractor shall provide all necessary transport, handling and storage of all materials, components and the like to their points of installation on site including transport to and from storage. The Contractor shall provide all necessary transport of labour to and from the site.

1.4. Schedule and Execution Plan

- 1.4.1. The Contractor shall prepare and submit to the Consultant for approval the construction schedule and an execution plan of temporary facilities, stockyards, etc., before the start of the Works.

1.5. Repairing and Correction

- 1.5.1. Any breakage(s) or defect(s) of existing buildings, road utilities, or part(s) of them caused by the Works including transportation for the works shall be repaired or corrected by the Contractor with his responsibility.

1.6. Workmanship and Materials

- 1.6.1. All workmanship shall be of the best standard. All goods and materials to be incorporated in the Works must be new, unused, of the most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the contract.
- 1.6.2. The Contractor shall submit for the approval of the Consultant a list of names and addresses of the manufacturers and trade marks or names of all the various types of materials and goods he propose to use in the Works. The list shall include reference to the specifications clause or article to which the materials and goods apply.
- 1.6.3. Materials shall be obtained from approved sources and used in accordance with the manufacturer's printed instructions. In the absence of a specification, all materials shall comply with a relevant standard. The consultant shall order the removal of any materials, which he has not approved.

1.6.4. No orders for materials and goods shall be placed until approval has been obtained for the materials and goods from the consultant.

1.6.5. The Contractor shall note that it is his responsibility to include in his price for the cost of the materials and products as specified and no adjustment will be allowed should the consultant reject the alternatives.

1.7. Obvious Work

1.7.1. Where an item of work is obviously required for the type of work being undertaken then it shall be deemed to have been included even though the item is not specifically mentioned or shown in the Drawings or Specifications.

1.8. Protection

1.8.1. The Contractor shall have the Works and adjoining properties protected from inclement weather. Any loss or damage caused by weather, carelessness or lack of skill of workers, accident or otherwise shall be of such property that is affected. The Contractor shall provide all necessary dustsheets, barriers and guardrails and clear away at completion.

1.8.2. The work shall be suspended for such time as may be directed and/or approved by the Consultant if the specified quality of work is difficult to maintain during inclement weather.

1.9. Scaffolding

1.9.1. The Contractor shall provide, erect, maintain, dismantle and clear away at completion proper and adequate including that required for subcontractor and suppliers. Putlog holes shall be made good to match the adjacent surface as the scaffolding is dismantled.

1.9.2. The Contractor shall be responsible for all safety precautions in connection with the scaffolding including the provision of all bracing, scaffold boards, toe boards and the like and for entire sufficiency for the work.

1.10. Construction Machinery, Plants and Equipment's

1.10.1. All necessary construction machines shall be provided and maintained by the Contractor and shall be approved by the Consultant.

1.10.2. If cranes or any other type of plant which places any load on the structure are proposed, all details of such plant shall be submitted to the Consultant for approval before the work is actually commenced. If approved by the Consultant and Consultanturally acceptable, permission may be given for the structure to be strengthened, in order to carry out loads, and the Contractor shall be responsible for any resulting additional costs.

1.10.3. The Contractor shall be responsible for making good to the satisfaction of the Consultant any damage to the permanent structure that may be caused by his plant and equipment.

1.11. Samples

1.11.1. The Contractor shall furnish for the approval with reasonable promptness, all samples as directed by the consultant. The Consultant shall check and approve such materials with reasonable promptness only for conformance with the design concept of the Works and for compliance with the information given in the Contract Document. The Work shall be in accordance with the approved samples.

1.11.2. All samples shall be delivered to the Consultant's office with all charges in connection therewith paid by the Contractor and deemed to be included in the Contract Price.

1.11.3. Duplicate final approved samples, in addition to any required for the Contractor's use, shall be furnished to the Consultant, one for office use and one for the site.

1.11.4. Samples shall be furnished so as not to delay fabrication, allowing the consultant reasonable time for consideration of the sample submitted.

- 1.11.5. Each sample shall be properly labeled with the name and quality of the material, manufacturer's name, name of project, the contractor's name and date of submission, and the specification clause to which the sample refers.

1.12. Ordering Materials

- 1.12.1. The Bills of Quantities shall not be used as a basis for ordering materials and the Contractor is entirely responsible for assessing the quantities of materials to be ordered.
- 1.12.2. Upon receipt of the Consultant's order to commence the Works, the Contractor shall immediately place orders for all required materials and will be held responsible for any delays occurring due to late placing of such orders.
- 1.12.3. The Contractor shall pay all expenses, taxes and dues etc. incurred on the procurement of materials from abroad

1.13. Water and Electricity for the Works

- 1.13.1. The Contractor shall make all necessary arrangements and provide all water for the proper execution of the Works, together with all transport, temporary plumbing, storage and distribution, pay all charges and alter, adept and maintain temporary work as necessary and remove and make good at completion.
- 1.13.2. The Contractor shall make all necessary arrangements and provide all artificial lighting and power (maintain a generator if necessary) for the proper execution and security of the Works and its protection, with all meters, temporary wiring and fittings, pay all charges and alter adapt and maintain the temporary work as necessary and remove and make good at completion.

1.14. Site offices for Contractor

- 1.14.1. The Contractor shall provide maintain and clear away on completion of the Contract all necessary site offices, canteens, messing and welfare facilities, temporary buildings, toilets and the like for all site staff employed by the Contractor and required by subcontractors and suppliers.
- 1.14.2. The offices shall be open at all normal working hours to receive instructions, notices and other communications.

1.15. Contractor's Site Area

- 1.15.1. throughout the period of the Contract the Contractor shall maintain the area of his operation within the limits of the site in a clean, tidy and safe condition by arranging materials and the like in an orderly manner. All rubbish, debris, waste materials and the like shall be systematically cleared from the site as it accumulates.
- 1.15.2. The Contractor shall take steps necessary as directed by the Consultant to minimize or eliminate dust, noise or any other nuisance, which may occur. Plant emitting dust, smoke, excessive noise or other nuisance shall not be permitted.

1.16. Progress Meeting

- 1.16.1. During the course of the Works, progress meetings shall be held at weekly intervals for the purpose of coordinating the Contractor's works and to ensure that full compliance is maintained.
- 1.16.2. Minutes of such meeting should be recorded; copies will be distributed to all persons concerned and full effect shall be given to all instructions contained therein.

1.17. Progress Photographs

- 1.17.1. The Contractor shall supply once a month, at the time of submitting his interim Certificates, photographs showing the progress of the Works.

1.18. Setting Out

- 1.18.1. The Contractor shall be responsible for accurately setting out the Works to the specified positions, dimension, levels and Building Lines and also checking the site surveys for dimensional and level accuracy and reporting any discrepancies before building work commences.
- 1.18.2. The Contractor shall provide the Consultant with all facilities, equipment and labour to enable him to check the setting out and levels of the Works at all times. The checking of any setting out point, line or level by the Consultant shall not in any way relieve the Contractor of his responsibility.
- 1.18.3. All setting out points, benchmarks, site rails, pegs and other survey points shall be clearly marked and protected from damage or disturbance during the execution of the Works.

1.19. Loading in Excess of Design Load

- 1.19.1. No loading in excess of the design loading shall be placed on any portion of the structure without the written permission of the Consultant.

1.20. Permanent Drainage, Electricity and Water connection

- 1.20.1. The Contractor shall allow for arranging and obtaining the permanent drainage, water and electricity connections to the proposed development and he shall be responsible for making all payments in connection therein.

1.21. Handing Over

- 1.21.1. Prior to handing over the proposed development the Contractor shall gain the approvals and respective Completion Certificates from all the local government authorities and the like that the work has been completed in accordance with their requirements.
- 1.21.2. Any payment in connection therewith shall be paid by the Contractor.

2. METAL WORKS

2.1. Definitions

Bead

A single run of weld metal deposited on a surface.

Butt Weld

A weld in which the weld metal lies substantially within the extension of the planes of the surfaces of the parts joined or within the extension of the planes of the smaller of the two parts of differing size. the edges of the metal pieces shall be bevelled or chiselled to the required shape at the throat.

Crater

A depression left in weld metal where the arc was broken or the flame was removed.

End Crater

A crater at the end of a weld or at the end of a joint.

Fillet Weld

A weld of approximately triangular cross-section joining two surfaces approximately at right angles to each other in lap joint, tee joint or corner joint. It is of two types (1) Continuous, (2) Intermittent.

Fusion Welding

Any welding process in which the weld is made between metals in a state of fusion without application of pressure.

