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28. IRON STEEL AND ALUMINUM WORKS

28.1 IRON AND STEEL WORKS

28.1.1 SCOPE

This Section covers general requirements of Iron steel, steel work fabrication, methods including precautions for erection of steel structures, painting and other general requirements incidental to steel work, for complete job as shown on the design drawings or as directed by the Engineer-in-Charge.

The applicable requirements of this section as determined by the Engineer- in-Charge shall apply to all Iron and structural steel works. The work covered by this section, consists of supply of all material, labour, plant, equipment and appliances including welding, bolts, nuts, washers, anchor bolts, embedded parts etc., fabrication, erection and painting in accordance with the specifications and as per drawings and as directed by the Engineer-in- Charge.

28.1.2 CODES AND STANDARDS

The work shall conform to the requirements of the following Codes and Standards, unless otherwise specified.

ASTM A-36-81	Structural steel specifications
ASTM A-307-80	Specifications for carbon steel bolts.
BS 729-71	Hot dip galvanized coating on iron and steel articles.
AWS D-12	Recommended Practice for welding steel

28.1.3 SUBMITTALS

Prior to execution of work and sufficiently in advance, the Contractor shall submit the following to the Engineer-in-Charge for approval:

- a) Shop Drawings
Shop Drawings, which shall show full construction details, quantities and locations, with metal gauges, reinforcing, cut-outs, holdfasts & attachment to adjacent construction and materials.
- b) Samples
Representative samples of a typical metal window and ventilator, hardware, accessories and any other product required.
For metal doors and shutters, cross-sections of typical welded jointed or assembled frame, in specified thickness showing reinforcing, welding and prime paint coat.
- c) Methodology
Methodology for fabrication, installation, erection and fixing.

28.1.4 QUALITY ASSURANCE

- a) Type and Form of Product
All metal doors, windows, ventilators and shutters shall be the product of reputable manufacturer and shall be of the type indicated on the Drawings, and shall conform to the requirements specified herein.
- b) Metal Doors and Shutters
All metal door and shutter frames shall be made of good quality cold rolled steel; exterior frames and doors shall be galvanized steel.

Frames shall be fabricated from locally available hot flush hollow pressed sections, 'Z' section angle, tee and channel or pipe sections as specified in the drawings. Materials shall conform to ASTM-A-36.

All frames shall be secured to the structure with strong wrought iron holdfasts. Holdfast shall be 50 mm. wide and 6 mm. thick and shall be secured to frames. Attachment shall be concealed.

Shutters shall be double skin made of frames of any of the sections noted above with faceplate of at least 18 S.W.G. or as shown in the drawings.

The internal surfaces of frames and shutter including frame shall be painted with one coat of epoxy primer or as specified.

External surfaces in contact with or embedded in concrete shall not be painted, greased or oiled. However, such surfaces shall be given a cement wash after sandblast cleaning. All other external surfaces shall be given two coats of primer and two coats of epoxy enamel paint or as specified.

Accessories such as hinges, steel standard track, roller and guides, standard bracket, anchors, bolts, locks handles, latches, L--drops, stoppers, hydraulic door closure shall be heavy duty and shall conform to the requirements shown on the drawings or as directed by the Engineer -in-Charge.

c) Metal Window and Ventilators

- Window frame and ventilator sections shall be of mild steel.
- Hinges shall be subject to the approval of the Engineer-in-Charge.
- All operating hardware shall be of bronze lacquered iron as specified.

d) Structural Steel

All structural steel shall conform to the requirements of ASTM A-36 or equivalent.

e) Welding

All welding shall be executed and inspected in accordance with the provisions of the applicable code of the American Welding Society.

f) Bolts

All bolts, including anchor bolts shall conform to the requirements of ASTM A-307 or equivalent.

28.1.5 DOORS AND WINDOWS

28.1.5.1 DELIVERY AND STORAGE

- a) Doors shall be packed individually in a manner which will ensure complete protection of all door surfaces and shall be stored in upright position, under cover, in a manner so as to prevent rust and damage.
- b) Frames shall be supplied with removable angle spreaders securely fastened to the bottom of each joint. The spreaders shall not be removed until frames are secured in place.
- c) Windows shall be delivered in a manner that prevents damages to the units and shall be stored off the ground, under cover, in a manner so as to prevent rust or damage.

28.1.5.2 PRODUCTS – GENERAL REQUIREMENTS

- a) All contours and arises in metal door shall be true and sharp as can be produced in the thickness of metal required.
- b) Construction joint of steelwork welded to full depth and width, or equivalent splice plates shall be welded on unexposed faces of frames. Exposed surfaces of welded joints shall be dressed and ground smooth to produce invisible connections.
- c) Reinforcement and stiffeners shall be welded to the inside of the frame surfaces.
- d) Window frames and ventilators shall conform to the sections shown on the detailed Drawings and all corners shall be electrically flashwelded and finished smooth.

