PAKAGE 8B

INTERIOR TENDER FOR ADMINISTRATION BUILDING

FOR

NALANDA UNIVERSITY-PHASE 1, AT RAJGIR, BIHAR.

TECHNICAL SPECIFICATIONS

(INTERIOR WORKS)

ARCHITECT AND PLANNERS

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Item No. 1.

Wooden Slats Wall Panelling

Supply & installation of wall panelling made of pinewood E1 grade fiberboard, melamine/veneer laminated finish, groove perforated L32-2 - (2mm grooves @ 32mm centers), backlined with Sound texblack acoustical fleece, tongue-groove edge for a seamless look, 5-test fire retardant grade/ Non FR, Acoustics NRC 0.65- 0.75 (For E300* Mounting), size 128x2440x16mm, volume density of base board 800 - 830 Kg/m3, 10-10.5Kgs/m2 (L32), installed by using Strut framework system. Slats to be backed with Synthethik PF 10x25 adhered to wall with stick .The Panneling shall be finished as per the drawings and to the satisfaction of the Engineer in Charge. All the support system shall be as per the Approved make list and the suspension system shall be got approved before starting installation at site.

Materials:

The material shall be High density fiber board slats having the total width of 128 mm with thickness of 16 mm. Each individual smaller division should be at least 28 mm with perforation in the gap between. The Wooden Slats perforated wall paneling shall have width of 128mm, thickness of 15mm and length 2440 mm or as required by the Architect/ engineer In Charge, made of a high density fiber board with minimum 830 Kg/M3 density substrate with a wood veneer as per the approved species from available option and a melamine balancing layer on the reverse side. The boards shall have a special perforation pattern where the visible surface has a "Helmholtz" fluted perforation of 2mm width and 14mm of visible panel each. The panels shall provide a fire reaction of Class of 1 as per Part 7 of BS 476. The edges of the panels shall be "tongue-and-grooved" to receive special clips for installation.

Fixing

All the support system shall be as per the Approved make list and the suspension system shall be got approved before starting installation at site. The panels shall be mounted on special aluminum splines using clips provided by Manufacturer and approved by the Architect/ Engineer-in-Charge. All the support system shall be as per the Approved make list and the suspension system shall be got approved before starting installation at site. No supporting system shall be visible outside as the system is held back with a tongue and groove method.

Measurements

Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01 sqm. The superficial area of the finished work shall be measured in square meters.

No deduction in measurements shall be made for openings of areas up to 40 square decimeter. Nothing extra shall be payable either for any extra material or labour involved in forming such openings.

Rate

Rate shall be for per square meter of panel including material, labor, tools and tackles required to complete the work as per the drawing and the satisfaction of Engineer in Charge.

Item No. 2.

Providing and fixing mineral fibre false ceiling tiles at all heights of size 595X595mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance > 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 &7)in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised @80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod upto 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be prepainted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the engineer-in-charge.

With 16 mm thick beveled tegular mineral fibre false ceiling tile (NRC 0.55 to 0.6)

Relevant specifications shall be followed as per CPWD specifications for DSR item number 26.27.1. In addition, the following specifications shall also be followed:

Material:

The material shall be mineral fibre false ceiling tiles at all heights of size 595X595mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance > 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 &7). The tiles shall have Beveled Tegular edges.

Fixing

The False ceiling shall be fixed in in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised @80gsm) 50 mm long 8mm outer diameter M-6

dash fasteners, 6 mm diameter fully threaded hanger rod upto 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be prepainted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the engineer-in-charge.

Measurement and Rate

Measurement shall be for per square meter of false ceiling installed. Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01 sqm. The superficial area of the finished work shall be measured in square meters.

No deduction in measurements shall be made for openings of areas up to 40 square decimeter. Nothing extra shall be payable either for any extra material or labour involved in forming such openings.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above. Rate shall be for per square meter of false ceiling installed.

Item No. 3.

Providing and fixing tiled false ceiling of specified materials of size 595x595 mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/ sqm, both side inclusive) consisting of main "T" runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross "T" of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main "T" at 600 mm center to center to form a grid of 1200x600 mm and secondary cross "T" of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, required cutting/making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main "T" runners to be suspended from ceiling using GI slotted cleats of size 27 x 37 x 25 x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm GI adjustable rods with galvanised butterfly level clips of size 85 x 30 x 0.8 mm spaced at 1200 mm center to center along main T, bottom exposed width of 24 mm of all T-sections shall be pre-painted with polyester paint, all complete for all heights as per specifications, drawings and as directed by Engineer-in-charge.

GI Metal Ceiling Lay in perforated Tegular edge global white color tiles of size 595x595 mm and 0.5 mm thick with 8 mm drop; made of GI sheet having

galvanizing of 100 gms/sqm (both sides inclusive) and 20% perforation area with 1.8 mm dia holes and having NRC (Noise Reduction Coefficient) of 0.5, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending and perforation, and backed with a black Glass fiber acoustical fleece.

Relevant specifications shall be followed as per CPWD specifications for DSR item number 12.52.2. In addition, the following specifications shall also be followed:

1 Materials

As per selection by architect or client

2 Installation

The G.I. frame and board partitions shall be fixed as per nomenclature of the item and directions of Engineer-in-Charge.

3 Jointing & Finishing

Joints of the boards are finished with specially formulated Jointing compound and fibre tape to provide seamless finish. Board surface can be decorated with any type of paint, wall paper, wood veneer & hard laminates. Services should be incorporated before commencement of board fixing.

4 Fitting and Fixtures

It is easy and simple to attach different fittings to wall panelling boards. Inclined nails can be fixed to the boards itself for light materials. For heavier materials the fastening should be centered on internal stud work or steel or wood frame behind the boards, fixed before boarding. Services should be incorporated before commencement of board fixing.

5 Tolerance

Tolerance in dimensions shall be + 5 mm.

6 Measurements

6.1 Length and breadth of superficial area of the finished work shall be measured correct to a cm. Area shall be calculated in square meter correct to two places of decimal. No deduction will be made of openings of areas upto 0.40 sqm nor shall extra payment be made either for any extra material or labour involved in forming such openings.

6.2 For openings exceeding 0.40 sqm. in area, deduction in measurements shall be made but extra will be payable for any extra material or labour involved in making such openings.

7 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including all scaffolding, staging etc.

Item No. 4.

Providing and Fixing 15 mm thick densified tegular edged eco-friendly light weight calcium silicate false ceiling tiles of approved texture of size 595 x 595

mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanised steel sections (galvanising @ 120 grams per sqm including both side) consisting of main 'T' runner suitably spaced at joints to get required length and of size 24x38 mm made from 0.33 mm thick (minimum) sheet, spaced 1200 mm centre to centre, and cross "T" of size 24x28 mm made out of 0.33 mm (Minimum) sheet, 1200 mm long spaced between main'T' at 600 mm centre to centre to form a grid of 1200x600 mm and secondary cross 'T' of length 600 mm and size 24 x28 mm made of 0.33 mm thick (Minimum) sheet to be inter locked at middle of the 1200x 600 mm panel to from grid of size 600x600 mm, resting on periphery walls /partitions on a Perimeter wall angle pre-coated steel of size(24x24X3000 mm made of 0.40 mm thick (minimum)

sheet with the help of rawl plugs at 450 mm centre to centre with 25 mm long dry wall screws @ 230 mm interval and laying 15 mm thick densified edges calcium silicate ceiling tiles of approved texture in the grid, including, cutting/ making opening "for services like diffusers, grills, light fittings, fixtures, smoke detectors etc., wherever required. Main 'T' runners to be suspended from ceiling using G.I. slotted cleats of size 25x35x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm G.I. adjustable rods with galvanised steel level clips of size 85 x 30 x 0.8 mm, spaced at 1200 mm centre to centre along main 'T', bottom exposed with 24 mm of all T sections shall be pre-painted with polyester baked paint, for all heights, as per specifications, drawings and as directed by Engineer-in-Charge.

Note :- Only calcium silicate false ceiling area will be measured from wall to wall. No deduction shall be made for exposed frames/ opening (cut outs) having area less than 0.30 sqm.The calcium silicate ceiling tile shall have NRC value of 0.50 (Minimum), light reflection > 85%, non- combustible as per B.S. 476 part IV, 100% humidity resistance and also having thermal conductivity <0.043 w/mK.

Relevant specifications shall be followed as per CPWD specifications for DSR item number 12.53. In addition, the following specifications shall also be followed:

1. Scope

False celling 15 mm thick densified tegular edged eco-friendly light weight calcium silicate false ceiling tiles of approved texture of size 595 x 595 mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanised steel sections (galvanising @ 120 grams per sqm including both side) consisting of main 'T' runner suitably spaced at joints to get required length and of size 24x38 mm made from 0.33 mm thick (minimum) sheet, spaced 1200 mm centre to centre, and cross "T" of size 24x28 mm made out of 0.33 mm (Minimum) sheet, 1200 mm long spaced between main'T' at 600 mm centre to centre to form a grid of 1200x600 mm and secondary cross 'T' of length 600 mm and size 24 x28 mm made of 0.33 mm thick (Minimum) sheet to be inter locked at middle of the 1200x 600 mm panel to from grid of size 600x600 mm, resting on periphery walls /partitions on a Perimeter wall angle pre-coated steel of size(24x24X3000 mm made of 0.40 mm thick (minimum)

sheet with the help of rawl plugs at 450 mm centre to centre with 25 mm long dry wall screws @ 230 mm interval and laying 15 mm thick densified edges calcium silicate ceiling tiles of approved texture in the grid, including, cutting/ making opening "for services like diffusers, grills, light fittings, fixtures, smoke detectors etc., wherever

required. Main 'T' runners to be suspended from ceiling using G.I. slotted cleats of size 25x35x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm G.I. adjustable rods with galvanised steel level clips of size 85 x 30 x 0.8 mm, spaced at 1200 mm centre to centre along main 'T', bottom exposed with 24 mm of all T sections shall be pre-painted with polyester baked paint, for all heights, as per specifications, drawings and as directed by Engineer-in-Charge.