In fusion welding - The depth to which the parent metal has been fused.

Weld Metal

All metal melted and or made plastic in making a weld and retained in the weld.

2.2. Materials

Materials	Standard	Remarks
Hot Rolled-Mild Steel Sections Excluding Angles and Hollow Sections	BS 4 Part – 1	To be hot rolled from weldable steel for structural purposes conforming to BS 4360
Hot-Rolled Ms Hollow Sections	BS 4848: Part 2	To be hot rolled from weldable steel for structural purposes conforming to BS 4360
Hot-Rolled Ms Angles	BS 4848: Part 4	To be hot rolled from weldable steel for structural purposes conforming to BS 4360
M.S. Bars	BS 4360	
M.S. Bars	BS 1775	
M.S. Plates	BS 4360	
Galvanized Steel Sheet	BS 2989	
Steel Plate & Sheet	BS 1449: Part 1	
Stainless Steel Tubes	BS 3014	
Stainless Steel Plate, Sheet & Strip	BS 1449: Part 2	
Aluminium Alloy Extruded Section	BS 1161 or BS 1474	
Aluminium Alloy Drawn Tube	BS 1471	
Aluminium Alloy Plate, Sheet & Strip	BS 1470	
Cepper Alloy Sections	BS 2874	
Cepper Alloy Tubes	BS 2871: Part 2	
Cepper Alloy Sheet, Strip And Foil	BS 2870	
Cepper Alloy Plate	BS 2875	
Fastenings - Wood Screws (Iron)	BS EN 20898-1	
Fastenings - Wood Screws (Brass)	BS 1210	
Fastenings - Bolts, Screws & Nuts	BS EN 20898-1	
Fastenings - Rivets	BS 641 & VS 4620 or as specified	
Expanding Bolts & Nuts	As specified	
Plugs	As specified	
Adhesives	As specified	
Electrodes For Manual Arc Welding	BS 639	

Note:

Evidence to show that the steel supplied conforms to the relevant British Standards shall be furnished to the Officer-in-Charge to his satisfaction. For steel conforming to the specification for Structural Steel of any other country, the relevant specifications shall be forwarded to the Engineer for prior approval.

2.3. Fabrication & Erection - Shopwork

2.3.1. Preliminaries

2.3.1.1. Quality of Work

Metal work shall be fabricated carefully and accurately to ensure compliance with design and performance requirements, using types and grades of metal as specified for the purpose. The finished work must be free from distortion and cracks. Proprietary products shall be used to the recommendations of the manufacturers.

Steel work shall be fabricated and erected by competent, experienced persons and shall generally conform to B.S 449: Part 2 – “specifications for the use of structural steel in Buildings.”

2.3.1.2. Co-Ordination

The work shall be carried out in co-ordination with the work on related building elements and services. The fabrication/installation drawings showing complete details of the work shall be furnished by the contractor well in advance for checking by the Officer-in-Charge; necessary modifications shall be made and sufficient number of corrected copies shall be furnished to the concerned parties.

2.3.1.3. Samples

Where directed, the contractor shall furnish samples of the components and obtain approval for the same before proceeding with the fabrication.

2.3.1.4. Inspection

The Officer-in-Charge shall have access at all reasonable times to all places where the work is being carried out, and shall be provided by the contractor with all the necessary facilities for inspection during construction.

2.3.2. Shop Preparation

2.3.2.1. Straightness

All material before and after fabrication, shall be straight unless required to be of curvilinear form, and shall be free from twists.

2.3.2.2. Clearances

Care shall be taken to ensure that the clearances specified are adhered to. The erection clearance for cleated ends of members connecting steel to steel shall be not greater than 2 mm. at each end. The erection clearance ends of beams without web cleats shall be not more than 3 mm at each end, but where for practical reasons this clearance has to be increased, the seating shall be suitable designed.

Where black bolts are used the holes may be made not more than 2 mm greater than the diameter of the bolts unless otherwise specified.

2.3.2.3. Cutting

Cutting may be by shearing, cropping, sawing or machine flame cutting. Hand flame cutting may be adopted subject to the approval of the Officer-in-Charge if thermal cutting is permitted for plates which will be subjected to dynamic or fatigue loading, the edges shall be machined. In the case of highly stressed welded joints, thermal cutting shall be controlled to prevent excess hardening. Sheared or cropped edges

shall be dressed to a neat workmanlike finish and be free from distortion where parts are to be in metal-to-metal contact.

2.3.2.4. Holing

Holes through more than one thickness of material for members such as compound stanchion and grider flanges shall where possible be drilled after the members are assembled and tightly clamped or bolted together. All matching holes for rivets and black bolts shall register with each other so that a gauge 2 mm less than the required diameter of hole will pass freely through the assembled members in a direction at right angles to such members.

Finished holes shall be not more than 2 mm larger in diameter than the diameter of the rivet or black bolt passing through them unless otherwise specified.

When holes are drilled in one operation through two or more separable parts, these parts when so specified by the Officer-in-Charge, shall be separated after drilling and the burrs removed.

Punching may be permitted before assemble when the thickness of material punched is less than 15 mm. The holes punched shall be 2 mm less in diameter than the required size and reamed after assemble to the full diameter.

Holes in connecting angles and plates other than splices, as also in roof members and light framing, may be punched full size through material not over 12 mm thick. This shall not be permitted for close tolerance or barrel bolts.

Where a connection is subject to impact or vibration or to reversal of stress (unless such reversal is solely due to wind) or, where for some special reason such as continuity in rigid framing or precision in alignment of machinery, slipping of bolts is not permissible, then rivets, close tolerance bolts, high strength friction grip bolts or welding shall be used. Holes for close tolerance and barrel bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance of +0.15 mm and – 0 mm. Parts to be connected with close tolerance bolts or barrel bolts shall preferably be firmly held together by tacking bolts or clamps, the holes drilled through all the thicknesses in one operation and subsequently reamed to size. All holes not drilled through all thicknesses in one operation shall be drilled to a smaller size and reamed out after assembly. Where this is not practicable the parts shall be drilled and reamed separately through hard bushed steel jigs.

Holes for rivets or bolts shall not be formed by a gas cutting process.

2.3.2.5. Flattened Ends Of Tubes

For welded, riveted or bolted connections, the ends of tubes may be flattened or otherwise formed provided the methods adopted are such as not to injure or deface the material. The change of section shall be gradual.

2.3.3. Shop Assemble

The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the specified cambers if any are provided.

All tubular members shall be sealed so as to prevent the access of moisture to the inside of the members (see also Clause 9.5.2)

2.3.4. Riveting

Rivets shall be heated uniformly throughout their length, without burning or excessive scaling, and shall be of sufficient length to provide a head of standard dimensions. They shall when driven, completely fill the holes and if countersunk, the countersinking shall be fully filled by the rivet, and proudness of the countersunk head being dressed off flush if required.

Riveted members shall have all parts firmly drawn and held together before and during riveting, and special care shall be taken in this respect for all single-riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

Wherever practicable machine riveting shall be carried out by using machines of the steady pressure type.

All loose, burned or otherwise defective rivets shall be cut out and replaced before the structure is loaded, and special care shall be taken to inspect all single-riveted connections.

Special care shall be taken in heating and driving long rivets.

2.3.5. Bolting

Bolts shall be of sufficient length to have at least one complete thread projecting beyond the outer face of the nut when tightened up.

Washers shall be provided in all cases. Where necessary, washers shall be tapered or otherwise suitable shaped to give the heads and nuts of bolts a satisfactory bearing.

In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together.

Where a tubular member is drilled to take bolts or studs, provision shall be made to prevent the access of moisture to the interior of the tube. For example, a transverse sleeve can be inserted where a bolt passes through a tube, or grommets can be used under the heads and nuts.

2.3.6. Welding

General

Steel shall normally be welded by the metal arc process conforming to B.S 5136. Other methods shall be subject to the approval of the Officer-in-Charge.

Welding of stainless steel, aluminium alloys, copper alloys, bronze etc. and brazing shall conform to the appropriate British Standard where specified, approval and testing of welders, and welding procedures shall be as per BS 4870, BS 4871 and BS 4872. Surfaces to

be welded shall be dry. When rain is falling or during periods of high wind, necessary precautions shall be taken to protect outdoor welding areas.

Welding shall be so carried out as to ensure that:

- a) Welds will be of good clean metal deposited by a procedure which will ensure uniformity and continuity of work.
- b) The surfaces of the weld will have an even contour and regular finish and will indicate proper fusion with the parent metal.

All slag shall be removed after making each run by light hammering followed by wire brushing.