- e) Weather baffles shall be integrally rolled and shall provide contact on all the four sides of the operating ventilators.
- f) Weep holes and drips shall be provided for drainage in accordance with Drawings or instructions of Engineer-in-Charge.
- g) All windows shall be designed for exterior glazing to accommodate glass thickness specified.
- h) Ventilators shall show in or out, as indicated on the Drawings and shall be mounted over heavy steel pivots with brass pins.
- i) Push bars for out swinging windows shall be a notched device for fixed settings and designed to lock shutters in open/closed position.
- j) In-swinging windows shall be provided with a casement for fastener, designed and arranged to close with wedging erection to draw each leaf firmly into contact with window fixed rail.
- k) Windows shall be provided with all necessary clips and anchors required for securing the windows to the structure.

28.1.5.3 FABRICATION OF DOORS AND WINDOWS

- a) Shape
The steel sections shall be thoroughly straightened in the shape by methods that will not injure it before being laid off or worked in any way.
- b) Cutting and Forming
All members shall be so cut and formed that they can be accurately assembled without being unduly cracked strained or forced into position.
- c) Jointing
The jointing of different parts of the members of mild steel shall be carried out by welding process in conformity with the requirements of American Welding Society for such joints. Welding points shall be made quite smooth by filing them and making smooth.
- d) Galvanizing
If required all exterior doors frames, anchors reinforcing and related items shall be fabricated from hot dipped galvanized steel, conforming to BS-729, Part-1. After fabrication all welds shall be touched up with liquid zinc.
Window frames and ventilators shall be hot dipped galvanized after fabrication conforming to BS-729 Part-1 as specified.

28.1.5.4 FABRICATION OF ROLLING SHUTTERS

- a) Shutters
The shutter shall be fabricated using standard galvanized corrugated segments of the required length according to size of the shutter and of 22 gauge thickness. These segments shall be inter-linked properly to allow rotation for smooth rolling up and down. In order to reduce noise during operation, 2 inch (50mm.) wide wire reinforced canvas belt shall be riveted (using aluminum rivets) to both shutter ends. The aluminum rollers shall be installed at top.
- b) Guide
The guides for the shutter shall be fabricated from mild steel plates and shall be embedded to wall or columns by providing necessary anchors.
- c) Main Rollers
The main rollers, mounted on the supporting pipe, on which the shutter has to roll up, shall be of mild steel with deep groove ball bearings and provision for greasing.

d) Supporting Shaft

The supporting shaft shall be of standard mild steel pipe, strong enough to support the load of the shutter with minimum deflection. This shaft shall have adequate supports at the ends fabricated from mild steel plates. Each shutter shall have separate bracket supports. However, due to space limitation for mounting, the same may be made common for adjacent shutter.

e) Coil Spring

On each end, between the bracket support and the roller coil, a spring shall be provided. The spring shall be of spring steel one end of which shall be fixed to the pipe and the other to the roller. These springs shall be suitable to balance the weight of the shutter to allow smooth operation.

f) Cover

The cover shall be fabricated from 22 gauge galvanized steel sheet of uniform shape and size without deformations.

28.1.5.5 INSTALLATION

a) Doors, Windows and Ventilators

The Contractor shall be responsible for proper protection and installation of all items furnished. Should the prime coat be damaged, or rust scale appears, he shall at his own expense and at the Engineer-in-Charge's direction, have all exposed surfaces cleaned to bare bright and re-primed with an approved priming coat before finish painting.

All items shall be installed plumb and square and shall be solidly anchored in a good workman-like manner in accordance with the approved Shop Drawings. The Contractor shall be responsible for the protection of installed items from damages by other trades. All items shall be left in operating neat and clean condition free from dirt, finger marks, etc. The Contractor shall be responsible for final cleaning before final acceptance.

b) Wire Gauze

Unless otherwise specified or directed by the Engineer-in-Charge, the wire gauze to be fixed with doors, windows and ventilators shall be 22 gauges having 12x12 mesh and shall be from an approved manufacturer.

c) Shutters

The installation of all components of the shutter shall be done true to line and level and in perfect plumb. It should be ensured that the shutter should roll up automatically after initial manual lifting upto a desired height. The shutter closing should also be easy smooth and unobstructed. The operation shall be performable by a single person.

28.1.5.6 PRIMARY COAT AND FINISHING

a) The non-galvanized doors, windows and ventilators shall be painted with primary coat of red oxide and good quality double boiled linseed oil or any approved anti-corrosion paint after proper grinding. Afterwards two coats of synthetic enamel paint of approved make and shade shall be given.

b) Two coats of red primer and one coat of synthetic enamel paint shall be applied on all components of shutters except galvanized shutter, after fabrication and before installation. One coat of synthetic enamel paint shall be applied to all exposed surfaces after installation. Before applying paint all surfaces shall be cleaned from rust, burrs, scale, dust or grease.

c) The finished work shall be strong and rigid; neat in appearance and free from defects. Plain surfaces shall be smooth and free from warp or buckle. Molded members shall be clean, straight and true. Fastenings shall be concealed where practicable.

d) The painting as specified shall be carried out in accordance with the applicable provisions of Section 17, Painting and Varnishing.