Note :- Only calcium silicate false ceiling area will be measured from wall to wall. No deduction shall be made for exposed frames/ opening (cut outs) having area less than 0.30 sqm. The calcium silicate ceiling tile shall have NRC value of 0.50 (Minimum), light reflection > 85%, non- combustible as per B.S. 476 part IV, 100% humidity resistance and also having thermal conductivity <0.043 w/mK.

2. Measurements

Length and breadth of the false celling shall be measured correct to a cm and the surface area worked out in square metre of the finished work.

3. Rate

The rate shall include the cost of all materials and labour required in providing false celling.

Item No. 5.

Providing & fixing false ceiling at all height including providing & fixing of framework made of special section, power pressed from M.S. sheets and galvanised with zinc coating of 120 gms/ sqm (both side inclusive) as per IS : 277 and consisting of angle cleat of size 25mm wide x 1.6mm thick with flanges of 27mm and 37mm, at 1200mm c/c, one flange fixed to the ceiling with dash fastener 12.5mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25 x10 x0.50mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I chanels 45 x15 x 0.90mm running at the spacing of 1200 mm c/c, to which the ceiling section 0.5mm thick

bottom wedge of 80mm with tapered flanges of 26 mm each having lips of 10.5mm, at 450mm c/c, shall be fixed in a direction perpendicular to G.I intermediate channel with connecting clip made out of 2.64mm dia x 230mm long G.I wire at every junction, including fixing perimeter channels 0.50mm thick 27mm high having flanges of 20mm and 30mm long, the perimeter of ceiling fixed to wall/ partitions with the help of Rawl plugs at 450mm centre, with 25mm long dry wall screws @ 230mm interval, including fixing of Calcium Silicate Board to ceiling section and perimeter channels with the help of dry wall screws of size 3.5 x25mm at 230mm c/c, including jointing & finishing to a flush finish of tapered and square edges of the board with recommended jointing compounds, jointing tapes, finishing with jointing compounds in three layers covering up to 150mm on both sides of joints and two coats of primer suitable for boards, all as per manufacture's specification and also including the cost of making opening for light fittings, grills, diffusers, cut outs made with frame of perimeter channels suitably fixed, all complete as per drawings,

specification and direction of the Engineer in charge but excluding the cost of painting with:

(a) 12.5 mm thick tapered edge gypsum moisture resistant board

Relevant specifications shall be followed as per CPWD specifications for DSR item number 12.14.3. In addition, the following specifications shall also be followed:

Shop drawings to be submitted and approval from Design Consultant to be taken by Contractor before execution.

1 Material

(i) Gypsum Board conforming to IS 2095 (Pt.-I)

These boards shall be stored flat in a covered clean and dry place. Different sizes and types of each of these boards shall be stacked separately.

The board shall be stacked on a flat platform on which a wooden frame shall be constructed with 50 mm x 25 mm battens in such a way that it will give support to all four edges and corners of the boards with intermediate battens placed at suitable intervals to avoid warping.

The boards shall be stacked in a solid block in a clear vertical alignment. The top sheet of each stack shall be suitably weighed down to prevent warping wherever necessary.

The boards shall be unloaded and stacked with utmost care avoiding damage to the corners and surface. In case of decorative plywood and decorative boards, the surfaces of which are likely to get damaged by dragging one sheet over another it is advisable that these are lifted as far as possible in pairs facing each other.

2 Frame

Frame of the section specified in the description of the relevant item or as directed by the Engineer-in-Charge shall be provided. The width of the scantlings provided shall be sufficient to provide a minimum nailing surface of 50 mm. The longitudinal and header scantlings shall be so arranged that (a) the boards can be fixed to form the panel arrangements required as per drawings or as directed by the Engineer-in-Charge (b) the longitudinal scantling to which the boards are mainly fixed are spaced at 30 to 45 cm centers, the actual spacing selected depending on the width of the cut board in the panel arrangement, (c) all edges of the cut board units are supported either on the longitudinal scantlings or on the header scantlings or on both.

The frame shall be given two coats of approved preservative paint (to be paid for separately) before the board is nailed on. M.S. angles or other sections shall be used for suspending the frame and will be paid for separately.

Where the joints in the board are to be covered with beadings the frames should allow 3 to 6 mm for space between boards.

The frame and painting thereof shall be paid for separately unless specifically included in the description of the ceiling item.

The bottom surface of the frame shall be checked and corrected to true planes and slopes.
Framing to be used should be from Saint Gobain/Lafarge or Jindal

3 Nails or Screws
The sheets shall be fixed to the frame scantling with G.I. headless nails 2.24 mm dia or screws as specified when the joints are to be left exposed. Where the joints will be covered with beadings, the sheets are to be fixed to the frames scantlings with G.I. felt headed (clout) nails 2.5 mm dia or screws as specified. The length of the nails or screws shall generally be equal to thickness of sheet plus 25 mm so that their grip on the framing members will not be less than 25 mm.

4 Fixing
The boards shall be laid with lengths parallel to all joints centered over the framing members. Where joints are to be covered, the boards may be spaced 3 to 6 mm apart as described in the respective manufacturers' specifications. Where joints are to be left exposed the sheets shall be butt laid with their edges abutting in moderate contact, but without having to force them into place. The boards shall be supported and held tight to the frame with timber pieces the later being moved outwards as the nailing proceeds. The boards are first nailed to the intermediate framing member proceeding from the center of the board outwards, the edges being nailed or screwed last.

Where the joints are to be left exposed, the outer rows of nails or screws are placed at 10 cm centers and about 12 mm from the edge of the sheet. In the rows in the middle of the sheets, the nails or screws are placed 20 cm apart. The nails or screws should be counter sunk in the underside of board with a suitable punch. Care shall be taken in driving the nails or screws so that the sheets are not marked by hammer blows.

Where the joints are to be covered with beadings, felt headed (clout) nails shall be used instead of nails without head. The spacing of the nails in the interior rows in boards shall be the same as in the preceding para. In the outer rows at edges to be covered by beadings, the nails will be spaced at 20 cm centers in each row with the nails staggered. The beadings will then be fixed over the sheets with screws at 20 cm centers in each row with the screws in the two rows staggered and passing through beading, sheet and framing so that ultimately the spacing of the fixing (nails and screws taken together) in each row will be at 10 cm centers so far as the sheets and frames are concerned.

5 Finishing
The exposed side of the board shall be truly level and plane without any local bulges or sags. The joints shall be truly parallel and/or perpendicular to the walls. The width of joints shall be uniform. Care shall be taken to see that the uniformity of colour of the sheets is not spoilt during the fixing operations.

Where the joints are required to be covered, beadings of size, pattern and material as approved by Engineer-in-charge be fixed with screws.

The ceiling shall be treated with painting if so required but such surface treatment will be paid for separately, unless specifically included in the description of the ceiling item.

6. Measurements

Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01 sqm. The superficial area of the finished work ceiling shall be measured in square meters.

No deduction in measurements shall be made for openings of areas up to 40 square decimeter. Nothing extra shall be payable either for any extra material or labour involved in forming such openings. For openings exceeding 0.40 sqm in area, deductions in measurements for the full opening will be made and in such case any labour involved in making these openings shall be paid for separately in running meters.

Wooden ceiling of boardings fixed to curve surfaces in narrow widths shall be measured and paid for separately and shall include making the joints to proper splay.

Circular cutting and waste shall be measured and paid for separately in running meters

7 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 6.

Providing and supplying Steel Writing Board for writing purpose using marker pen. Medium Density Fibre (MDF) Board to be covered with electrogalvanized steel sheet conforming to IS: 277-2003(Reaffirmed 2007),Amdts.1&2, of 0.3 to 0.4 mm thickness on the front and with sheet of 0.25 mm to 0.03 mm thickness on the back side of MDF Board. Writing top surface of White Boards to receive e3 vitreous Enamelled coating of 0.11 mm min thickness on top. Galvanising on All other surfaces of Sheet steel to be of 0.03 mm min. thickness. The top surface of Writing board shall be free from waviness and shall show no scratches when HB to 3H pencils are used for writing. The surface shall show excellent erasability when the specified writing medium is used. It should be possible to fully erase the marking of permanent marker pens using methanol, without adversly affecting the e3 vitreous coating in any manner.

The core material shall be 9 mm thick MDF board having Bulk Density of 750 kg per cubic metre and Grade-1 as per IS: 12406-2003 Edition 2.2. Both the top and the backing sheet shall be properly fixed with the MDF board using suitable adhesive with mechanical press to avoid any moisture absorption.

The Writing board will be fixed to walls with the help of suitable size Stainless steel screws and wooden/PVC rowl plugs with teak wood framing of 65 mm x 50 mm size on the periphery and 30 mm x 50 mm wide stiffeners on the backside.

1. General

The core material shall be 9 mm thick MDF board having Bulk Density of 750 kg per cubic meter and Grade-1 as per IS: 12406-2003 Edition 2.2. Both the top and the backing sheet shall be properly fixed with the MDF board using suitable adhesive with mechanical press to avoid any moisture absorption. The electrogalvanized steel sheet conforming to IS: 277-2003(Reaffirmed 2007),Amdts.1&2, of 0.3 to 0.4 mm thickness on the front and with sheet of 0.25 mm to 0.03 mm thickness on the back side of MDF Board shall be provided.