Weld metal shall not be allowed to spatter on surfaces which will be visible in the completed work.

But welds which will be visible in the completed work shall be dressed off smooth and flush with adjacent surfaces.

2.3.6.1. Equipment for Welding Of Steel

Equipment

The contractor shall be responsible for ensuring that the capacity of welding plant, instruments, cables and accessories is adequate and suitable for the welding procedure to be used and for maintaining all welding plant and ancillary equipment in good working order. The contractor shall also take all necessary safety precautions in connection with the work. All electrical plant in connection with the work shall be adequately earthed. The welding return lead from the work shall be adequate in cross section and shall be correctly connected and earthed.

Adequate means of measuring the current shall be available with the welding plant or a portable ammeter shall be provided.

Electrodes

The electrodes used for manual metal arc welding shall comply with the requirements of BS 639 or other appropriate standard with the prior approval of the Officer-in-Charge. Electrodes shall be selected having regard to the application i.e. joint design, welding position and the properties required to meet service conditions.

All consumables shall be stored and handled with care and in accordance with the manufacturers' recommendations. Electrodes filler wires, rods and fluxes that show signs of damage or deterioration shall not be used.

Covered electrodes shall be stored in their original packets or cartons in a dry place adequately protected from the effects of the weather. When special protection or other treatment during storage or immediately prior to use is recommended by the manufacturer of the electrodes, they shall be treated accordingly.

2.3.6.2. Butt Welds

The details of the angle between fusion faces gap between parts etc. shall be as per BS 5135.

The details for a single V-butt weld (without backing) are given below.

The dimensions of the weld preparation may have to be modified for welding in positions other than flat, in which case they should be the subject of arrangement between the contracting parties.

In the as welded conditions the weld face shall be proud of the surface of the parent metal, the butt weld shall be built up so that the thickness of reinforcement at the centre of the weld shall be not less than 10% of the size of the butt weld nor more than 3 mm. See fig. 9/1. Where a flush surface is required, the butt weld shall be first built up as specified above and then dressed flush. When no dressing is to be carried out, the permissible weld profile shall either be as specified or as directed.

a) Full Penetration Butt Welds

Full penetration single V, U, J, bevel or square butt welds shall be completed by depositing a sealing run of weld metal on the back of the joint; else where these or other butt welds are to be welded from one side only, backing material may be used except where it is agreed between the Officer-in-Charge and the contractor that, by the adoption of an approved special method of welding, full penetration will be obtained without the use of backing material.

Note: It should be noted that under fatigue conditions backing material may be undesirable.

Backing material shall consist of another steel part of the structure, or of material approved by the Officer-in-Charge. Where backing material is employed, the joint shall be arranged in such a way as to ensure that complete fusion of the parts to be joined is readily obtained.

In all complete penetration butt welds which are to be welded from both sides, the particular welding procedures which allow this to be done without back gouging shall be adopted; but where complete penetration cannot be achieved, the back of the first run shall be gouged out by suitable means to clean sound metal before welding is started on the gouged out side.

b) Partial Penetration Butt Welds

Partial penetration butt welds shall not be allowed unless specially designed in which case; the weld shall have a throat thickness not less than that specified.

2.3.6.3. Fillet Welds

A fillet weld as deposited shall be not less than the specified dimensions clearly indicated as throat thickness and/or leg length as appropriate, taking into account the use of deep penetration processes or partial penetration. The effective length of a fillet weld designed to transmit loading shall be not less than 50 mm nor 6 times its leg length.

For concave fillet welds, the actual throat thickness shall be not less than 0.7 times the specified leg length. For convex fillet welds, the actual throat thickness shall be not more than 0.9 times the actual leg length.

Where the specified leg length of a fillet weld at the edge of a plate or section is such that the parent metal does not project beyond the weld, melting of the outer corner or corners which reduces the throat thickness, shall not be allowed.

2.3.6.4. Preparation Of Joint Faces

If preparation or cutting of the material is necessary, this shall be done by shearing, chipping, grinding, machining, thermal cutting, thermal gouging or machine gas cutting. Edges shall be left free of slag. When shearing is used, the effect work hardening shall be taken into account and precautions shall be taken to ensure that there is no cracking of the edges.

Fusion Faces

The preparation of fusion faces, angle of bevel, root radius and root face shall be to the required accuracy.

Fusion faces and adjacent surfaces shall be free from cracks, notches or other irregularities which might be the cause of defects or would interfere with the deposition of the weld.

Fusion faces and the surrounding surfaces for a distance of at least 12 mm shall be free from heavy scale, moisture, oil, paint or any other substance which might affect the quality of the weld or impede the progress of welding. This is particularly important when a controlled hydrogen welding process is used.

2.3.6.5. Assembly for Welding

Parts to be welded shall be assembled such that the joints to be welded are easily accessible and visible to the operator. Welding shall be done in the flat position whenever practicable.

Jigs and manipulators shall be used where practicable so that the welding can be carried out in the most suitable position.

a) Alignment of Butt Joints

The root edges or root faces of butt joints shall not be out of alignment by more than 25% of the thickness of the thinner material for material up to and including 12 mm thick, or by more than 3 mm for thicker material. For certain applications and welding processes closer tolerances may be necessary.

b) Fit Up Of Parts Joined By Fillet Welds

The edges and surfaces to be joined by fillet welds shall be in as close contact as possible since any gap increases the risk of cracking, but in no case shall the gap exceed 3 mm.

2.3.6.6. Tack Welds

Tack welds shall be not less than the throat thickness or leg length of the root run to be used in the joint and shall be subject to the same welding conditions as those specified for the root run. The length of the tack weld shall not be less than four times the thickness of the thicker part or 50 mm whichever is the smaller.

Where a tack weld is incorporated in a welded joint its shape shall be suitable for incorporation in the finished weld and it shall be cleaned and fused thoroughly with the final weld. Cracked, broken or otherwise defective tack welds shall be removed before final welding.

2.3.6.7. Identification

When specified by the Officer-in-Charge adequate means of identification, either by an identification mark or other record, shall be provided to enable each weld to be traced to the welder (s) by whom it was made.

2.3.6.8. Inspection & Testing

The Officer-in-Charge shall have access to the contractor's work at all reasonable times, and the contractor shall provide him with all facilities necessary for inspection during manufacture and on completion.

Welds showing cavities or in which the weld metal tends to fall over the parent metal without proper fusion shall be cut out and re-welded to the satisfaction of the Officer-in-Charge. Care shall be taken to avoid under cutting of the base metal along the weld edges and where serious undercutting occurs the reduction shall be made good to the satisfaction of the Officer-in-Charge.

Where specified for important works, radiographic or ultrasonic testing procedures shall be carried out to the satisfaction of the Officer-in-Charge.

Finished welds and adjacent parts shall be protected with clean boiled linseed oil after all slag has been removed.

Welds shall not be painted or otherwise obscured until they have been accepted by the Officer-in-Charge.

Quality of Welds

Welds joints shall be free from defects that would impair the service performance of the construction.

2.3.6.9. Correction Of Faulty Welds

Where welds do not comply with the requirements of the Clauses above, the defective portions shall be cut over they shall then be re-welded and re-inspected in accordance with this standard. Where serious undercutting of the base metal along the weld edges is noticed, the education shall be made good to the satisfaction of the Officer-in-Charge.

2.3.7. Machining Of Butts, Caps, & Bases

Stanchion splices and butt joints of compression members dependent on contact for the transmission of compressive stresses shall be accurately prepared to butt so that the permitted stress in bearing is not exceeded nor eccentricity of loading created which would induce secondary bending in the members. Stanchion caps and bases shall be prepared in a similar manner to the above, and where this is obtained by machining, care shall be taken that any attached gussets, connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by more than 2 mm.

2.3.8. Slab Bases & Caps

Slab bases and slab caps, except when cut from material with true surfaces, shall be accurately machined over the bearing surfaces and shall be in effective contact with the end of the stanchion. A bearing face which is to be grouted direct to a foundation need not be machined if such face is true and parallel to the upper face.

To facilitate grouting, holes shall be provided where necessary in stanchion bases for the escape of air.

2.3.9. Marking

Each piece of steel work shall be distinctly marked before delivery in accordance with a marking diagram, and shall bear such other marks as will facilitate erection.

2.3.10. Painting

All surfaces which are to be painted, oiled or otherwise treated shall be dry and thoroughly cleaned to remove all loose scale and loose rust; all other steel worked shall be given one coat of red oxide of iron paint at the earliest possible opportunity. During the process of erection and subsequently until the work is completed the contractor shall maintain these protective coats.