28.1.5.7 GLAZING

Applicable Standards

Latest editions of the following British Standards are relevant to these specifications wherever applicable.

BSI	British Standards Institution
952	Glass for glazing
5051	Security glazing Part I & II
CP.152	Glazing

28.1.5.8 GENERAL

- a) Each type of glass shall have the manufacturer's label on each pane, and the labels shall remain on the glass until final cleaning.
- b) Glazing sealant shall be as recommended by the manufacturer for the particular application.
- c) Spacer shims (distance pieces) shall be plasticized polyvinyl chloride (PVC). Thickness shall be equal to space shown on drawings between glass and rebates, bead or cleat. Depth shall give not less than 6mm. cover of glazing sealant.
- d) Contractor shall submit samples for each type of glass, minimum 100mm. x100mm. in size with protective edges. Samples of glazing sealant minimum 0.1 liter of specified types shall be submitted. Samples of minimum of three glass blocks shall also be submitted.
- e) Contractor shall submit 300 mm. long sample of each type of glazing gasket.
- f) Contractor shall also submit printed materials manufacturer's installation instructions for specified glazing glass block gaskets, compounds sealants and accessories including description of required equipment and procedures and precautions to be observed.

28.1.5.9 DELIVERY STORAGE AND HANDLING

- a) Contractor shall deliver materials in manufacturer's original, unopened containers clearly labeled with manufacturer's name and address, material, brand, type, class and rating as applicable.
- b) Contractor shall store the materials in original unopened containers with labels intact/protected from ground contact and from elements which may damage glass.
- c) Contractor shall handle the materials in a manner to prevent breakage of glass and damage to surfaces.

28.1.5.10 MATERIALS

- a) General
Glass shall be free from all blemishes, bubbles, distortions and other flaws of any kind and shall be properly cut to fit the rebates so as to have a uniform clearance of 1.6 mm. round the panes between the edges of glass and the rebates. All glass shall be best quality from reputable manufacturer as approved by the Engineer-in-Charge.
Unless otherwise indicated glass shall be of the following weight per square metre for various sizes mentioned below:
 - i) Not exceeding 300 x 350 mm. - 4.3 Kg/M.
 - ii) Exceeding 300 x 350 mm. but not exceeding 600x600 mm. - 8.0 kg/M.
 - iii) Exceeding 600 x 600 mm. but not exceeding 750x750 mm. - 9.0 kg/M.
 - iv) Exceeding 750 x 750 mm. but not exceeding 900x900 mm. - 9.8 kg/M.
 - v) Plate glass 6 mm. thick shall be used where size of glass exceeds 900mm. either in breadth or in length or in both.
- b) Sheet Glass
Sheet glass shall be of thickness and size shown on the Drawings. Each glass shall be bedded with a thin layer of good quality putty as approved by the Engineer-in-Charge and should be fixed with glazing bead securely screwed and finished off neatly.

- c) **Obscure Glass**
Obscure glass shall not be less than 5 mm. thick with one side smooth and polished whereas the other side with pattern to be selected by the Engineer-in-Charge, if specified, sheet glass shall be made obscure by grinding off the polish from one side.
- d) **Plate Glass**
Plate glass shall be first quality polished transparent glass, conforming to the applicable requirements of BS 952. Unless otherwise indicated, plate glass shall be 6 mm. thick with two surfaces ground smooth and polished so as to give clear undistorted vision and reflection.
- f) **Wire Reinforced Glass**
Wire reinforced glass shall be 6.35 mm. thick polished plate reinforced with Georgian wire conforming to the applicable requirements of BS 952.
- g) **Tinted Glass**
The imported tinted glass for doors, windows and ventilators shall be of specified thickness and tint and shall be from a manufacturer as approved by the Engineer-in-Charge. The tinted glass shall comply with the applicable specifications of B.S. 952.
- h) **Solar Control Film/Glass**
The approved Solar Control film shall be applied on all sun-facing glasses of doors and windows as indicated on the Drawings. It shall consist of aluminum vapour coated polyester film with water activated adhesive thereon. Color shall be soft grey. The film shall be optically clear from the inside. Total thickness shall be 0.025 mm. to 0.033 mm..
- h) **Glass Blocks**
The glass block shall be of specified size and shall be from a Manufacturer approved by the Engineer-in-Charge.
- i) **Putty**
Putty for wood frames shall be of the best linseed oil conforming to the requirements of BS-544 and for metal frames best metallic putty. Wherever required the putty shall be colored to match with woodwork. The rebates, if not painted, shall be well primed with boiled linseed oil to prevent the wood drawing the oil from the putty.
- j) **Unbreakable Glazing (Poly Carbonate Sheet)**
Unbreakable glazing material shall be LEXAN MR-4000 sheet as manufactured by GE Structural Product or approved equivalent and shall be provided as glazing where shown on the Drawings. It shall have the property of high impact resistance, weather resistance, clarity, 'and durability. It should be attractive and light weight.