The Writing board will be fixed to walls with the help of suitable size Stainless steel screws and wooden/PVC rawl plugs with teak wood framing of 65 mm x 50 mm size on the periphery and 30 mm x 50 mm wide stiffeners on the backside.

2. Measurement

Surface area of blinds should be measured in square meters correct to two places of decimal. Nothing extra shall be paid. Cost shall include motors for operating the blinds.

3. Rate

The rate shall include the cost of all materials and labor involved in all the operations described above.

Shop drawings to be submitted and approval from Design Consultant to be taken by Contractor before execution.

Item No. 7.

Supply and Installation of Tack board acoustical panels, hardened square edge, FR grade NRC fabric (colour choice), wrapped on encapsulated glass fibre core panels made from size 600x1200x25mm, volume density 100-120Kgs/m3, weight 3.0kg/m2 installed by using Strut Impale Clip. Panels should have Acoustics – NRC 0.9 (For D50 Mounting), Fire Resistance Class 1(UK) as per manufacturer specifications. The Panelling shall be finished as per the drawings and to the satisfaction of the Engineer in Charge. All the support system shall be as per the Approved make list shall be got approved before starting installation at site.

1.0 General

Tack board material shall be as per the item description.

2. Fixing

Tack board to be fixed to wall, /partition with suitable size SS Screws or 3M or equivalent two way adhesive tape in such a way that screws are not visible from the front side of Tack board

3. Measurement

Surface/usable area of boards should be measured in square meters correct to two places of decimal. Nothing extra shall be paid.

4. Rate

The rate shall include the cost of all materials and labor involved in all the operations described above.

Shop drawings to be submitted and approval from Design Consultant to be taken by Contractor before execution.

Item No. 8.

Tack Board Panel –

Supplying and fixing Tack board in line and level as per architectural drawing and as directed by engineer in charge. Tack board made of Fabric: Fine Jute Fabric of Color as approved during sampling on the front side. Thickness: of Jute Fabric 1±0.1 mm. The top surface should be smooth, finish, without any wrinkles, fungus proof, terminate proof & eye catching. The color should not fade even if the Tack board is fixed in direct sunlight position. Soft Board: Thickness: 12.00 mm. thick Density of Soft board should be 2.5 kg/m2. Linear expansion/ contraction in range 33% to 90% RH @ 200 C: % max. 0.5. The core material is soft board. The board should be soft, resilient, light colored sheet material of approved make. Soft board with 12 mm thick beading on each side should be fixed to backside plywood with adhesive. Back Side plywood: The Backside of the Tack board to be supported with 12.00 mm thick marine plywood confirming to IS 710 of approved make. The plywood will be fixed to walls with the help of suitable size Stainless steel screws and wooden/PVC rowl plugs with teak wood support for levelling.

Tack board with plywood to be fixed to wall/partition with suitable size SS Screws or equivalent Two way adhesive tape or with adhesive in such a way that screws are not visible from the front side of Tack board as per drawing and as directed by engineer in charge.

1. General

Tack board made of Fabric: Fine Jute Fabric of Color as approved during sampling on the front side. Thickness: of Jute Fabric 1±0.1 mm. The top surface should be smooth, finish, without any wrinkles, fungus proof, terminate proof & eye catching. The color should not fade even if the Tack board is fixed in direct sunlight position. Soft Board: Thickness: 12.00 mm. thick Density of Soft board should be 2.5 kg/m2. Linear expansion/ contraction in range 33% to 90% RH @ 200 C: % max. 0.5. The core material is soft board. The board should be soft, resilient, light colored sheet material of approved make. Soft board with 12 mm thick beading on each side should be fixed to backside plywood with adhesive. Back Side plywood: The Backside of the Tack board to be supported with 12.00 mm thick marine plywood confirming to IS 710 of approved make

2. Fixing

Tack board to be fixed to wall, /partition with suitable size SS Screws or 3M or equivalent two way adhesive tape in such a way that screws are not visible from the front side of Tack board

3. Measurement

Surface/usable area of boards should be measured in square meters correct to two places of decimal. Nothing extra shall be paid.

4. Rate

The rate shall include the cost of all materials and labor involved in all the operations described above.

Shop drawings to be submitted and approval from Design Consultant to be taken by Contractor before execution.

Item No. 9.

Providing & Fixing premium quality Manually operated Roller blinds with Solar protection fabric of high tenacity Polyester Yarn with PVC Coating & Grey Backing, & offer 100% blackout / heat radiance. Fabric shall have GREENGUARD (Gold) Indoor Air Quality & Children & School Certified.

Weight: 300 to 350 g/m2 (+/-5%), Thickness: 0.47 to 0.55 mm (+/-5%), Fabric Openness Factor: 0%, Tensile Strength (Warp/Weft): 160/170 daN / 5cm, Tearing Strength (Warp/Weft): 11/13 daN, Solar Transmission- 0%, Solar Reflectance 25-69%, Solar Absorption 28-31%, Fungistatic Treatment: Degree 0, Excellent (EN ISO 846-A).

Roller Tube shall be of extruded Aluminium alloy 38mm O.D (or as per system dimension) with a minimum wall thickness of 1.0mm duly anodised for long life.Clutch shall be wrap spring design with high strength fibreglass reinforced polyster assembly and high carbon steel springs to transmit motion from driving to driven members of clutch mechanism. Clutch shall operate by directionally with the use of an endless beaded chain. Clutch mechanism shall be crash proof, prevent slippage and shall raise and lower smoothly to any desired height. Clutch shall never need adjustment. Idler shall be of high strength fibreglass reinforced polyster, consisting of an outside sleeve and centre shaft. Sleeve shall provide bearing surface for roller tube and rotate freely on centre shaft, providing smooth, quiet and long wearing operation. Brackets shall be of tomised steel powder coated to give superior finish. Bracket shall accommodate overhead, side or face mounting with clutch assembly on either end of the roller.Bottom of the blind shall be provided with aluminium tube powder coated in a colour matching to the fabric. The fabric shall be enclosed in the suitably created pocket along with the tube. The tube shall be closed from sides with end caps to give a neat look.

1. Scope:

The item shall be executed as per the item description. All the materials used shall be as per the approved make list. Each Curtain shall be provided with individual control rope or shall be motorised as per final design.

2. Measurement

Surface area of blinds should be measured in square meters correct to two places of decimal. Nothing extra shall be paid. Cost shall include all the accessories required to operate the blinds.

3. Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

Shop drawings to be submitted and approval from Design Consultant to be taken by Contractor before execution.

Item No. 10.

Providing & Fixing premium quality Manually operated Roller blinds with Pre-stressed Micro-Aerated Solar protection fabric of high tenacity Polyester Yarn with PVC Coating & Fungistatic Treatment and should block the light flux & offer elimination of glare and sunlight.

Fabric for Blinds: Composition: 40% Polyester / 60% PVC, Weight:400 g/m2 (+/-5%), Thickness:0.45 mm (+/-5%), Fabric Openness Factor: 3% , Tensile Strength (Warp/Weft): 220/220 daN / 5cm, Tearing Strength (Warp/Weft): 30/25 daN, Fire Retardancy:M2 (NFP92-507)- Roller Tube shall be of extruded Aluminium alloy 38mm O.D (or as per system dimension) with a minimum wall thickness of 1.0mm duly anodised for long life. Clutch shall be wrap spring design with high strength fibreglass reinforced polyester assembly and high carbon steel springs to transmit motion from driving to driven members of clutch mechanism. Clutch shall operate by directionally with the use of an endless beaded chain. Clutch mechanism shall be crash proof, prevent slippage and shall raise and lower smoothly to any desired height. Clutch shall never need adjustment. Idler shall be of high strength fibreglass reinforced polyester, consisting of an outside sleeve and centre shaft. Sleeve shall provide bearing surface for roller tube and rotate freely on centre shaft, providing smooth, quiet and long wearing operation. Brackets shall be of tomised steel powder coated to give superior finish. Bracket shall accommodate overhead, side or face mounting with clutch assembly on either end of the roller. Bottom of the blind shall be provided with aluminium tube powder coated in a colour matching to the fabric. The fabric shall be enclosed in the suitably created pocket along with the tube. The tube shall be closed from sides with end caps to give a neat look.

1. Scope:

The item shall be executed as per the item description. All the materials used shall be as per the approved make list. Each Curtain shall be provided with individual control rope.

2. Measurement

Surface area of blinds should be measured in square meters correct to two places of decimal. Nothing extra shall be paid. Cost shall include all the accessories required to operate the blinds.

3. Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

Shop drawings to be submitted and approval from Design Consultant to be taken by Contractor before execution.

Item No. 11.

Providing and fixing Motor for Motor operated blinds with remote over manually operated blinds of above items.

Motor for the motorized Operation of the blinds to confirm the following requirements: Rated Torque 6NM, RPM 28, Protection IP 44 and above, Rated Voltage 230 mm with suitable Remote to operate up to 4 nos. Motorised blind in a single room

The clutch is of wrap spring design. High carbon steel springs are provided to transmit motion from driving to driven members of clutch mechanism. Clutch is operated directionally by the use of Remote Transmission Service type Motor with Remote control. Clutch never needs any adjustment. The Idler is of high strength reinforced plastic, consisting of a centre shaft. The idler is mounted on the heavy quality bracket (to Take the load of Blinds, Ideler and the Motor Mechanism) by using a plastic lock. The metal sleeve inside the plastic lock provides bearing surface for the centre shaft, which rotates freely, providing smooth, quiet and long wearing operation in a roller tube of 32mm (OD) (depending upon the size) aluminium extruded grooved tube made of alloy T6063 weighing 0.27kg/m. Control unit and Idler are fixed to the either ends of the tube comprising Roller Head Rail which is made of aluminium extruded rail Power coated in white. Control unit and Idler are mounted on the Head rail with powder coated M.S. brackets The fabric of the blind is fitted to the tube with heavy duty adhesive tape. Bottom rail is an aluminium extruded rail with a groove for fixing the fabric and powder coated in white. It is fixed to the bottom of the fabric and the purpose of it is, to keep the fabric in tension and straight. The fabric is fitted to the tube using plastic insert. The end caps of the tube are ABS. The size of rail shall be 21mm (OD) made of Alloy HE 9 WP weighing 0.17kg/m. The fabric shall be attached to the roller tube with high quality self-adhesive tape. . Operational action shall be smooth and upto the satisfaction and as per direction of engineer in charge .