Shop contact surfaces need not be painted unless specified. If so specified, they shall be brought together while the paint is still wet.

Surfaces not in contact, but inaccessible after shop assembly, shall receive the full specified protective treatment before assembly. This does not apply to the interior of sealed hollow sections.

All faces to be riveted or bolted together shall be painted before assembly.

In the case of surfaces to be welded, the steel shall not be painted or metal coated within a suitable distance of any edges to be welded if the paint specified or the metal coating would be harmful to welders or impair the quality of the welds.

Welds and adjacent parent metal shall not be painted prior to de-slagging, inspection and approval.

Parts to be encased in concrete shall not be painted or oiled.

2.4. Erection - Site Work

2.4.1. Plant & Equipment

The suitability and capacity of all plant and equipment used for erection shall be to the satisfaction of the Officer-in-Charge.

2.4.2. Storing & Handling

All structural steel at the site shall be stored and handled so that members are not subjected to excessive stresses, damage deformation etc.

2.4.3. Permission

The erection of steel work shall be started only after obtaining the permission of the Officer-in-Charge.

2.4.4. Setting Out

The positioning and levelling of all steel work, the plumbing of stanchions and the placing of every part of the structure with accuracy shall be in accordance with the approved drawings and to the satisfaction of the Officer-in-Charge.

2.4.5. Security during Erection

The work may be erected in suitable units as may be directed by the Officer-in-Charge. Fabricated members shall be lifted at such points as will avoid the deformation or excessive stress in members.

The structures or part of it placed in position shall be secured against overturning or collapse by suitable means.

During erection the work shall be securely bolted or otherwise fastened and if necessary temporarily braced, so as to make adequate provision for all erection, stresses and conditions, including those due to erection equipment and its operation. Neither riveting, permanent bolting nor welding shall be done until proper alignment has been obtained.

2.4.6. Modification to Fabrication

Modification to fabricated steel work which would involve cutting, welding etc. must not be made without the prior approval of the Officer-in-Charge.

2.4.7. Painting after Erection

All surfaces to be painted shall be dry and thoroughly cleaned from all loose scale and rust.

The specified protective treatment shall be completed after erection. All rivet and bolt heads and site welds after de-slagging shall be cleaned. Damaged or deteriorated paint surfaces shall first be made good with the same type of paint as the shop coat. Where specified, surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop priming) and shall be brought together while the paint is still wet.

Where the steel has received a metal coating in the shop, this coating shall be completed on site so as to be continuous over any welds and site rivets or bolts. Protection may be completed by painting on site in lieu of metal coating subject to the approval of the Officer-in-Charge. Bolts which have been galvanized or similarly treated are exempted from this requirement.

Site painting should not be done when humidity is such as to cause condensation on the surface to be painted. Please also see clause 15.8

2.4.8. Bedding Of Stanchion Bases & Bearing Of Beams & Girders On Stone, Brick or Concrete (Plain or Reinforced)

Bedding shall be carried out with Portland cement grout or mortar or fine concrete.

For multi-storied buildings this operation shall not be carried out until a sufficient number of bottom lengths of stanchions have been properly line, leveled and plumbed and sufficient floor beams are in position.

Whatever method is employed, the operation shall not be carried out until the steel work has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges and immediately before grouting the space under the steel shall be thoroughly cleaned.

The belt holes and space beneath column base plates shall be filled with grout or mortar of specified below:

- a) Space not deeper than 25 mm neat cement slurry to as thick a consistency as possible and pured under a suitable pressure head.
- b) Spaces between 25 mm and 50 mm deep; A mortar of cement and fine aggregate in the proportion of 1.1, just fluid enough to pour, poured under a suitable head and tamped as filling proceeds.
- c) Spaces over 50 mm deep: A damp dry mortar of cement fine aggregate 1:2 well tamped against properly fixed forms as filling proceeds.

2.4.9. Encasing of Steelwork in Foundations & Filling between Grillage Beams

Grillage beams and all steel in foundations shall be solidly encased in dense concrete of structural Gr. 20 (10 mm) with a minimum cover of 100 mm.

2.4.10. Erection of Trusses

Trusses shall be lifted only at nodes. The trusses above 10 m in span shall not be sligned at the apex, as this will develop compression stresses in the bottom tie member. They shall be lifted by slinging at two mid points of rafters, which shall be temporarily braced by a wooden member of a suitable section. After the trusses are placed in position, purlings and wind bracings shall be fixed as soon as possible.

The end of the truss which faces the prevailing winds shall be fixed with holding down bolts, and the other end kept free to move. In case of trusses of spans upto 10 m the free end of the truss shall be laid on lead sheet or steel plate as per design, and the holes for holding down bolts shall be made in the form of oblong slots, so as to permit the free movement of the truss end. For larger spans, the truss shall be provided with bearing as per design.

2.5. Rolling Shutters

General

Rolling steel shutters shall be the product of an approved and recognized manufacturer regularly engaged in the production of the type of shutters required. Standard commercial products, which meet the general requirements of the specifications and vary only in non-essential details, shall be accepted subject to the approval of the Officer-in-Charge. These shall include necessary locking arrangements and handles etc. These shall be suitable for fixing in the specified location and position i.e. outside or inside on or below lintel or between jambs of the opening. The doors shall be either push and pull type or operated manually or mechanically with a suitable gear mechanism.

2.5.1. Shutters

These shall consist of mild steel laths 1 21 mm thick (18 G) and 80 mm wide or as specified. The laths shall be machine rolled from a continuous strip into an easy curve free from crimps or sharp bends and with an effective bridge depth of 16 mm. These shall be interlocked together throughout their entire length and jointed at the ends with end locks designed in such a way as to maintain alignment and protect the slat against abrasion in the guides. All joints shall be completely air and weather tight.

The shutter shall be supported by means of spring barrels which in turn are supported by cast iron or steel brackets. The shutter slats shall coil on the spring barrel. A galvanized steel sheet hood not lighter than 18 G reinforced as for the end closures for the hood.

The spring shall be preferably of coiled type and shall be manufactured from high tensile spring steel wire or strip of adequate strength to balance the shutters in all positions.

2.5.2. Guide Channels

The guide channel shall be a mild steel deep channel section of rolled, pressed or built up (fabricated) construction. The thickness of the sheet used shall not be less than 3 mm. The minimum depth for guide channels shall be as follows:

Clear width of Shutter	Depth of Guide Channel
Under 3.5 m	60 mm
3.5m and above	75 mm

The gap between the two legs of the guide channel shall be sufficient to allow the free movement of the shutter and at the same time close enough to prevent the rattling of the shutter due to wind.

Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to walls or columns by means of bolts or screws. The spacing of cleats shall not exceed 750 mm. Alternatively the guide channels may be provided with suitable dowels, hooks, or pins for embedding in the walls.

2.5.3. Fixing

The installation shall be mounted plumb, square and true on the vertical surface of lintels and/or masonry. When completed, the door shall completely fill the opening for which it was designed and shall not obstruct the opening when in the open position. The shutters shall operate easily and smoothly under all conditions.

2.6. Tubular Roofs & Columns

2.6.1. Structural Steel Tubes

These shall conform to B.S. 1775 and shall be one of the following types:

- I. Hot finished welded (HFW) type.
- II. Hot finished seamless (HFS) type
- III. Electric resistance welded (ERW) type.

The steel shall contain:

- I. Not more than 0.06 per cent Sulphur
- II. Not more than 0.06 per cent Potassium

The steel shall have a yield strength of 209 n/mm^2 or as specified. The sizes of tubes and wall thickness shall be as specified.

Tolerances

These shall be in conformity with BS 1775 for each type of Tube. The tubes shall not deviate from straightness by more than $1/600$ of any length. Tubes shall be cleanly finished and reasonably free from scale. They shall be free from crack, surface flaws, lamination and other defects. The ends shall be cut clean and square with the axis of the tubes unless otherwise specified. Where Galvanized tubes are specified these shall be not dip galvanized and in conformity with the requirements of BS 1775.

Minimum Wall Thickness of Tubes

Structural tubes shall have the minimum wall thickness indicated below depending upon the exposure.

Construction not exposed to weather	3.2 mm
Construction exposed to weather	4.0 mm
Structures not readily accessible for Maintenance	5.0 mm

2.6.2. Fabrication

This shall conform to the requirements of clause 9.2.

Caps & Bases For Column

The ends of all the tubes for columns, transmitting loads through the ends, shall be true and square to the axis of the tube and shall be provided with a cap or base accurately fitted to the end of the tube and screwed, welded or shrunk on. The cap or base plate shall be true and square to the axis of the column.