28.1.5.11 BEADS AND SHIMS

Glazing beads shall be of deodar wood.

Spacer shims (distance pieces) shall be of plasticized polyvinyl chloride (PVC). Thickness shall be equal to space shown on the Drawings between glass and rebate, bead or cleat. Depth shall give not less than 6 mm. cover of putty.

28.1.5.12 GLAZING SEALANTS AND COMPOUNDS

Contractor shall provide material colored to match frame in which glass is installed and only compounds known to be fully compatible with surfaces which they will contact as follows.

- 1) Two component polysulfide glazing for sealant.
- 2) One component acrylic glazing for sealant.
- 3) Acrylic-latex glazing sealant consisting of modified latex rubber and acrylic emulsion, non-hardening, non-staining and non-bleeding.

- 4) Cleaners, Primers & sealer as recommended by the sealant manufacturer.

28.1.5.13 ACCESSORIES

- a) Glazing Sealant

It shall be tape or ribbon of polymerized butyl or mixture of butyl and polyisobutylene compounded with inert fillers and pigments, solvent based, 95 percent solids thread or fabric reinforced, paintable, non-staining.

- b) Setting Blocks

It shall be chloroprene (Neoprene) 70 to 90 durometer hardness, compatible with sealant used, channel shaped and of the necessary height for proper perimeter clearance.

- c) Channels, Gaskets, and spacer's

It shall be chloroprene (Neoprene), 40 to 50 durometer hardness compatible with sealant used.

28.1.5.14 INSTALLATION OF GLAZING

- a) Preparation

All rebates and grooves shall be clean, dry and unobstructed at the time of glazing. The beads shall match the surrounds. Manufacturer's recommendations for the putty, metal surrounds and primer shall be followed.

- b) General

All glazing shall be wind and watertight on completion. Edge clearance shall be equal all around each pane, and not less than 3 mm. No void or space shall be left at the back of bedding compound. Surplus bedding compound to top and side edges shall be stripped at an angle to avoid collection of water. Sand blasted glass shall be protected from oil attack by treating edges before fixing, and cleaning surfaces after fixing, as recommended by glass manufacturer.

- c) Glass

Glass shall be secured with spring clips or cleats as provided or recommended by the manufacturer. Back-putty shall be of regular thickness, not less than 1.5 mm. short of sight line. Surface shall be brushed lightly to seal putty to glass.

- d) Fixing

For bead fixing, setting blocks shall be located as required in BS 6262. Spacer shims (distance pieces) shall be used in all external bead fixing and located opposite each other on each side of glass not more than 600mm. apart around the perimeter.

- e) Control Film

All run-facing glasses shall be washed properly with potable water to render them free from any greasy matter. Solar control film shall be applied on cleaned glass by authorized servicemen for this work as approved by the Engineer-in-Charge. The film shall be applied on the glass before it is fixed at its appropriate place. The film shall be applied with approved adhesive in such a way that no air bubble is left between the glass and film and optical clarity is not affected.

- f) Depth of Rebate

The minimum rebate depths will depend upon the area of the pane and block and exposure conditions as under:

For small panes upto 0.372 square meter in area inside buildings or for external panes not exceeding 0.093 square meter, the depth should not be less than 6.3 mm. For linseed oil or metal putty the depth should not be less than 7.9 mm. for wood or metal and 9.5mm. for stone brick or similar material. For non-setting compounds, the depths should not be less than 9.5 mm.

The depth of rebate shall be increased for larger panes or for panel which butt together, and for exposed conditions. The increase in rebate shall be as shown on the Drawings or as directed by the Engineer-in-Charge.

28.1.5.15 INSTALLATION OF GLASS BLOCKS

The method and equipment used for transporting the glass blocks and neat white cement paste shall be such as that will not damage the glass block nor delay the mixed paste of white cement. Glass blocks shall be laid as shown in the drawings or as directed by the Engineer-in-Charge. Both Horizontal and vertical joints shall be approximately not more than 1/16" in thickness and completely filled with white cement paste. Each glass block shall be bedded firmly by tapping with the rubber hammer. All Horizontal and vertical joints shall be parallel to each other. All glass block shall be erected true to line plumb and level. Excess mortar at the outer edges shall be removed with cloth. After completion of days' work, the glass block wall shall be thoroughly cleaned with water and/or damp cloth as directed by the Engineer-in-Charge.

28.1.5.16 CARE AGAINST DAMAGE

While glazing operation is in progress great care shall be taken to avoid breakage or damage to the glass and adjoining glazing. The Contractor shall make good at his own cost, all glass broken by his workmen while cleaning or carrying out other operations. On the completion of the glazing work, all glass that has been set by the Contractor shall, if it becomes loose, within the maintenance period, be re-fixed at Contractor's expense.