1. Scope:

The item shall be executed as per the item description. All the materials used shall be as per the approved make list. Each Curtain shall be provided with individual control rope.

2. Measurement

Motor calculating per nos. Nothing extra shall be paid. Cost shall include all the accessories required to operate the blinds.

3. Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

Shop drawings to be submitted and approval from Design Consultant to be taken by Contractor before execution.

Item No. 12.

Steel work in built up tubular (round, square or rectangular hollow tubes etc.) trusses etc., including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer, including welding and bolted with special shaped washers etc. complete.

(a)Hot finished welded type tubes

Relevant specifications shall be followed as per CPWD DSR item number 10.16.1.

1.1 Structural Steel Tube

These shall be of:

1. Hot finished welded (HFW) type, or

2. Hot finished seamless (HFS) type, or

3. Electric resistance or induction butt welded (ERW), having carbon content less than 0.03 percent, yield stress of 21.5 kg/mm2 (YST 210) type.

Conforming to the requirement of IS 1161. The steel tubes when analysed in accordance with the method specified in IS 228 shall show not more than 0.06 percent sulphur, and not more than 0.06 per cent phosphorous.

Tubes shall be designated by their nominal bore. These shall be light, medium or heavy as specified depending upon the wall thickness. The standard size and weights of tubes are listed in Appendix C. Hollow sections shall be as per IS 4923.

Tubes shall be clean finished and reasonably free from scale. They shall be free from cracks, surface flaws, laminations and other defects. The ends shall be cut clean and square with axis of tube, unless otherwise specified.

1.2 Minimum Thickness of Metals

Wall thickness of tubes used for construction exposed to weather shall be not less than 4 mm and for construction not exposed to weather it shall be not less than 3.2 mm where structures are not readily accessible for maintenance, the minimum thickness shall be 5 mm.

1.3 Fabrication

1.3.1 The component parts of the structure shall be assembled in such a manner that they are neither twisted nor otherwise damaged and be so prepared that the specified cambers, if any, are, maintained. The tubular steel work shall be painted with one coat of approved steel primer after fabrication. All fabrication and welding is to be done in an approved workshop. The joint details shall be generally as per S.P-38 of B.I.S publication.

1.3.2 Straightening : All material before being assembled shall be straightened, if necessary, unless required to be of curvilinear form and shall be free from twist.

1.3.3 Bolting : Washers shall be specially shaped where necessary, or other means, used to give the nuts and the heads of bolts a satisfactory bearing.

In all cases, where the full area of the bolts is to be developed, the threaded portion of the bolt shall not be within the thickness of the parts bolted together and washers of appropriate thickness shall be provided to allow the nuts to be completely tightened.

1.3.4 Welding : Where welding is adopted, it shall be as per IS 816.

1.3.5 Caps and Bases for Columns : The ends of all the tubes, for columns transmitting loads through the ends, should be true and square to the axis of the tubes and should 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 should be true and square to the axis of the column.

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

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

1.4 Hoisting and Erection

Tubular trusses shall be hoisted and erected in position carefully, without damage to themselves, other structure, equipment and injury to workman.

The method of hoisting and erection proposed to be adopted shall be got approved from the Engineer-in-charge. The contractor shall however be fully responsible, for the work being carried out in a safe and proper manner without unduly stressing the various members. Proper equipment such as derricks, lifting tackles, winches, ropes etc. shall be used.

1.5 Measurements

The work as fixed in place shall be measured in running metres correct to a centimetre on their weights calculated on the basis of standard tables correct to the nearest kilogram unless otherwise specified.

Weight of cleats, brackets, packing pieces bolts nuts, washers distance pieces separators diapharam gussests (taking overall square dimensions) fish plates, etc. shall be added to the weight of respective items unless otherwise specified. No deduction shall be made for skew cuts.

1.6 Rate

The rate shall include the cost of labour and materials involved in all the operations described above including application of one coat of approved steel primer, i.e. red oxide zinc chrome primer conforming to IS 2074.

Item No. 13.

Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required.

In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works

Relevant specifications shall be followed as per CPWD DSR item number 10.25.2 and item number 16 above.

Item No. 14.

Providing and fixing aluminum work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminum sections shall be smooth, rust free, straight, mitered and jointed mechanically wherever required including cleat angle, Aluminum snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.(glazing and paneling paid separately) . Powder coated aluminium (minimum thickness of powder coating 50 micron)

(a) For fixed portion

Relevant specifications shall be followed as per CPWD DSR ITEM NUMBER 21.1.1.2. The following specifications shall also be followed.

1. Scope:

Aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitered and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / panelling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.(glazing and paneling paid separately) . Powder coated aluminium (minimum thickness of powder coating 50 micron)

2. Measurement

Installation of material measure in Kg. as per drawing nothing extra shall be paid. Cost shall include all the accessories required.

3. Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 15.

Providing and fixing aluminum work for doors, windows, Shutters, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminum sections shall be smooth, rust free, straight, mitered and jointed mechanically wherever required including

cleat angle, Aluminum snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge.(glazing and paneling paid separately) .Powder coated aluminium (minimum thickness of powder coating 50 micron) (a) For shutters of doors, windows, Furnitures & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber / neoprene gasket required.

Relevant specifications shall be followed as per CPWD DSR ITEM NUMBER 21.1.2.2. and item number 16 above.

Item No. 16.

Providing and fixing of wood work in frames of doors, windows, clerestory windows, partitions and other frames, wrought framed and fixed in position with hold fast lugs or with dash fasteners of required dia & length

(a) : Second class teak wood.

Relevant specifications shall be followed as per CPWD DSR ITEM NUMBER 9.1.1. The following specifications shall also be followed.

1. General

Timber for door, window and ventilators frames shall be as specified finished dimensions in drawing and as directed by engineer in charge. Timber shall be sawn in the direction of the grains. All members of a frame shall be of the same species of timber and shall be straight without any warp or bow. Frames shall have smooth, well-planed (wrought) surfaces except the surfaces touching the walls, lintels, sill etc., which may be left clean sawn. Rebates rounding or moulding shall be done before the members are jointed into frames. The depth of the rebate for housing the shutters shall be 15 mm, and the width of the rebates shall be equal to the thickness of the shutters. A tolerance of ± 2 mm shall be permitted in the specified finished dimensions of timber sections in frames.

2 Joints

The Jamb posts shall be through tenoned in to the mortise of the transoms to the full thickness of the transoms and the thickness of the tenon shall be not less than 2.5 cm. The tenons shall closely fit into the mortise without any

wedging or filling. The contact surface of tenon and mortise before putting together shall be glued with polyvinyl acetate dispersion based adhesive conforming to IS 4835 or adhesive conforming IS 851 and pinned with 10 mm dia hard wood dowels,

or bamboo pins or star shaped metal pins. The joints shall be at right angles when checked from the inside surfaces of the respective members. The joints shall be pressed in position as per drawing and as directed by engineer in charge. Each assembled door frame shall be fitted with a temporary stretcher and a temporary diagonal brace on the rebated faces.

3 Fixing of Frames

The frames shall be got approved by the Engineer-in-Charge before being painted, oiled or otherwise treated and before fixing in position. The surface of the frames abutting masonry or concrete and the portions of the frames embedded in floors shall be given a coating of coal tar. Frames shall be fixed to the abutting masonry or concrete with holdfasts or metallic fasteners as specified. After fixing, the jamb posts of the frames shall be plugged suitably and finished neat. Vertical members of the door frames shall be embedded in the floor for the full thickness of the floor finish and shall be suitably strutted and wedged in order to prevent warping during construction. A minimum of three hold fasts shall be fixed on each side of door and window frames one at centre point and other two at 30 cm from the top and bottom of the frames. In case of window and ventilator frames of less than 1 m in height two hold fasts shall be fixed on each side at quarter point of the frames. Hold fasts and metallic fasteners shall be measured and paid for separately.

4 Measurements

Wood work wrought, framed and fixed shall be measured for finished dimension without any allowance for the wastage or for dimensions beyond specified dimension. However, in case of members having moldings, rounding's or rebates and members of circular or varying sections, finished dimensions shall be taken as the sides of the smallest square or rectangle from which such a section can be cut. Length of each member shall be measured over all to the nearest cm so as to include projection for tenons. Width and thickness shall be measured to the nearest mm and the quantity shall be worked out in unit of upto three places of decimal.

5 Rate

The rate shall include the cost of material and labour involved in all the operations described above except the hold fasts or metallic fasteners which will be paid for separately.

Item No. 17.

Providing wood work in frames of Partitions with Glass/Wooden panels/Plywood Panels/gypsum board. Wooden members are to be fixed to cover the M.S./Aluminium sections of the main partition frames from all sides as per the detailed drawings including fixing the wooden members with necessary screws, nuts, bolts etc. Wooden members of Shutters frame if any and wooden beadings for fixing Glass panels, wooden panels, and plywood panels of the partition with wooden members of the frames will also be paid under this same item. The work to be carried out as per the detailed drawings and as directed by Engineer In charge.