Sealing of Tubes

When the end of a tube is not automatically sealed by virtue of its connection by welding to another member, the end shall be properly and completely sealed. Before sealing, the inside of the tube shall be dry and free from loose scale.

Flattened Ends

In tubular construction the ends of tubes may be flattened or otherwise formed to provide for welded, riveted or bolted connections provided that the methods adopted for such flattening do not injure the material. The change of sections shall be gradual.

2.6.3. Hoisting & Fixing

Shall conform to 8.3.

2.7. Steel Doors, Window, Ventilators & Composite Units

General

The type, overall sizes and location of steel door window and ventilators shall be either as shown on the drawings or as per details given by the Officer-in-Charge. For doors, the provision of the threshold or the tie-bar at the bottom of the door frame shall be as specified or as directed. (Usually external doors are provided with threshold and the internal doors with tie bars.)

The actual sizes of doors, windows and ventilators shall not vary by more than 1.5 mm from the dimensions given in the drawings. Where these are not built into the wall construction, the openings shall allow 12 mm clearance around to facilitate easy installation later on.

2.7.1. Materials

Cold rolled steel sections made from steel sheet conforming to BS 1449: Part I.

2.7.2. Protection

Rust proofing and protective finishes shall be as specified.

2.7.3. Workmanship

The fabrication, erection, glazing and finishing shall conform to the following standards.

BS 1245	Metal door frames (steel)
BS 990: Part 2	Steel windows generally for domestic and similar buildings
BS 1767	Steel windows for industrial buildings
BSCP 152	Glazing and fixing of glass for buildings

2.8. Aluminium Framed Sliding Glass Doors

These shall be made of extruded Aluminium alloy sections anodized to Grade AA 25 as per BS 1615 or as specified mechanically jointed and erected and finished conforming in all respects to BS 5286.

2.9.**Aluminium Windows**

These shall be made of extruded aluminium alloy sections anodized to Grade AA 25 as per BS 1615 or as specified, mechanically jointed, erected and finished conforming in all respects to BS 4873.

3. IRON MONGERY

Definitions

Locks

A device for securing a door, gate, lid, drawer or the like when closed, consisting of a bolt or a system of bolts propelled or withdrawn by a mechanism operated by a key or other means.

A mechanism combining of one case, a spring bolt and a dead bolt operated respectively by handles and a removable key.

Bolt

The part of the lock which provides the fastening by protruding from the lock case to engage in the staple, striking plate, link, shackle, or other member.

Catch

A device to hold the spring bolt of a lock or latch in the 'in' and/or 'out' position respectively.

Staple

A box like fitting fixed on a door jamb into which the bolt or bolts of a rim lock or rim latch door.

Mortice Lock

Any lock for fixing in a mortice cut in the closing edge of a door.

Latch

A device operable from both sides and generally self engaging for holding closed a door, gate or the like. It consists of a movable part falling by gravity or sliding or moving by means of a spring into a retaining member of some sort, the moving part of the device being operated by a handle and not by a removable key.

Mortice Latch

Any latch of fixing in a mortice cut in the closing edge of the door.

Rim Latch

A latch for fixing to the face of the door, having a bevelled spring bolt and usually incorporating a jumbo bolt.

Handle

Any item or part of any item of door, drawer, cupboard, or gate furniture, intended to be held in the hand for opening, closing or moving to another position, the article to which it is fixed.

Hasp & Staple

A device for securing a door, gate or lid in a closed position by the use of a padlock. The hasp consists of two members hinged together. One member is always a plate for fixing; the other member may be a slotted flap or wire loop arranged to pass over and around the staple. The staple consists of either a flat fixing plate from which a wire hoop projects or a flat bent plate pierced by a hole to receive the shackle of the padlock.

Door Bell

A device to enable callers to draw attention to their presence by means of ringing a bell.

Kicking Plate

A plate fixed across the face of a door to protect the lower part of the door from disfigurement or wear.

Push Plate

A plate larger than a finger plate to the face of a door to protect the door from disfigurement. Any plate lettered 'Push' which is fixed to a door as an instruction for opening.

General

This section deals with common items of iron mongers. These shall be of iron, brass, aluminium or as specified and shall be well made, reasonably smooth and free from flaws and other defects.

All hinges, locks, etc. shall generally be of blackened steel except near the coast or unless otherwise specified.

Finish

The finish shall be as below or as specified.

- a) Iron fittings – These shall be smooth finished and treated against rust formation.
- b) Brass fittings – These shall be finished bright, chromium plated, oxidized or as specified.
- c) Aluminium fittings – These shall be anodized. The surface shall be prepared to a satin finish and the grade of anodizing shall be as specified.

Note: Grades of anodizing shall confirm to BS 1615 and depend on the location and frequency of cleaning. For example Grade AA 20 corresponds to 20 microns average coating thickness.

Fixings

Screws used for fittings shall be of the same metal and finished in the same way as fittings, except that chromium plated brass screws shall be used for fixing aluminium fittings. Fixings shall be of the size indicated in the drawings or as directed. Screw holes shall be countersunk to suit the head of specified wood screws.

Fittings

Fittings shall be fixed in proper position as shown in the drawings or as directed by the Officer-in-Charge. These shall be truly vertical or horizontal as the case maybe. Screws shall be driven home with a screw driver and not hammered in. Recesses for counter sinking of hinges etc. shall be cut to the exact size and depth and shall be close fitting. Holes for through bolts shall be carefully sugared. Particular care shall be taken while fixings are made to flush doors made of plywood.

Samples of all iron mongers shall be produced well in advance and approval obtained from the Officer in Charge. Subsequent supplies shall conform in all respects to the sample produced. Sizes shall be specified. Some details of components are shown in the figures.

3.1. Hinges

3.1.1. Knuckle Type Hinges

General

All hinges shall be free from flaws and defects that may adversely affect the appearance or service.

All edges shall be smooth and square without burrs or sharp projections. Movement of the hinges shall be free and easy and shall have no play or shake. The leaves shall be free to rotate one with the other through a minimum of 200°. The holes for the hinge pins shall be central and square to the knuckles. All hinge pins shall be riveted firm with well formed countersunk or domed heads. All screw holes shall be counter sunk with no sharp edges.

3.1.1.1. Steel Hinges

Steel hinges shall be one of the following types conforming to BS 1227. All steel hinges shall be smooth finished and tested against rust formation.

- i. Broad steel butt hinges.
- ii. Steel butt hinges (heavy gauge)
- iii. Steel butt hinges (light gauge)
- iv. Steel cabinet hinges
- v. Steel parliament hinges
- vi. Steel tee hinges
- vii. Steel strap hinges

Steel hinges of the following types shall conform to BS 1227 part IA

- i. Rising butt hinges
- ii. Falling butt hinges
- iii. Lift off butt hinges

Hinges shall be manufactured from mild steel sheets, plates, or stripes and hinge pins from mild steel wires all conforming to the requirements of BS 1227. Dimension of hinges and knuckles, diameter of hinge pins, size, number and location of screw holes etc. shall be as given in the figures.

Tee hinges shall be fixed with 6 mm diameter bolts with the nuts on the inside.

3.1.1.2. Solid Drawn (Extruded) Brass Knuckle Type Hinges

These shall conform to BS 1227 part IA. Section 4 and shall be one of the following types.

- i. Brass broad butt hinges
- ii. Brass strong butt hinges
- iii. Brass washered butt hinges
- iv. Brass projection butt hinges
- v. Brass rising butt hinges
- vi. Brass falling butt hinges
- vii. Brass backflap butt hinges
- viii. Brass counterflap butt hinges
- ix. Brass lift off butt hinges

Brass hinges shall be made of extruded brass sections (brass conforming to BS 249)

Pins shall be made of steel or brass wire as specified. Hinges with washers shall be fitted with washers made of steel, phosphor bronze or nylon as directed.

The helix and lining of knuckles of rising hinges or falling hinges shall be anodized. The finish shall be polished brass, polished chromium plate, satin chromium plate, bronze, metal antique or as specified.

3.1.1.3. Extruded Aluminium Knuckle Type Hinges

These shall conform to section 6 of BS 1227 Part IA. The hinges shall be anodized to Grade AA. 15 of BS 1615. Hinge pins shall be of Aluminium or stainless steel. Hinges shall be fitted with washers at least 1.27mm thick between knuckles. These washers shall be of nylon or stainless steel.