No glazing shall be considered complete until and unless paint and other stains have been removed from the surface of the glass and checked by the Engineer for water tightness.

28.1.5.17 PROTECTION AND CLEANING OF GLAZING

- a) Remove all smears labels and excess glazing sealant. Leave clean inside and outside free from scratches. The Contractor shall be responsible for the protection of installed glass. Before final acceptance, damaged or broken glass shall be removed and replaced with new glass at no additional expense to the Employer.
- b) All glass surfaces shall be washed clean both inside and outside within two weeks prior to final acceptance by the Employer

28.1.6 MISCELLANEOUS STEEL WORK

28.1.6.1 GENERAL

The work covered shall include furnishing; fabricating, installing and painting

Miscellaneous Steel Work including the following:

- Steel stairs
- Steel Joists, Protection angles and channels
- Steel Grating
- Steel Hand Rail
- Steel Gates
- Embedded plate, anchor bolts and other miscellaneous items

Drawings, material, fabrication, surface preparation shall conform to the applicable requirements of relevant clauses of these specifications. Any proposed deviation due to field conditions and availability of local material shall be submitted to the Engineer-in-Charge for approval a week prior to the start of the work.

- a) Steel Stairs
 - i) General

Structural steel stairs complete with grating treads or checkered plate treads, landings, supporting structures, handrail supports etc. shall be furnished and installed in accordance with working drawings.
 - ii) Material

Except otherwise indicated in the working drawings, materials shall conform to the requirements of ASTM A36 (specifications for structural steel).
 - iii) Installation

The stairs shall be installed in a first class workman like manner. Connections to adjacent concrete structures shall be made with anchor bolts or shall be welded to embedded part at site as shown on the drawings. .
- b) Steel Joists, Protection Angles and Channels

Steel protection angles joists and channels as shown on drawings and specified shall be erected true to line and level. Steel angles and channels shall be grouted and fixed in position by using anchors as shown on the drawings or as directed by the Engineer-in-Charge.
- c) Steel Grating

Steel grating shall conform to the requirement as shown on drawings. All panels shall be banded on the all edges as specified.
- d) Steel Hand Rail

Steel Hand Rail shall be fabricated in accordance with the drawing or as directed by the Engineer-in-Charge and shall conform to the applicable requirement of ASTM A53 for the type and class of pipe indicated.

28.1.7 FENCING

28.1.7.1 GENERAL

This work shall consist of constructing post and barbed wire fence or chain link fence in accordance with the details and at the locations shown on the Drawings or as directed by the Engineer-in-Charge.

28.1.7.2 MATERIALS

- a) Barbed Wire

Barbed wire shall conform to the requirements of ASTM A-121 Class-1. The barbed wire shall consist of two (2) strands of twelve and a half ($12\frac{1}{2}$) gauge wire, twisted with two (2) points, fourteen (14) gauge barbs spaced ten (10) cm apart.
- b) Chain Link Fabric

Chain link fabric shall be fabricated from ten (10) gauge galvanized wire conforming to AASHTO M-181 and shall be of the type shown in the Drawings. Before ordering the chain link fabric the Contractor shall submit a sample of the material to the Engineer-in-Charge for his approval.
- c) Concrete Posts

Concrete posts shall be made from 1:2:4 (4000 psi – 6"x12" cylinder strength) concrete in accordance with Section 5 – Plain & Reinforced Concrete. The posts shall be cast to the length shown on the detailed drawings and shall have a smooth surface finish.
- d) Steel Posts

Steel posts shall be of the section length as specified or as shown on the Drawings. The posts shall be of copper bearing steel and shall conform to the requirements of AASHTO M-183 for the grade specified.

e) Wooden Ballies

The wooden ballies shall be of shisham or kail wood as specified and approved by the Engineer-in-Charge.

f) Steel Reinforcement

Steel reinforcement for the concrete posts shall be deformed steel bars Grade-60 or Grade-40as specified conforming to the provisions of Section 5 – Plain & Reinforced Concrete.

The Concrete shall comply with provisions of Section 5 – Plain & Reinforced Concrete.

g) Hardware

Nuts, bolts, washers and other associated hardware shall be galvanized after fabrication as specified in ASTM 153.

28.1.7.3 CONSTRUCTION REQUIREMENTS

a) Erection of Posts

The posts shall be erected vertically in position, inside the formwork of the foundation block prior to the placing of the concrete and shall be adequately supported by bracing to prevent movement of the post during the setting process of the concrete. The posts shall be erected to the height and location shown on the Drawings or as directed by the Engineer-in-Charge.

b) Installation of Chain Link Fabric

The chain link fabric shall be set to line and elevation and pulled tight between each post before spot welding or other method of fixing is carried out.