(a) : Second class teak wood

Relevant specifications shall be followed as per CPWD DSR ITEM NUMBER 9.1.1. The following specifications shall also be followed.

1. General

Timber for door, window and ventilators frames shall be as specified finished dimensions in drawing and as directed by engineer in charge. Timber shall be sawn in the direction of the grains. All members of a frame shall be of the same species of timber and shall be straight without any warp or bow. Frames shall have smooth, well-planed (wrought) surfaces except the surfaces touching the walls, lintels, sill etc., which may be left clean sawn. Rebates rounding or moulding shall be done before the members are jointed into frames. The depth of the rebate for housing the shutters shall be 15 mm, and the width of the rebates shall be equal to the thickness of the shutters. A tolerance of ± 2 mm shall be permitted in the specified finished dimensions of timber sections in frames.

2 Joints

The Jamb posts shall be through tenoned in to the mortise of the transoms to the full thickness of the transoms and the thickness of the tenon shall be not less than 2.5 cm. The tenons shall closely fit into the mortise without any

wedging or filling. The contact surface of tenon and mortise before putting together shall be glued with polyvinyl acetate dispersion based adhesive conforming to IS 4835 or adhesive conforming IS 851 and pinned with 10 mm dia hard wood dowels, or bamboo pins or star shaped metal pins. The joints shall be at right angles when checked from the inside surfaces of the respective members. The joints shall be pressed in position as per drawing and as directed by engineer in charge. Each assembled door frame shall be fitted with a temporary stretcher and a temporary diagonal brace on the rebated faces.

3 Fixing of Frames

The frames shall be got approved by the Engineer-in-Charge before being painted, oiled or otherwise treated and before fixing in position. The surface of the frames abutting masonry or concrete and the portions of the frames embedded in floors shall be given a coating of coal tar. Frames shall be fixed to the abutting masonry or concrete with holdfasts or metallic fasteners as specified. After fixing, the jamb posts of the frames shall be plugged suitably and finished neat. Vertical members of the door frames shall be embedded in the floor for the full thickness of the floor finish and shall be suitably strutted and wedged in order to prevent warping during construction. A minimum of three hold fasts shall be fixed on each side of door and window frames one at centre point and other two at 30 cm from the top and bottom of the frames. In case of window and ventilator frames of less than 1 m in height two hold fasts shall be fixed on each side at quarter point of the frames. Hold fasts and metallic fasteners shall be measured and paid for separately.

4 Measurements

Wood work wrought, framed and fixed shall be measured for finished dimension without any allowance for the wastage or for dimensions beyond specified dimension. However, in case of members having moldings, rounding's or rebates and members of circular or varying sections, finished dimensions shall be taken as the sides of the

smallest square or rectangle from which such a section can be cut. Length of each member shall be measured over all to the nearest cm so as to include projection for tenons. Width and thickness shall be measured to the nearest mm and the quantity shall be worked out in unit of upto three places of decimal.

5 Rate

The rate shall include the cost of material and labour involved in all the operations described above except the hold fasts or metallic fasteners which will be paid for separately.

Item No. 18.

Extra rate over second class teak wood for providing and fixing first class Burma teak wood instead of second class teak wood as required as per drawing and as directed by engineer in charge.

1 Measurements

As per mention above items

2 Rate

Only extra rate to be provided of base rate items. The rate shall include the cost of material and labour involved in all the operations described above.

Item No. 19.

Providing and fixing paneled or paneled and glazed shutters for doors, windows and clerestory windows, including ISI marked M.S. pressed butt hinges bright finished of required size with necessary screws, excluding paneling which will be paid for separately, all complete as per direction of Engineer-in-charge.

(a) : Second class teak wood 35 mm thick shutters

Relevant specifications shall be followed as per CPWD DSR ITEM NUMBER 9.5.1.1. The following specifications shall also be followed.

Paneled or glazed shutters for doors, windows, ventilators and cupboards shall be constructed in the form of timber frame work of stiles and rails with panel inserts of timber, plywood, block board, veneered particle board, fibre board wire gauze or float glass. The shutters may be single or multi paneled, as shown in the drawings or as directed by the Engineer-in-Charge. Timber for frame work, material for panel inserts and thickness of shutters shall be as specified. All members of the shutters shall be straight without any warp or bow and shall have smooth well planed face at right angles to each other.

Any warp or bow shall not exceed 1.5 mm for door shutter and 1 mm for window and ventilator shutters The right angle for the shutter shall be checked by measuring the diagonals and the difference between the two diagonals should not be more than 3 mm. Generally paneled glazed or paneled and glazed shutter shall conform to IS 1003 (Pt. 1 & 2).

1 Frame Work

1.1 Timber for stiles and rails shall be of the same species and shall be sawn in the directions of grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the required dimensions. The stiles and rails shall be joined to each other by plain or haunched mortise and tenon joints and the rails shall be inserted 25 mm short of the width of the stiles. The bottom rails shall have double tenon joints and for other rails single tenon joints shall be provided. The lock rails of door shutter shall have its centre line at a height of 800 mm from the bottom of the shutters unless otherwise specified. The thickness of each tenon shall be approximately one-third the finished thickness of the members and the width of each tenon shall not exceed three times its thickness.

1.2 Gluing of Joints : The contact surfaces of tenon and mortise shall be treated, before putting together, with bulk type synthetic resin adhesive conforming to IS 851 suitable for construction in wood or synthetic resin adhesive (Phenolic and aminoplastic) conforming to IS 848 or polyvinyl acetate dispersion based adheshive conforming to IS 4835 and pinned with 10 mm dia hardwood dowels or bamboopins or star shaped metal pins; after the frames are put together and pressed in position by means of press.

1.3 Stiles and bottom rail shall be made out of one piece of timber only. Intermediate rail exceeding 200 mm in width may be of one or more pieces of timber. The width of each piece shall be not less than 75 mm. Where more than one piece of timber is used for rails, they shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels at regular intervals not exceeding 200 mm.

2 Measurements

Framework of Shutters : The overall length and width of the framework of the shutters shall be measured nearest to a cm in fixed position (overlaps not to be measured in case of double leaved shutters) and the area calculated in square metres correct to two places of decimal. No deduction shall be made to form panel openings or louvers. No extra payments shall be made for shape, joints and labour involved in all operations described above.

3 Rate

Rate includes the cost of materials and labour involved in all the operations described above. The framework and panelling of each type or glazed panels shall be paid separately. The rate for framework includes the cost of hinges and necessary screws as specified description. However, extra shall be paid for providing moulded beading where specified. Nothing extra shall be paid for plain beading.

Item No. 20.

Providing and fixing panelling or panelling and glazing in panelled or panelled and glazed shutters for doors, windows and clerestory windows (Area of opening for panel inserts excluding portion inside grooves or rebates to be measured). Panelling for panelled or panelled and glazed shutters 25 mm to 40 mm thick :

(a) Second class teak wood

Relevant specifications shall be followed as per CPWD DSR ITEM NUMBER 9.7.1. The following specifications shall also be followed.

1 Door Shutters

1.1 Finished dimensions and tolerances of components of door shutters has been given in Table 5 below.

TABLE 5

Dimensions and Tolerances of Components of Door Shutters

Sr. No.	Description	Width	Thickness
	mm	mm	mm
			A DOOR SHUTTERS
(a)	Vertical Stile, top and freeze rail	100 + 3	35 + 1 or 40 + 1
(b)	Lock rail	50 + 3	35 + 1 or 40 + 1
(c)	Bottom rail	200 + 3	35 + 1 or 40 + 1
(d)	Muntin	100 + 3	35 + 1 or 40 + 1
(e)	Glazing bar	40 + 3	35 + 1 or 40 + 1

1.2 Size and Types : Size and types of the timber panels and glazed shutters shall generally conform to modular sizes specified in Table 6 below.

TABLE 6

Dimension of Door Shutters

Sl. No.	Designation of Doors	Width mm	Height mm
(1)	(2)	(3)	(4)
(i)	8DS 20	700	1905 (1945)
(ii)	8DS 21	700	2005 (2045)
(iii)	9DS 20	800	1905 (1945)
(iv)	9DS 21	800	2005 (2045)
(v)	10 DS 20	900	1905 (1945)
(vi)	10 DS 21	900	2005 (2045)
(vii)	12 DT 20	11001)	1905 (1945)
(viii)	12 DT 21	11001)	2005 (2045)

Notes :

(1) The designation refers to modular sizes of door openings. First number stands for width and the last for height in modules (M = 100 mm). Alphabet D refers to doors, 'S' to single and 'T' to double leaf shutter.

(2) Standard sizes of door frames are covered in IS 4021 and IS 4351.

(3) The standard widths and heights for panel doors are arrived at as shown in Fig. 6 of IS 1003 (Pt. 1).

In case the modular height is taken from the finished floor level, the height of the door shall be the one given in bracket. In the case of double leave shutters, the rebate in the shutter shall be as given in 6.15 of IS 1003 (Pt. 1).

1.3 Window and Ventilator Shutters : Window and ventilator shutters shall conform to IS 1003 (Part 2).

1.3.1 Dimensional Sizes and Tolerances : The finished dimensions and tolerances of different component shall be as given in Table 7 below .

TABLE 7

Dimensions and Tolerances of Components of Window and Ventilator Shutters

Description of components	Window Shutters		Ventilator Shutters	
	Width mm	Thickness mm	Width mm	Thickness mm
Stiles and rails	100 ± 3	25 ± 1	80 ± 3	20 ± 1
		30 ± 1		22.5 ± 1
				25 ± 1
				27.5 ± 1
				30 ± 1
Munting	100 ± 3	25 ± 1	60 ± 3	-do-
		30 ± 1		
Glazing bars	40 ± 1	25 ± 1	40 ± 1	-do-
		30 ± 1		

1.3.2 Designation : Window and ventilator shutters shall be designated by symbols denoting the width, type and height of window and ventilators in following manner.