3.1.2. Spring Hinges

These shall be single acting when the shutter is to open on one side only or double acting when the shutter is to open on both sides. The hinges shall be made of mild steel or brass as specified. They shall work smoothly and shall hold the door truly vertical in the closed position.

The size of the spring hinge shall be taken as the length of the plate.

3.1.2.1. Mild Steel

The cylindrical casing shall be made either from mild steel of 1.60 mm thickness, lap jointed and brazed, welded and riveted, or from solid drawn tube of wall thickness 1.60 mm pressed to form the two casings. It shall be stove enamelled black or as specified.

3.1.2.2. Cast Brass

The cylindrical casing shall be made either from brass steel of 1.60 mm thickness, lap jointed and brazed, or from solid drawn tube of not less than 1.60 mm wall thickness. It shall be stove satin/bright nickel plated, copper oxidized, or as specified.

3.2. Door Closer

Hydraulic door closers (exposed type) shall be made of cast iron/aluminium alloy/zinc alloy and of shape and pattern approved by the Officer-in Charge.

The door closers may be polished or painted and finished with lacquer to the desired colour.

3.2.1. Mild Steel Closers

All dents, burrs, and sharp edges shall be removed from various components and they shall be pickled scrubbed and rinsed to remove grease, rust, scale or any other foreign elements. After pickling, all the mild steel parts shall be given phosphate treatment, in accordance with standard practices.

3.2.2. Aluminium Closers

Aluminium alloy door closers shall be anodized and the anodic coating shall not be less than grade AA 15 of BS 1615.

3.3. Door Bolts

3.3.1. Sliding Bolts

General

The fixing and staple bolts shall be cast with 6 mm studs.

Bolts shall be finished to shape and have threaded ends and provided with round worms and nuts of square or hexagon type. All screw holes shall be counter sunk to suit the counter sunk head of woods screws of specified size. All edges and corners shall be finished smooth. In the case of a single leaf door, a hole of suitable size shall be drilled in the door frame and an iron or brass shield plate cut to shape be fixed at the face of the hole.

3.3.1.1. Mild Steel Sliding Door Bolt

These shall be made of mild steel sheets and rods and treated against rust.

3.3.1.2. Cast Brass Sliding Door Bolts

These shall be made from rolled brass. The hasp shall be of cast brass and secured to the bolt. Alternatively, the hasp and the bolt may be cast in one piece. All components shall be finished smooth and polished before assembly. Cast brass sliding bolts shall be finished bright, chromium plated, oxidized or as specified.

3.3.1.3. Aluminium Sliding Door Bolt

These shall be made of aluminium alloy. Aluminium sliding door bolts shall be anodized to Gr AA 15 of BS 1615.

3.3.2. Barrel Bolts/Tower Bolts

Tower bolts vary in length from 75 mm to 380 mm. These shall be well made and free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts shall be made of sheet of thickness 12 mm or more, and shall have counter sunk screw holes to suit the counter sunk head of the wood screws. All sharp edges and corners shall be removed and finished smooth. The plate shall be screwed to the inside of the door so that the bolt engages or shoots in a metal socket or staple fixed on the door frame, or metal socket let into the floor.

3.3.2.1. Mild Steel Bolts

Mild steel tower bolts shall have barrel made in mild steel plate. The bolt shall be mild steel or cast iron rod of suitable diameter. The plates and straps after assembly shall be firmly riveted or spot welded.

The rivet head shall be properly formed and the rivet back shall be finished flush with the plate.

The bolts shall be bright finished or plated as specified and the barrel and socket, stove enamelled black.

3.3.2.2. Brass Bolts

Brass tower bolts with cast brass barrel and rolled or cast brass bolt.

Or

Brass tower bolts with barrel of extruded sections of brass rolled or drawn brass bolt.

The knobs of brass tower bolts shall be cast and the bolt fixed with a knob.

3.3.2.3. Brass Tower Bolts

Bolts and barrel polished or plated as specified.

3.3.2.4. Aluminium Bolts

Aluminium barrel tower bolts with barrel and bolt of excluded sections of aluminium alloy. The knob shall be properly screwed to the bolt and riveted at the back.

Aluminium alloy tower bolts shall have anodized bolt and barrel unless otherwise specified. The anodic film may be either transparent or dyed as specified. The quality of the anodized finish shall not be less than grade AA 10 of BS 1615.

3.3.3. Flush Bolts

These shall be of cast brass, cast Aluminium alloy or extruded Aluminium alloy as specified. Only one material shall be used in the manufacture of all the components of flush bolts except the spring which shall be of flush bolts of phosphor bronze or steel strip. When the rod is completely in its maximum bolting position by the spring, the length of the bolt shall be of such that, when the bolt is pulled down, the top of the bolt shall be flush with the top of the lip face. The top of the bolt shall be given a taper of 45° to enable easy pull or push.

Brass flush bolts shall be satin or bright polished alternatively, they may be nickel or chromium plated as specified in BS 1224, or copper oxidized.

Aluminium flush bolts shall be anodized and the quality of the anodized finish shall not be less than grade AA 15 of BS 1615.

3.4. Mortice Latch/Mortice Lock/Mortice Latch & Lock Rim Latch/Rim Lock/Rim Latch & Lock

These shall confirm to BS 5872 in regard to design and dimensions.

3.5. Door Handle

The door handles shall be well made and free from defects. These shall be finished correct to shape and size dimensions.. All edges and corners shall be removed and finished smooth so as to facilitate easy handling. Cast handles shall be free from casting defects. Where the grip portion of the handle is joined with the piece by mechanical means, the arrangement shall be such that, the assembled handle shall have adequate strength comparable to that of integrally cast handles.

The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size, and window handles of 75 mm size, unless otherwise specified. These shall be fixed with 25 mm long no. 6 wood screws.

Door handles shall be of the following types according to the material used.

3.5.1. Mild Steel Handles

These shall be of mild steel sheet, pressed into oval section. Iron handles shall be treated against rust formation.

3.5.2. Cast Brass Handles

These shall be of cast brass of specified size and of the shape and pattern specified. Brass handles shall be finished bright, chromium plated, oxidized, or as specified.

3.5.3. Cast Aluminium Handles

These shall be of aluminium of specified size, and of shape and pattern specified.

Aluminium handles, shall be anodized and the anodic coating shall not be less than grade AA 15 of BS 1615 as specified.

3.6. Casement Fastener

Where specified casement fasteners for windows shall be of brass and of a sturdy and suitable design with a cross tongue and a mortice plate fixed to the mullion of the windows. The fasteners shall be oxidized black.

3.7.**Casement Stays**

These shall be of brass, straight or curved. The hinge pin shall be mild steel or phosphor bronze. There shall be no blow holes in any part of the window stay and the movement of the window stay shall be free and easy. The screw holes shall be countersunk to suit Countersunk 19 mm X no 6 wood screws. The window stays shall be bright finished oxidized or chromium plated.

3.8.**Hooks & Eyes**

These shall be mild steel, hard drawn brass, or as specified. These shall be well made and free from defects. They shall be finished to the correct shape and dimensions so as to function properly when they are in use. Cast hooks eyes and plates shall be free casting and other defects. All sizes of hooks and eyes shall be determined by the length of the hooks measured 'out to out'. Unless otherwise specified the articles shall be finished bright. Mild steel hooks and eyes shall be treated against rust formation. Cast brass hooks and eyes shall be finished bright or chromium plated.

3.9. Hasp & Staple

Hasp and staple shall be of Mild Steel, Brass and Aluminium. The hinge pin which in all cases shall be of mild steel (or phosphor bronze in the case of brass hasp and staples) shall be firm and its riveted heads well formed. The movement of the hasp shall be free, easy and square and shall not have any play or shake. The hasp shall fit the staple correctly. The size shall be determined by the length of the bigger leaf of the hasp.

The staple except in the case of a cast one shall be riveted properly to its plate. The safety type hasp shall be secured to the door by two small bolts where as the staple is generally screwed on the door/frame. A padlock is a necessary adjunct to the hasp and staple. The padlock maybe galvanized steel, brass or bronze. All screw holes shall be clean and counter sunk to suit counter sunk wood screws. All edges and corners shall be rounded.

3.9.1. Mild Steel Hasp & Staple

These shall be manufactured from mild steel sheets and shall be finished with/without protective coating, stove enamelled or plated.

3.9.2. Brass Hasp & Staple

These shall be manufactured by casting and finished polished, oxidized or as specified.

3.9.3. Aluminium Hasp & Staple

These shall be made from dye sections and shall be anodized. The anodic coating shall not be less than grade AA 15 of BS 1615.