Where splicing of the fabric is necessary or at joints the lapping of the chain link fabric shall be a minimum of ten (10) cm and shall occur only at the concrete post. No horizontal splicing will be permitted. The fabric shall be fixed to the concrete post as shown on the Drawings.

28.2 ALUMINIUM WORKS

28.2.1 APPLICABLE STANDARDS

Latest editions of following ISO and British Standards are relevant to these Specifications wherever applicable.

ISO (International Organization for Standardization)

6612 Windows & Doors - Wind resistance tests

6613 Windows & Door - Air permeability test

BSI (British Standard Institution)

1227 Hinges

4873 Aluminum alloy windows

28.2.2 SUBMITTALS

a) General

The Contractor shall in general comply with the provisions of Clause 28.1.3 and 28.1.4.

b) Manufacturer's Certificate

The Contractor shall on request get certificate signed by the manufacturer stating that each lot has been sampled tested and inspected and has met the requirements in accordance with these specifications and the same shall be furnished to the Engineer-in-Charge.

c) Guarantee

The manufacturer shall furnish his standard written guarantee against leakage of rain water excessive infiltration of dust air and all defects in materials, workmanship covering all the work under this section.

Such guarantee shall be in addition to and not in lieu of all other liabilities which manufacturers and the Contractor may have by law or other provision of the Contract Agreement.

28.2.3 INSPECTION & TESTING

- a) Contractor shall arrange tests and analysis if directed by the Engineer- in-Charge of scaled models of each Door, window ventilator type at the maker's works or any laboratory specified by the Engineer-in-Charge for the material supplied by him to be tested in the presence of the Engineer-in-Charge/Inspector to whom test certificates, proof sheets etc. shall be furnished. The models shall be submitted to the Engineer-in-Charge for approval prior to testing. Nevertheless neither the fact that the materials have been tested in the presence of the inspector nor that the Engineer-in-Charge may have been furnished with test certificates in lieu of sending an inspector to the works shall affect the liberty of the Engineer-in-Charge to reject after delivery of materials found not in accordance with these specifications.
- b) After approval of shop drawings and tests etc. the Contractor shall submit at his own cost one mock-up sample of each type of aluminum works complete with glazing, all components assembly method and required fittings and accessories prior to the actual fabrication of the bulk. The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

28.2.4 PRODUCT DELIVERY AND STORAGE

- a) The Contractor shall deliver doors windows ventilator and louvers in a manner preventing damage to units. The contractor shall store materials off the ground under cover in a manner preventing deterioration or damage.
- b) All embedded parts and anchor bolts shall be delivered to the site carefully and keeping the fabricated shape and configuration. All these parts shall be suitably marked for identification.

28.2.5 MATERIAL

- a) All the sections used for Doors, windows, ventilators & fly screens shall be of best quality aluminum products such as equal and unequal angles, channels, tubes, corrugated strips moulding setc; in accordance with international standards conforming to ASTM B-308 & B-221.
- b) Frames
The frames of aluminum doors, windows, ventilator, louvers and fly proof shutters shall be formed from rolled, strip or extruded aluminum and be at least 2mm. thick deluxe section. Fastenings bolts and screws shall be made from hardened aluminum.
- c) Fasteners shall be stainless steel of a type selected to prevent galvanic action with the components fastened.
- d) Gaskets shall be vinyl glazing channel gasket according to commercial standard CS-230-60.
- e) Hardware as required shall be manufacturer's standard hardware of aluminum, stainless steel or other corrosion resistant materials and shall blend in design with the frame finishes.
- f) Joint sealant shall be approved elastomeric.
- g) Fittings and fixtures shall be as per approved samples.

28.2.6 FINISHED COATING

- a) General
The finished coating shall be as stated on the Drawings and applied strictly in accordance with the manufacturer's instructions.

The color of the coating shall be selected from available ranges if not stated in the drawing and or bill of quantities. The Contractor shall offer samples for approval prior to the final selection and the manufacture of these elements.

b) Anodized coating

The aluminum anodizing shall comply with BS 3987 and be integral color hard coat anodizing 550kp/mm² hardness, minimum 25 microns thick.

The color of anodizing shall be as described on the drawings. Samples of color including limits of color variation shall be submitted to the Engineer-in-Charge for his approval before work commences. The Engineer-in-Charge reserves the right to reject the products of any supplier who cannot guarantee a reasonable limit of color variation, the acceptable limit of variation being at the Engineer-in-Charge's discretion.

c) Polyester Powder coating

All aluminum sections that are to receive a polyester powder coating shall be given a caustic etch followed by an anodic oxide treatment to obtain an architectural class 1 anodic coating. Anodization should be not less than 25 micron thickness.