(a) Width : It shall be indicated by the number of modules in the width of opening

(b) It shall be indicated by the following letters of alphabet:

W-window, V- Ventilator , S-Single shutter, T-Double shutter

(c) Height : It shall be indicted by the number of modules in the height of opening.

Example : 10 WT 12 would mean a window shutter suitable for a double shutter window of 10 modules width and 12 modules height.

12 V 6 would mean ventilator shutter suitable for a ventilator of 12 modules width and 6 modules height.

1.3.3 Sizes : Sizes of window and ventilator shutters shall generally conform to the modular sizes specified in Tables 8 and 9 respectively. These sizes are derived after allowing the thickness of the frame and a margin of 5 mm all round based on 100 mm module. However sizes of shutters should be as per issued detailed drawings.

1.3.4 Tolerances on the overall dimensions of window and ventilator shutter shall be + 3 mm.

TABLE 8

Dimensions of Timber Window Shutters

Designation	Width mm	Height mm
(1)	(2)	(3)
6 WS 12	500	1100
10WT 12	460	1100
12 WT 12	560	1100
6 WS 13	500	1200
10 WT 13	460	1200
12 WT 13	560	1200

TABLE 9

Dimensions of Timber Ventilator Shutters

Designation	Width mm	Height mm
(1)	(2)	(3)
6 V 6	500	500
10 V 6	900	500
12 V 6	1100	500

2 Mounting and glazing bars where required shall be stubtenoned to the maximum depth which the size of the member would permit or to a depth of 25 mm whichever is less. Unless otherwise specified the finished dimensions of the components of frame work of shutters shall be as given in Table 7. The tolerance on width of styles and rail shall be ± 3 mm. The tolerance in thickness will be ± 1 mm. The thickness of all components of frame work shall be the same as the thickness of the shutter. Tolerance on over all dimensions of the shutter shall be ± 3 mm.

3 Rebating

The shutters shall be single-leaf or double leaved as shown in the drawings or as directed by the Engineer-in-Charge. In case of double leaved shutters, the meeting of the stiles shall be rebated by one- third the thickness of the shutter. The rebating shall be either splayed or square.

4 Panelling

The panel inserts shall be either framed into the grooves or housed in the rebate of stiles and rails. Timber, plywood, and particle board panels as given in sub head and shall be fixed only with grooves. The depth of the groove shall be 12 mm and its width shall accommodate the panel inserts such that the faces are closely fitted to the sides of the groove. Panel inserts shall be framed into the grooves of stiles and rails to the full depth of the groove leaving space of 1.5 mm. Width and depth of the rebate shall be equal to half the thickness of stiles and rails. Glass panels, asbestos panels wire gauze panels and panel inserts of cupboard shutters shall be housed in the rebates of stiles and rails.

4.1 Timber Panels : Timber panels shall be preferably made of timber of large width; the minimum width and thickness of the panel shall be 100 mm, and 15 mm respectively. When made from more than one piece, the pieces shall be jointed with a

continuous tongued and grooved joint glued together and reinforced with headless nails at regular intervals not exceeding 100 mm. Depth and thickness of such joint shall be equal to one-third of thickness of panel. The panels shall be designed such that no single panel exceeds 0.5 square metre in area. The grains of timber panels shall run along the longer dimensions of the panels. All panels shall be of the same species of timber unless otherwise specified.

4.2 Plywood Panels : Plywood boards used for panelling of shutters shall be BWP type or grade as specified. Each panels shall be a single piece of thickness, 9 mm for two or more panel construction and 12 mm thickness for single panel construction unless otherwise specified.

4.3 Veneered Particle Board Panels : Veneered Particle board used for panelling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive as specified. Each panel shall be a single piece of thickness 12 mm unless otherwise specified.

4.4 Fiber Board Panels : Fiber board used for panelling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive Each fiber board panel shall be a single piece unless otherwise specified.

4.5 Wire Gauze Panels: Wire Gauze used for panelling of shutters shall be woven with 0.63 mm dia galvanized mild steel wire to form average aperture size of 1.40 mm as specified. Wire gauze shall be securely housed into the rebates of stiles and rails by giving right angles bend turned back and fixed by means of suitable staples at intervals of 75 mm and over this wooden beading shall be fixed. The space between the rebate and the beading shall be fixed with putty to give a neat finish. Each wire gauze panel shall be a single piece, and the panels shall be so designed that no single panels exceeds 0.5 sqm in area. However, care shall be taken to prevent sagging of wire gauge, of panel by providing and fixing 20 x 20 mm square or equivalent beading to the external face to the required patterns as decided by the Engineer-in-Charge.

4.6 Glass Panels : Glass panelling (Glazing) shall be done as specified. Glazing in the shutters of doors, windows and ventilators of bath, WC and Lavatories shall be provided with frosted glass the weight of which shall be not less than 13 kg/sqm. Frosted glass panes shall be fixed with frosted face on the inside. Glass panels shall be fixed by providing a thin layer of putty conforming to IS 419 applied between glass pane and all along the length of the rebate and also between glass panes and wooden beading.

4.7 Putty can be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding boiled linseed oil to the mixture to form a stiff paste and adding varnish to the paste at the rate of 1 litre of varnish to 18 kg of paste. Fixing of glass panes without beading shall not be permitted. Glazing shall be done after the shutters have been primed and prepared for painting, so that wood may not draw oil out of putty.

4.8 Finish : Panels of shutters shall be flat and well sanded to a smooth and level surface.

5 Beading

Beadings in paneled shutter shall be provided where specified in drawings or directed by the Engineer-in-Charge. Each length of beading shall be single piece. Joints at the

corners shall be mitered and exposed edges shall be rounded. Beading shall be fixed with headless nails at 75 mm intervals. For external shutters, the beading shall be fixed on the outside face.

6 Machine/Factory made Shutters

Machine made shutters, where specified, shall be procured from an approved factory. For machine made shutters, operations like sawing, planning, making tongue and tenons, cutting grooves, mortises and rebates, drilling holes and pressing of joints shall be done by suitable machines. Machines made shutters shall be brought to the site fully assembled but without any priming coat. Panel inserts of sheet glass and wire gauze may, however, be fixed at site.

7 Fixing of Shutters

For side hung shutters of height upto 1.2 m, each leaf shall be hung on two hinges at quarter points and for shutter of height more than 1.2 m, each leaf shall be hung on three hinges one at the centre and the other two at 200 mm from the top and bottom of the shutters. Top hung and bottom hung shutters shall be hung on two hinges fixed at quarter points of top rail or bottom rail. Centre hung shutter shall be suspended on a suitable pivot in the centre of the frame. Size and type of hinges and pivots shall be as specified. Flap of hinges shall be neatly counter sunk into the recesses cut to the exact dimensions of flap. Screws for fixing the hinges shall be screwed in with screw driver and not hammered in. Unless otherwise specified, shutters of height more than 1.2 m shall be hung on butt hinges of size 100 mm and for all other shutters of lesser height butt hinges of size 75 mm shall be used. For shutter of more than 40 mm thickness butt hinges of size 125 × 90 × 4 mm shall be used. Continuous (piano) hinges shall be used for fixing cup-board shutters where specified.

8 Fittings

Fittings shall be provided as per schedule of fittings or as per drawing or as decided by Engineer-in-Charge. Appendix H gives for guidance the schedule of fittings and screws usually provided. Cost of providing and fixing shutter shall include cost of hinges and necessary screws for fixing the same. All other fittings shall be paid for separately. The fittings shall conform to specifications. Where the fittings are stipulated to be supplied by the client free of cost, screws for fixing these fittings shall be provided by contractor and nothing extra shall be paid for the same.

9 Wooden Cleats and Blocks

Wooden cleats and blocks shall be fixed to doors and windows as directed by Engineer-in-Charge, as per size and shape approved by him. These are included in the cost of providing and fixing the shutters.

10 Measurements

For paneling of each type or for glazed panel length and width of opening for panels inserts or glazed panels shall be measured correct to a cm before fixing the beading and the area shall be calculated to the nearest 0.01 sq.m. The portions of the panel inserts or glazed panel inside the grooves or rebates shall not be measured for payment.

11 Rate

Rate includes the cost of materials and labour involved in all the operations described above. The framework and paneling of each type or glazed panels shall be paid separately.

Item No. 21.

(b) Fly proof stainless steel grade 304 wire gauge with 0.5 mm dia. wire and 1.4 mm wide aperture with matching wood beading

Relevant specifications shall be followed as per CPWD DSR ITEM NUMBER 9.7.8. The following specifications shall also be followed.

The relevant specification of above item shall be followed except that the work is to be done in panels of covering of Fly proof stainless steel grade 304 wire gauge with 0.5 mm dia etc.

Item No. 22.

Providing and fixing ISI marked flush door shutters conforming to IS : 2202 (Part I) non-decorative type, core of block board construction with frame of 1st class hard wood and well matched commercial 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters, lipping with 2nd class teak wood/savan wood battens 25 mm minimum depth on all edges of flush door shutters :

(a) : 35 mm thick excluding ISI marked Stainless Steel butt hinges with necessary screws

Relevant specifications shall be followed as per CPWD DSR ITEM NUMBER 9.21.1 and 9.23. The following specifications shall also be followed.

Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS 2202 (Part I). Nominal thickness of shutters may be 35 mm. Thickness and type of shutters shall be as specified.