4. CARPENTRY AND JOINERY

4.1. Materials

- 4.1.1. Timber shall be in accordance with the requirements of BS 1186 'Quantity of Timber and Workmanship in Joinery', Part 1, 'Quality of Timber'.
- 4.1.2. Timber and timber products shall be subject to the inspection and approval of the Consultant.
- 4.1.3. Timber shall be seasoned to stable moisture content compatible with the finished use, straight and true and free from wind, warp and distortion and in lengths suitable for the members required.
- 4.1.4. All timber shall be in long lengths and laps, scars or splices shall be over a bearing surface. Where obtainable, finishing timber exposed to view shall be in single lengths.

4.2. Preservation of Timber

- 4.2.1. All timber shall be treated for insect attack and is to be of the correct moisture content and free from surface moisture content and dirt.
- 4.2.2. All rafters, purlins, framing scribe pieces, wall plates, and trusses etc. shall be treated for insect attack with approved timber preservative. No extra payment shall be made for such coating and will be considered inclusive in the rate of the respective item in the BOQ.
- 4.2.3. Treatment shall be- carried out after all cutting and shaping is completed.

4.3. Hardware

- 4.3.1. Hardware shall be standard quality and samples shall be submitted to the Consultant for approval.
- 4.3.2. All hinges shall be stainless steel or brass and shall be approved by the Consultant.
- 4.3.3. The dimensions and quality of hardware shall meet the requirements and shall not be rusted, deformed or defective.

4.4. Dimensions and Finish

- 4.4.1. All dimensions of timber given are finished dimensions.
- 4.4.2. All elements and others of structural nature, which are exposed, must be machine planed to a smooth finish.
- 4.4.3. All unexposed timber shall be machine planed to a rough finish.
- 4.4.4. All joinery work shall be dressed on all four sides and hand dressed where necessary and sanded to all exposed surfaces. All arises in any way accessible shall be sanded and smoothed off.

4.5. Workmanship

- 4.5.1. All connection whether nailed, screwed glued, mortised or dove-tailed shall be accurately made and properly executed to provide sound, satisfactory connections for the class of work required.
- 4.5.2. Timbers containing defects or distortions shall not be used.
- 4.5.3. All joinery shall be manufactured by skilled tradesman with accurate tolerances and set out and with tools, jigs, machines and equipment appropriate for the work.
- 4.5.4. Assembly of the joinery units and joinery frames, etc. shall be by means of glued connections appropriate to the work - mortise and tendon, housing and doweling, etc. where practicable including the use of glued blocks wherever required. Nailing, screwing shall only be used with prior approval of the Consultant; corrugated fasteners shall not be used for effecting connections.

5. CONCRETE WORKS

5.1. General

- 5.1.1. Materials used in the works shall be new, of the qualities and kinds specified herein and equal to approved samples. Delivery shall be made sufficiently in advance to enable further samples to be taken and tested if required. No materials shall be used until approved and materials not approved shall be immediately removed from the works.
- 5.1.2. Materials shall be transported, handled and stored on the site or elsewhere in such a manner to prevent damage, deterioration or contamination.

5.2. Cement

- 5.2.1. Cement shall be Ordinary Portland cement of an approved brand.
- 5.2.2. Cement shall conform to BS 12.
- 5.2.3. Cement shall be of recent manufacturer and used within 6 months of manufactured date.
- 5.2.4. The Contractor shall with each fresh consignment of cement delivered to the site furnish the Consultant with a copy of the Manufacturer's statement of compliance with the above Standard Specification together with the date of manufacture, certified by an independent agency in the country of origin and its date of delivery to Site.
- 5.2.5. Check tests will be required by the Consultant. These tests shall be carried out at the Contractor's expense.
- 5.2.6. Any cement failing to meet the required standards will be rejected and replaced at the Contractor's expense.
- 5.2.7. Any cement not conforming to BS 12 shall not be used unless otherwise approved by the Consultant.

5.3. Aggregate

- 5.3.1. Fine aggregate shall be river sand conforming to BS 882.
- 5.3.2. Coarse aggregate shall be crushed stone excluding limestone or derivatives of limestone conforming to BS 812.
- 5.3.3. Aggregate shall not contain injurious amount of rubbish, dirt, organic impurities and other foreign matters.
- 5.3.4. Strength of aggregate shall be more than that of hardened concrete paste.
- 5.3.5. Shape of coarse aggregate shall not be flat or slender.
- 5.3.6. Aggregate to be used in concrete shall possess the qualities indicated in the following tables.

Quality of Aggregates

Aggregate type	Open dry specific gravity	Percentage of water absorption (%)	Percentage of solid volume for the evaluation of particle shape (%)	Clay lump (%)	Loss in washing test (%)	Organic impurity (%)	Water soluble chloride (%)
Coarse aggregate	≤ 2.5	≤ 3.0	≥ 55	≤ 0.25	≤ 1.0	0	≤ 0.25
Fine aggregate	≥ 2.5	≤ 3.5		≤ 1.0	≤ 3.0	0	≤ 0.01

*Colour of test solution not to be darker than standard solution.

Grading requirements for aggregates

Percentage passing each sieve by weight (%)

Agg.	Max. size (mm)	Nominal sieve size (mm)												
		40	30	25	20	15	10	5	2.5	1.2	0.6	0.3	0.1	
Coarse	25													5
		100	100	90	60		20	0	0					
Fine	20			100	90		20	0	0					
					100		55	10	50					
							100	90	80	50	25	10	2	
							100	100	90	65	35	10		

- 5.3.7. Manufactured sand and blast furnace slag to be use in concrete shall not be used unless otherwise specified or approved by the Consultant.
- 5.3.8. In case of using fine aggregate of 0.0 1 % or more water soluble chloride content, the necessary measures for corrosion inhibiting of reinforcement shall be instructed by the Consultant.
- 5.3.9. The maximum size of coarse aggregate shall be 25 mm.
- 5.3.10. Sources of aggregate shall be to the approval of the Consultant and samples of aggregate from the proposed source shall be submitted to the Consultant at least 28 days before its intended use.

5.4. Water

- 5.4.1. Water shall not contain injurious amount of impurities that may adversely affect concrete and reinforcement.
- 5.4.2. Ground water shall not be used for concrete works.
- 5.4.3. Water shall be obtained from a public supply where possible, and shall be taken from any other sources only if approved by the Consultant.
- 5.4.4. Only water of approved quality shall be used for washing out formwork, curing concrete and similar surfaces.

5.5. Handling and Storage of Material

- 5.5.1. Cement
 - 5.5.1.1. Cement shall be stored in a manner to prevent weathering.
 - 5.5.1.2. Bagged cement shall be piled no more than 10 bags so as to permit easy inspection.
 - 5.5.1.3. Cement caked even to the slightest extent shall not be used. Such cement and rejected cement shall be immediately separated from other bags of cement so that they shall not be mistaken for others.

5.5.2. Aggregate

5.5.2.1. Aggregate shall be stored in a manner effectively separating coarse and fine aggregate according to type and shall be prevented from inclusion of dirt, rubbish and other undesirable foreign matters.

5.5.2.2. Coarse aggregate shall be unloaded and piled in a manner not to cause segregation of small and large particles. Aggregate to be stored in piles shall be in mounds of moderate height and at a location where good drainage is provided.

5.6. **Mix Proportion and Strength**

5.6.1. Mix ratio for reinforced concrete shall be in the proportion 1:2:3 (cement: fine aggregate: coarse aggregate) by dry volume. If the required design strength is not achieved with this mix proportion the contractor shall design an appropriate mix and obtain the consultants approval before its use.

5.6.2. Mix ratio for lean concrete shall be in the proportion 1:2:6 (cement: fine aggregate: coarse aggregate) by dry volume.

5.6.3. Water-cement ratio for concrete shall be 0.4% to 0.45%.

5.6.4. The specified design strength of reinforced concrete shall be 25 N/mm².

5.6.5. The required slump of concrete shall be 100 mm.

5.6.6. Design mix proportion shall be to obtain required workability, consistency and durability.

5.6.7. Where specified in the drawings, an approved waterproofing agent shall be added to the concrete. Details of waterproofing agent including certificates of compliance to relevant standards and other specifications and details shall be submitted for consultants' approval before it's use.

5.7. **Production of Concrete**

5.7.1. Field-mixed Concrete Plant

5.7.1.1. The Contractor shall select the necessary facilities for storage, batching, mixing and transporting of each of the materials and submit them for approval of the Consultant prior to start work.