All aluminum works shall be finished in colored electrostatic polyester powder coating as per DIN standard 53151, 53153, 53156 or equal and approved to Ralcolor subject to the Engineer-in-Charge's approval.

d) Coating Thickness

As and when instructed by the Engineer-in-Charge, the Contractor shall provide certificates from independent laboratories that the minimum thickness as specified has been applied to the aluminum sections. Failure to provide such information shall result in the complete installation being rejected and replaced at the Contractor's expense.

e) Dissimilar Materials

All aluminum surfaces that are to be in contact with cured concrete, mortar, steel and other metals shall have the contact surfaces protected wherever they may entrap moisture or corrosive elements. Metals that are to be in contact with mortar or concrete shall be protected with a two coat bituminous coating. Prime paint shall be applied to steel parts of anchors, anchor inserts, reinforcement, supports, and all parts after field welding or blotting with zinc chromate. Minimum dry film thickness shall be of 1 mil for zinc chromate.

28.2.7 FABRICATION

a) General

All nuts, bolts, washers and screws used for assembly and fixing shall be of adequate strength for their purpose within the design and shall be stainless steel grade 18/8.

All sealants used in the assembly of, and in the fixing of cladding and window framing, shall be non-setting to allow thermal movement without detriment to those joint sealants used for peripheral caulking and shall be one part silicone sealant and shall conform to BS 4245. All spliced joints between mullions will be sealed with an approved silicone product, compatible with other sealants and packing used. All ironmongery which is to have the same finish as the frames and shall be approved by the Engineer-in-Charge.

At all opening of windows and doors and where there are louvered screens and doors, a fly screen shall be provided to the approval of the Engineer-in-Charge, constructed following the principles & specifications as described elsewhere in this specification.

Glazing sections shall be set in special heat resisting PVC and of channel type. Separate glazing sections on each side of the glass will not be permitted. The following table indicates the basic requirements for window construction. The weights of framing make no allowance for beads, glazing bars, opening light framing, coupling mullions or transoms.

Classification	Min. weight of basic frame kg/m run	Max. superficial area of window in Sq. M.	Max. Dimension either way mm.	Remarks
Light	0.60	1	1500	
Light	1.00	3	2000	
Medium	1.50	5	2500	
Medium	2.00	9	3000	
Heavy	2.50	12	3500	
Heavy	3.00	12	3500	With door

b) Sliding Windows and doors

Weather-stripping - high density acrylic wool weather pile shall be used. There should be double brushes at every contact between shutter and frame sections for complete insulation. These should be present consistently throughout the unit between the inside and the outside and no portions without it are permitted.

The rollers for sliding shutters for both windows as well as doors shall be of the adjustable type. The adjusting screws must be accessible in the assembled state of the shutters and a vertical adjustment of 7 mm. should be possible.

All sections for sliding windows and doors should be hollow section and the cross section dimensions of the sections should not be less than 60x40mm.

The outer frame must be suitable for accommodating sliding fly screens as required.

The handle-latch set should have all visible surfaces finished as the aluminum sections. The handle must have a proper grip. A small projecting flange or recess in the shutter sections cannot be accepted to serve as handles. The latching mechanism should not be surface mounted but should be concealed within the sections. Sash rails of vertical sliding windows are to be of tubular box sections with corner joints of outer frames and sashes interlocked, and the balance mechanism is to be an approved proprietary product.

c) Side hung windows, doors and ventilators

All windows and doors should be weather-stripped with heat resistant PVC sections. The weather protection should be achieved by a positive compressive action against the PVC section and should not depend on external contact with the PVC section. At every contact between two profiles two weather-stripping sections should be provided to complete weather protection.

The bottom sections for hinged doors must be capable of being adjusted vertically if necessary. The gap between the bottom section and the floor should be covered with a pair of special splay-type PVC sections.

The shutter sections for both windows as well as doors shall be hollow section type and shall be overall size 57 x 45 mm. and door sections shall be overall size 81 x 45 mm. (including flanges).

The shutters of the windows and doors should be assembled with concealed corners of high rigidity. Hinges should be concealed within the sections.

Hinges shall be anodized aluminum with stainless steel pins and nylon washers. Handles shall be anodized aluminum finished to match the aluminum sections and mounted with self-lubricating nylon washers.

A mortise cylinder rim automatic deadlock of high quality with double pin tumbler is to be used.

Windows shall have anodized aluminum handles, color as framing and a latching mechanism securing the shutter to the frame both at the top and bottom.

Fitting where required:

- d) Single action door closer concealed in the head bar of the outer frame and mounted on an adjacent pivot at the threshold and deadlock fitted.
- e) The left hand leaf of double doors with flush bolts at head and sill with deadlock fitted to the right hand leaf.
- f) Escape doors to have panic bolt assembly with vertical elements concealed in the stile and door closer as in (a).

- g) Fly screens

Fly screens shall be fitted to all opening leaves of windows or sliding doors, consisting of a separate metal sub-frame in with aluminum mesh fly wire. The fly screens shall be adequately secured with suitable dips, set screws or turn buckles and shall be removable for maintenance purposes. Fly screen doors shall consist of similar section to metal casement doors and shall be fitted with removable panels of fly wire.