1. General

Width and height of the shutters shall be as shown in the drawings or as indicated by the Engineer- in-Charge. All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 per cent when tested according to IS 1708.

2 Core

The core of the flush door shutters shall be a block board having wooden strips held in a frame constructed of stiles and rails. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails including lipping, where provided shall not be less than 45 mm and not more than 75 mm. The width of each wooden strip shall not

exceed 30 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the stiles.

End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be of one species only but it may or may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

3 Face Panel

The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either plywood or cross-bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the plywood shall be between 0.5 mm and 1.5 mm for commercial veneers and between 0.4 mm and 1.0 mm for decorative veneers, provided that the combined thickness of both is not less than 2.2 mm. The direction of the veneers adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS 1328.

4 Lipping

Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping. If required groove shall be made in lipping as per drawing or as directed by engineer in charge.

5 Rebating

In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10 mm. The rebating shall be either splayed or square type as shown in drawing where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30 mm.

6 Opening for Glazing

When required by the purchaser opening for glazing shall be provided and unless otherwise specified the opening for glazing shall be 250 mm in height and 150 mm or 200 mm in width unless directed otherwise. The bottom of the opening shall be at a height of 1.4 m from the bottom of the shutter. Opening for glazing shall be lipped internally with wooden batten of width not less than 25 mm. Opening for glazing shall be provided where specified or shown in the drawing.

7 Venetian Opening

Where specified the height of the venetian opening shall be 350 mm from the bottom of the shutter. The width of the opening shall be as directed but shall provide for a clear space of 75 mm between the edge of the door and venetian opening but in no case the opening shall extend beyond the stiles of the shutter. The top edge of the opening shall be lipped internally with wooden battens of width not less than 25 mm. Venetian opening shall be provided where specified or shown in the drawing.

8 Tolerance

Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be ± 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

9 Adhesive

Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS 848.

10 Tests

Samples of flush door shutters shall be subjected to the following tests:

(a) End Immersion Test

(b) Knife Test

(c) Glue Adhesion Test

One end of each sample shutter shall be tested for End Immersion Test. Two specimens of 150 x150 mm size shall be cut from the two corners at the other end of each sample shutter for carrying out Glue Adhesion Test. Knife Test shall be done on the remaining portion of each sample shutter. Test shall be done as laid down in Appendix F

11 Sample Size

Shutters of decorative and non-decorative type from each manufacturer, irrespective of their thickness, shall be grouped separately and each group shall constitute a lot. The number of shutters (sample size) to be selected at random from each lot for testing shall be as specified in Table 10. If the total number of shutters of each type in a work (and not the lot) is less than twenty five, testing may be done at the discretion of the Engineer-in-Charge and in such cases extra payment shall be made for the sample shutter provided the sample does not fail in any of the test specified in 10 below.

For knife test, glue adhesive test, slamming test, the end immersion test, the number of shutters shall be as per col. 4 of Table 10.

TABLE 10

Sample Size and Criteria for Conformity

Lot Size	Sample Size	Permissible no of defective	Sub. Sample size
(1)	(2)	(3)	(4)
Upto 26 to 50	8	0	1
51 – 100	13	1	2
101 – 150	20	1	2

151 – 300	32	1	3
301 – 500	50	2	4
501 and above	80	2	5

12 Criteria for Conformity

All the sample shutters when tested shall satisfy the requirements of the tests laid down in Appendix F. The lot shall be declared as conforming to the requirements when numbers of defective sample does not exceed the permissible number given in col. 3 of Table 10. If the number of sample shutters found unsatisfactory for a test is one, twice the number of samples initially tested shall be selected and tested for the test. All sample shutters so tested shall satisfy the requirement of the test. If the number of samples found unsatisfactory for a test is two or more, the entire lot shall be considered unsatisfactory.

13 Fixing

This shall be as specified in 7 above.

14 Measurements

Length and width of the shutters shall be measured to the nearest cm in closed position covering the rebates of the frames but excluding the gap between the shutter and the frame. Overlap of two shutters shall not be measured.

All work shall be measured net as fixed and area calculated in square metres to nearest two places of decimal. No deduction shall be made for providing venetian opening and opening for glazing.

15 Rates

The rate includes the cost of material and labour involved in all the operations described above. Extra rate shall be payable for providing rebates in double leaved shutters. Glazing when provided shall be measured & paid for separately.

Item No. 23.

Providing and fixing 25 mm thick calibrated BWP plywood confirming to IS 710 with necessary fixing arrangement including adhesive, nails, screws etc. all complete, as per approved drawings and as per direction of engineer in charge.

For wooden panelling, partitions, wardrobes, cabinets, band, patta, benches, Tables, modesty panels etc.

1 Installation

The wooden frame, Wardrobe, Cabinets in kitchen and bath rooms, Panelling, Benches, Modesty Panels, and wooden partitions shall be fixed as per nomenclature of the item, as per the detailed drawings and directions of Engineer-in-Charge.

2 Jointing & Finishing

Joints of the boards are finished with specially formulated Jointing compound and fiber tape to provide seamless finish. Board surface can be decorated with any type of paint, wall paper, wood veneer & hard laminates. Services should be incorporated before commencement of board fixing.

3 Fitting and Fixtures

It is easy and simple to attach different fittings to wall paneling boards. Inclined nails can be fixed to the boards itself for light materials. For heavier materials the fastening should be centered on internal stud work or steel or wood frame behind the boards, fixed before boarding. Services should be incorporated before commencement of board fixing.

4 Tolerance

Tolerance in dimensions shall be + 5 mm.

5 Measurements

Length and breadth of superficial area of the finished work shall be measured correct to a cm. Area shall be calculated in square meter correct to two places of decimal. No deduction will be made of openings of areas up to 0.40 sqm nor shall extra payment be made either for any extra material or labour involved in forming such openings. For openings exceeding 0.40 sqm. In area, deduction in measurements shall be made but extra will be payable for any extra material or labour involved in making such openings.

6 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 24.

Providing and fixing 18 mm thick calibrated BWP plywood confirming to IS 710 with necessary fixing arrangement including adhesive, nails, screws etc. all complete, as per approved drawings and as per direction of engineer in charge.

For wooden panelling, partitions, wardrobes, cabinets, band, patta, benches, Tables, modesty panels etc.

Relevant specifications shall be followed as per item number 24 except that 18 mm thick Calibrated BWP plywood confirming to IS 710 shall be used. Rate shall be for per Square meter.

Item No. 25.

Providing and fixing 12 mm thick calibrated BWP plywood confirming to IS 710 with necessary fixing arrangement including adhesive, nails, screws etc. all complete, as per approved drawings and as per direction of engineer in charge.

For wooden panelling, partitions, wardrobes, cabinets, band, patta, benches, Tables, modesty panels etc.

Relevant specifications shall be followed as per item number 24 except that 12 mm thick Calibrated BWP plywood confirming to IS 710 shall be used. Rate shall be for per Square meter.

Item No. 26.

Providing and fixing 8 mm thick calibrated BWP plywood confirming to IS 710 with necessary fixing arrangement including adhesive, nails, screws etc. all complete, as per approved drawings and as per direction of engineer in charge.

For wooden panelling, partitions, wardrobes, cabinets, band, patta, benches, Tables, modesty panels etc.

Relevant specifications shall be followed as per item number 24 except that 8 mm thick Calibrated BWP plywood confirming to IS 710 shall be used. Rate shall be for per Square meter.

Item No. 27.

Providing and fixing 6 mm thick calibrated BWP plywood confirming to IS 710 with necessary fixing arrangement including adhesive, nails, screws etc. all complete, as per approved drawings and as per direction of engineer in charge.

For wooden panelling, partitions, wardrobes, cabinets, band, patta, benches, Tables, modesty panels etc.

Relevant specifications shall be followed as per item number 24 except that 6 mm thick Calibrated BWP plywood confirming to IS 710 shall be used. Rate shall be for per Square meter.

Item No. 28.

Providing and fixing 12.5 mm thick fire rated gypsum board conforming to IS: 2095: part I with necessary fixing arrangement including adhesive, nails, screws etc. all complete, as per approved drawings and as per direction of engineer in charge.

For wooden panelling, partitions, wardrobes, cabinets, band, patta, benches, Tables, modesty panels etc.

Material

Relevant specifications shall be followed as per CPWD DSR ITEM NUMBER 9.158. The following specifications shall also be followed.

The material shall conform to IS: 2849.

Laying

(i) Panels are stored in a dry place and water should not come in contact with panels during or after construction. If the panels get wet, they should be dried before use.

(ii) The floor should be perfectly level before laying the first course. All panels must be properly aligned to the plumb. Successive layer of panels must be alternatively staggered so that vertical joints are not in the same line.

(iii) The recommended quantity of Gypsum Bonding Plaster must be used for joints and filling the grooves made for conduits, pipelines, etc. Excess Bonding Plaster must be scooped and removed, so that the joints and the places where the grooves are filled in are flush and even.

(iv) The walls should be dry and sanding done properly especially at joints before the primer is applied so that the surface is even and joints will not be visible after painting. Avoid chasing with chisel and hammer. Use electrical saw or grooving tools for conduting etc.

(v) The recommended span of walls is maximum 6 meters and maximum height is 4.5 meters.

(vi) Gypsum panel can easily be cut with coarse tooth hand saw, electric jigsaw, etc. The panels can be cut, sawn, drilled, milled or dowelled on the job. For concealed piping and conduit, the depth of groove should not exceed 50 mm. Hammer and chisel techniques to form chases must be avoided.

(vii) Sanding: This application is to make the surface level without undulations. To make the gypsum wall surface level (in particular at joints, where there is excess bonding plaster), do sanding with sand paper at joints and other places, wherever you find uneven surface, otherwise joints will be visible after painting. It is important to sand all joints uniformly.