5.7.2. Measuring

5.7.2.1. All materials shall be measure by volume for each batch and water may be measured volumetrically.

5.7.2.2. Cement shall be measured by number of bags unless automatic cement weight measure is in use.

5.7.3. Mixing Control

5.7.3.1. Concrete mixture shall be constantly controlled to obtain required workability and mixed strength. Mixing time for each batch shall be not more than 3 minutes.

5.7.4. Quality Control

5.7.4.1. The Contractor shall conduct tests for quality control toward insuring that concrete of the required quality is constantly produced.

5.7.4.2. The Contractor shall have all quality control tests report ready for submission as required by the Consultant.

5.7.5. Quality Inspection of Concrete at the Point of Placement

5.7.5.1. The Contractor shall conduct tests on concrete at the point of placement. When test results meet the tolerances given below, the concrete shall be qualified to have passed the tests.

- a) The tolerance between actual slump and required slump of the concrete shall be ± 2.0 mm

5.7.5.2. For the estimation of compressive strength of concrete in compressive strength tests, when compressive strength of 95% of the test samples is not less than the specified design strength, it shall be qualified to have passed the test. In case of failure to the above requirements, the Contractor shall take necessary measures such as to perform appropriate test as instructed by the Consultant.

5.8. Transporting and Placing

5.8.1. General

5.8.1.1. The Contractor shall establish manner and schedule for transporting and placing of concrete and obtain approval of the Consultant.

5.8.1.2. Concrete shall be transported in a manner to minimize segregation, spill, age and other changes in quality thereof.

5.8.1.3. Concrete shall be placed and consolidated in a manner to insure uniformity and optimum density.

5.8.1.4. In case of rain or other conditions that may affect the quality of concrete during concreting, the Contractor shall take necessary measures as instructed by the Consultant.

5.8.2. Time Limit

5.8.2.1. The time limit from start of mixing to completion of placing of a batch as a rule, shall be 30 minutes.

5.8.3. Preparation prior to Placing.

5.8.3.1. The place where concrete is to be deposited shall be cleaned and sheathing shall be sprinkled with water. Subsequently, water accumulated in the form shall be removed.

5.8.4. Construction Joint

5.8.4.1. Joint surfaces shall be cleaned, made free of laitance and other foreign matters, and an approved bonding agent applied prior to concreting. Joint surface shall be roughened if directed by the Consultant.

5.8.4.2. The locations of shapes of construction joints shall be consulted and approved by the Consultant.

5.8.5. Concrete Placing

5.8.5.1. Concrete placing shall be proceeded to keep the surface of placed concrete as horizontal as possible.

5.8.5.2. Concrete shall be continuously poured to compact around reinforcing bars and comers of formwork. Concrete should not be dropped from a height of more than 2.8 meters without taking appropriate measures to prevent segregation.

5.8.5.3. The maximum time interval between placements of continuous concreting shall not exceed 0.5 hours. However, when special measures are taken this time limit may be changed according to instruction or approval of the Consultant.

5.8.6. Consolidation

- 5.8.6.1. Vibrating of concrete and tapping of formwork shall be performed to wall, column and other places difficult for concrete to proceed. Proper number of workers for placing and compacting concrete shall be arranged.
- 5.8.6.2. Vibrator shall be operated for concrete called for water tightness, difficult portion for concrete to proceed and other cases directed by the Consultant. However, vibrator shall not be touched reinforcing bars and shall not be operated more than 30 seconds at same spot.
- 5.8.6.3. Concrete shall be placed 300 - 600 mm thickness at once in case vibrator is performing. In case flexible-insert-vibrator is called for, concrete shall not be placed thicker than the length of the insert or vibrator at one pouring.

5.8.7. Placing Speed

- 5.8.7.1. Concrete shall be placed at the speed suited for the workability of the concrete and condition of the place of placement, which insures proper consolidation of concrete.

5.9. Concrete Curing

5.9.1. Curing Method

- 5.9.1.1. After concrete has been placed, the concrete surface shall be kept moist by sprayed with water or by other appropriate methods, and shall be protected from direct sunlight and rapid drying. The top surface of slabs shall be kept flooded with water at all times after concreting for the duration of curing period. This curing period shall be for not less than 14 days.
- 5.9.1.2. As a rule, no foot traffic or loads shall be permitted on concrete for at least 24 hours after placement.

5.10. Test

5.10.1. General

- 5.10.1.1. The contractor shall be required to conduct all tests according to BS method and procedure.
- 5.10.1.2. Test, as a rule, shall be conducted at the locations directed or at the testing institutions approved by the Consultant.
- 5.10.1.3. The Consultant shall conduct test, as a rule.
- 5.10.1.4. In case of failure in test, measure shall be taken as instructed by the Consultant.
- 5.10.1.5. The Contractor shall keep test records during the work and for 2 years completion of the contracted work.

5.10.2. Material

- 5.10.2.1. Cement Test
 - 1) Setting test.
 - 2) Soundness test.
 - 3) Compressive strength test.Note: Item (1) shall be conducted once in every manufacturer.
Item (2) & (3) shall be conducted once in every 2,000 bags.
- 5.10.2.2. Aggregate test:
 - 4) Grading and fineness modules.

5.11. Concrete Testing

5.11.1. Fresh concrete

- 5.11.1.1. Slump, air content, shall be conducted daily, and more often at request of the Consultant.

5.11.2. Compressive strength test of concrete

Test for estimation on strength of concrete in structure:

- 5.11.2.1. In order to assume estimated strength of concrete in structure, compressive strength test shall be conducted for prepared test pieces on the 7th day and 28th day and those test pieces shall be made for sampling at placing of concreting.
- 5.11.2.2. Strength test shall be conducted for each of the following conditions: each days pour, each class of concrete, each change of supplies or source and each 100 cubic meter of concrete or: fraction thereof. The number of test pieces to be used in a test shall be not less than 3 for each test of the 7th day and the 28th day unless otherwise instructed by the Consultant.
- 5.11.2.3. Test pieces shall be made in accordance with British Standards, and sampling shall be taken as near as possible at the point of placement.
- 5.11.2.4. Test pieces shall be stored without being disturbed and shall be covered during the first 24 hours, and carefully transported specimens to the testing laboratory. Test pieces shall be cured in water after de-moulding. The temperature of test pieces shall be kept as close as possible to the temperature of the concrete in structure until the time of testing.

5.12. Defective Concrete and Finishes

- 5.12.1. Honeycombed surfaces shall be made good or on the instruction of the Consultant be cut out by the Contractor and make good at his own expense.
- 5.12.2. Concealed concrete faces shall left as from the formwork except honeycombed surfaces shall be made good. Faces of concrete to be rendered shall be roughened by approved means to form a key. Faces of concrete that are to have finished other than those specified shall be prepared in an approved manner as instructed by the Consultant.
- 5.12.3. Concrete arches as shown on the drawings shall be precast with 10mm granite chippings as aggregate, ground smooth to expose aggregate and applied with a clear weather-proof coating
(Formwork to be applied with a retarding agent and treated as required to expose aggregate prior to casting). Samples shall be submitted for consultants' approval before pre-casting the arches.

6. ROAD MARKING

6.1 Application

This Specification sets out the requirements for paints which are intended to be used as roadmarkings on road surfaces. This Specification is applicable to paints intended for use by spray application and intended to be incorporated with beads which give road markings their retroreflective properties.

6.2 Paint Composition

All paints shall be lead-free. Lead free means less than three times the method detection limit.

All paints shall comply with current legislative requirements, in particular the Hazardous Substances and New Organisms Act 1996. The manufacturer shall provide evidence of classification and reference the Group Standard(s) applying to the material(s).

6.3 PACKAGING

Paints shall be packaged in sound, clean and dry containers constructed of a material which is inert to the contents, and sufficiently robust to withstand normal conditions of handling and storage without rupture or leakage. The container shall be capable of being readily resealed, and shall be gas-tight.

6.4 LABELLING

The following information shall be legibly shown each container of paint or on a label permanently attached to each container of paint:

- (a) the name of the Supplier/Manufacturer;
- (b) the description "Roadmarking Paint" or equivalent wording;
- (c) the contents by volume, in litres;
- (d) production or batch number and date of manufacture;
- (e) storage and handling information required by regulatory authorities;
- (f) the colour of the paint film shall be specified (yellow/white);
- (g) its classification with respect to its ability to withstand trafficking; and
- (h) any classification or information relevant to the HSNO Act.

Suppliers/Manufacturers making a statement of compliance with this Specification for a paint (including statements on labelling, other packaging, or in promotional material) shall ensure that such statement is true and accurate and is supported by appropriate documentation and laboratory test results.