The aluminum frame .to the fly screen shall be finished to match the framing of the window or sliding door with color and type of mesh to Engineer-in-Charge 's approval.

- h) Glazing

The glass shall conform to specification laid down under Section 28.1.6; 'Glazing' and shall be free from all blemishes, bubbles, distortions and other flaws .of any kind and shall be properly cut to size as shown on drawings, so as to fit the grooves in window members. All the glass shall be best quality of approved manufacture or equivalent standard as approved by the Engineer-in-Charge.

28.2.8 ERECTION AND WORKMANSHIP

28.2.8.1 ERECTION

- a) Raw plugs and anchoring bolts shall be embedded into the concrete or masonry for holding the doors, windows, ventilators and louvers in their correct position.
- b) Care shall be taken to install the doors and windows, ventilators and louvers in line and plumb, solidly anchored in a good workman-like manner in accordance with the Drawings. Should any scale or scratch appear on the surface of doors, windows, ventilators and louvers the Contractor shall at .his own expense and at the Engineer-in-Charge's direction have all exposed surface cleaned to bare bright metal and made good as required.

All joints between structure and the metal shall be fully caulked and painted. All works shall be installed in strict accordance with the manufacturer's instructions.

28.2.8.2 WORKMANSHIP

The Contractor shall be responsible for the protection and installation of all items furnished. All items shall be installed plumb and square and shall be solidly anchored in a good workmanship like manner in accordance with the manufacturer's instructions and as specified herein. All items shall be left in operating, neat and clean condition, free from dirt, finger marks, cement mortar stains etc. The Contractor shall be responsible for final cleaning before the final acceptance.

The glass panes shall firmly be secured in the rebates with the rubber gasket. Beads and grooves shall be ensured to be clean, dry and unconstructive at the time of glazing. The complete unit shall be airtight and watertight on completion.

No door and window shall be considered complete until the finger prints and other stains and marks have been removed from the surface of glass and aluminum.

Temporary protection shall be achieved by applying water soluble protective coating capable of withstanding the action of mortar.

Protective coating shall be applied in the manufacturer's plant to the exposed surface of all components after removing all fabrication compounds, mixture and dirt accumulations.

28.2.8.3 FINISHING

All exposed surfaces shall be carefully polished and all alloy defects, die marks scratches, strokes or other surface blemishes shall be buffed to a clear surface and given an anodic oxides treatment. The structural shape of aluminum members shall be of uniform quality, color and temper; clean, round, commercially straight and free from injurious defects

28.2.9 PROTECTION AND CLEANING

- Temporary protection shall be achieved by applying water soluble protective coating capable of withstanding the action of mortar.
- Apply coating in the manufacture(s) plant to the exposed surfaces of all components.
- Before application of coating, remove all fabrication compounds, moisture and dirt accumulations.

28.2.10 DEFECTIVE WORK

In the event of non-conformance to specifications and drawings the aluminum work shall be rejected by the Engineer-in-Charge and the Contractor shall remove and - replace the rejected works by new work of same specifications.

28.3 MEASUREMENT AND PAYMENT

28.3.1 COMPOSITE RATE

The measurement and payment for the items of the work of Iron, Steel and Aluminum Works hereof shall be made corresponding to the applicable CSR item as provided in Contract Agreement and shall constitute full compensation, for procurements, transportations, performance in all respect and completion of work as specified including the site clearance as approved by the Engineer-in-Charge.

28.3.2 LABOUR RATE

The measurement and payment for the items of the work of Iron, Steel and Aluminum Works hereof shall be made corresponding to applicable CSR item as provided in Contract Agreement and shall constitute full compensation for procurements transportations, performance in all respect and completion of work as specified including site clearance, as approved by the Engineer-in-Charge except the cost of materials to be provided by Department at designated location as defined in the Contract Agreement.

28.3.3 QUANTIFICATION

The unit of measurement shall be measured as mentioned below in accordance with corresponding CSR items.

1. For surface area items, the quantity of work shall be measured by surface area. The unit of measurement shall be Square meter or Square foot. Following item of CSR are measured according to this criteria;
Item No.: 28-1 to 28-14, 28-17, 28-19 to 28-29, 28-41 to 28-43, 28-48 to 28-52 and 28-64
2. For linear items, the quantity of work shall be measured linearly along centre line of structure. The unit of measurement shall be running meter or running foot. Following items of CSR are measured according to this criteria;
Item No.: 28-40, 28-40A, 28-54, 28-55 , 28-56 and 28-59 to 28-63

3. For linear items, the quantity of work shall be measured linearly along centre line of structure. The unit of measurement shall be running Centimeter or running Inch. Following items of CSR are measured according to this criteria;
Item No.: 28-38 and 28-39
4. The following items shall be measured as %age Increase;
Item No.:28-65 and 28-67
5. The following items shall be measured as Weight unit i.e. Kilogram or Pound;
Item No.:28-15, 28-16,28-18,28-31 to 28-37 and 28-44 to 28-46