Measurements

The length and height shall be measured correct to a cm. Area shall be calculated in square meters correct to two place of decimal.

Rate

The rate shall include the cost of materials and labour involved in all the operations described above.

Item No. 29.

Providing and fixing thermal insulation with Resin Bonded Fibre glass wool conforming to IS: 8183 having density 48 kg/m3, 40 mm thick, wrapped in 200G Virgin Polythene Bags fixed to wall with screw, rawel plug & washers and held in position by criss crossing GI wire etc. complete as per directions of Engineer-in-Charge.

Relevant specifications shall be followed as per CPWD DSR item number 12.57. The following specifications shall also be followed.

With Resin Bonded Fibre Glass Wool (Bonded Mineral Wool)

Material

The material shall be mineral wool made from rock slag or glass processed from a molten state into fibrous form and shall be bonded with a suitable binder. Bonded mineral wool shall conform to specifications of group I of IS 8183.

Dimensions: The bonded mineral wool shall be supplied in width of 50, 60, 75 and 100 cms, and length of 100, 120 and 140 cms and the thickness of the bonded mineral wool shall be 25, 40, 50, 65 or 75 mm.

Tolerances

For width and length, the dimensional tolerances of the bonded mineral wool slabs shall be -½%. For nominal thickness in the range 25 to 75 mm the tolerance shall be -2 mm. An excess, in all dimensions is permitted.

Requirements for Fibre Glass Wool

TABLE 12.11

Sr.no	Characteristics	Group I	Test Reference
1.	Bulk density	12 to 15 kg/cum	IS 3144
2.	Recovery after compression	not less than 90% of original thickness	Annex. A of IS 8183
3.	Shot content max	500 micron - 5% 250 micron - 15%	IS 3144
4.	Moisture content and absorption	not more than 2%	IS 3144
5.	Incombustibility	Incombustible	IS 3144
6.	Thermal conductivity deg. C at mean temperature 50 deg.C	0.49 mw/ cmoC	IS 3346
7.	Sulphur content	Not more than 0.6%	IS 3144

General

Bonded mineral wool insulation can be either laid over false ceiling or alternatively it can be fixed to the ceiling when the space above false ceiling is being used for carrying return air. In the first case the bonded mineral wool can either be fixed with suitable adhesive to the false ceiling board or else it can simply be rolled over the suspended false ceiling. In the second case when space above false ceiling is to be used for carrying return air 1.5" x 1.5" slotted angle (3" length) shall be fixed to the ceiling by means of rawl plugs at 2’0" spacing. Draw 14 gauge tie wires from the slots. Make a mat of mineral wool insulation backed with scrim cloth with a light coating of Plaster of Paris or polythene faced hessian and 24g x 1" wire mesh netting. The joints of wire netting should be butted and tightly laced down with G.I. wire. Stretch the mat tightly across the angles holding it in place by means of tie wires.

Measurements

Length and breadth of the roofing insulation shall be measured correct to a cm and the surface area worked out in square metre of the finished work. No deduction shall be made for openings of areas upto 40 square decimetre. No extra payment will be made for any extra material or labour involved in forming such openings. For openings exceeding 40 square decimetre in area, deduction for the full opening will be made, but no extra will be paid for any extra material or labour involved in forming such openings. Boarding fixed to curved surfaces in narrow widths shall be measured and paid for

separately. Circular cutting and waste shall be measured and paid for separately in running metres.

Rate

The rate shall include the cost of all materials and labour required in providing bonded mineral wool.

Item No. 30.

Providing and fixing 8 mm thick exterior grade non asbestos heavy duty fiber cement board with necessary fixing arrangement and screws etc. all complete , as per approved drawings and as per direction of engineer in charge.

Relevant specifications shall be followed as per CPWD DSR item number 9.158. In addition the following specifications shall also be followed.

Fibre boards shall be of medium density cement board reinforced with wood fibre and shall be of external grade capable to, produced by fiberizing steamed wood under pressure, blended with adhesive and wax and formed into solid panels under controlled conditions of heat and pressure as per IS 14862. Fibre cement board should be of minimum density 1300kg/ m3 (±50) and comply to ASTM C 1185 and ISO 8336 part (E) for confirming durability properties and BS 476 – part 5, 6 & 7, Thermal conductivity should be minimum 0.15 W/m°K and PH value should be in the range of 7 – 8

Adhesive

The adhesive used for bonding shall be BWP type synthetic resin conforming to IS 848.

Thickness

Fibre boards are available in thickness 6, 9, 12, 15, 18, 22, 25, 30, 35 & 40 mm. The tolerance in thickness shall be ± 0.3 mm. Thickness of fibre boards and adhesive used for bonding shall be as per manufacturers standards and shall be as per relevant IS Codes. Unless otherwise stated, exterior grade fibre boards bonded with BWP type synthetic resin adhesive shall be used.

Fixing

The fibre cement board shall be fixed on the structure using self tacking screws. The screws shall be of approved make and shall be SDST screws of stainless steel.

Measurement

Measurement shall be for per square meter of board installed.

Rate

Rate shall be for per square meter of board installed including the cost of screws, tools, tackles, labour and scaffolding.

Item No. 31.

Providing and fixing 6 mm thick exterior grade non asbestos heavy duty fiber cement board with necessary fixing arrangement and screws etc. all complete, as per approved drawings and as per direction of engineer in charge.

Relevant specification shall be followed as per Item Number 31 except that 6 mm Exterior grade non asbestos cement board as per BOQ description.

Item No. 32.

Providing and fixing PVC ABS edge beading 2 mm thick / second class teakwood beading 12 mm thick with necessary fixing arrangement and screws etc. all complete, as per approved drawings and as per direction of engineer in charge for various thickness of plywood for wardrobes, cabinets, partitions etc.

Beading

Beadings in panelled shutter and other places shall be provided where specified in architectural drawings or directed by the Engineer-in-Charge. Each length of beading shall be single piece. Joints at the corners shall be mitred and exposed edges shall be rounded. Beading shall be fixed with headless nails at 75 mm intervals. For external shutters, the beading shall be fixed on the outside face.

Item No. 33.

Providing & fixing to wall band up to 300 mm wide made from 12 mm thick marine plywood conforming to IS: 710 finishing with 4 mm veneer and second class teak wood beading, back side supporting second class teakwood Patti 48 X 48 mm top and bottom with necessary fixing arrangement and screws etc. all complete, as per drawing and as directed by engineer- in- charge.

1. General

All the items to be used shall be as per the approved make list. The wooden band shall be done at site as per the item description and the good for construction drawings. The work shall include all the items mentioned in the item description.

2. Measurement and Rates

Measurement shall be per running meter of the band. The rate shall be inclusive of all materials, screws, adhesives, nails, labour, tools and tackles required to complete the work as per the drawings and to the satisfaction of the Engineer in Charge.

Item No. 34.

Providing & fixing to wall band up to 300 mm wide made from exterior Grade-I MDF Board 18 mm thick confirming to IS:12406 with second class teak wood beading and back side supporting second class teakwood patti 48x48 mm top and bottom with necessary fixing arrangement and screws etc. all complete as per drawing and as directed by engineer- in- charge.

1. General

All the items to be used shall be as per the approved make list. The wooden band shall be done at site as per the item description and the good for construction drawings. The work shall include all the items mentioned in the item description.

2. Measurement and Rates

Measurement shall be per running meter of the band. The rate shall be inclusive of all materials, labour, screws, adhesives, nails, tools and tackles required to complete the work as per the drawings and to the satisfaction of the Engineer in Charge.

Item No. 35.

Providing & fixing C shaped pelmet up to 200 mm made wide from 18 mm thick marine plywood conforming to IS: 710 finishing front side with 4 mm thick veneer and second class teak wood beading ,back side supporting to wall with necessary fixing arrangement and screws etc. all complete, as per drawing and as directed by engineer- in- charge.

1. General

All the items to be used shall be as per the approved make list. The C shape pelmet shall be done at site as per the item description and the good for construction drawings. The work shall include all the items mentioned in the item description.

2. Measurement and Rates

Measurement shall be per square meter of the pelmet. The rate shall be inclusive of all materials, labour, tools and tackles required to complete the work as per the drawings and to the satisfaction of the Engineer in Charge.

Item No. 36.

Providing & Fixing decorative high pressure laminated sheet of plain / wood grain in gloss / matt / suede finish with high density protective surface layer and reverse side of adhesive bonding quality conforming to IS : 2046 Type S, including cost of adhesive of approved quality.

a) 1.0 mm thick on one side only

Relevant specifications shall be followed as per CPWD DSR item number 9.127.2. In addition the following specifications shall also be followed.

1 Scope:

Decorative thermosetting synthetic resin bonded laminated sheets shall generally conform to IS 2046. This material is intended for interior use and is not intended for load bearing applications. The decorative high pressure laminated sheet of plain / wood grain in gloss / matt / suede finish or as approved by authority.

2. Material

A sheet consisting of layers of fibrous sheet material (for example, paper) impregnated with thermosetting resins and bonded together by means of heat a pressure of not less than 7 MPa (1 MPa = 1 MN/m2), the outer layer or layers on one or both sides having decorative colours or designs. Decorative high-pressure laminated sheet (HPL) as defined this standard is made from core layers impregnated with phenolic and/or amino plastic resins and a surface layer or layers impregnated with amino plastic resins (mainly melamine resins).

3 Requirements:

When inspected in daylight (or D 65 standard illuminant and again under a tungsten illuminant) there shall be no significant difference between a standard agreed by the supplier and the specimen under test.

Having only one side bearing decorative surface the other side being roughened or given an appropriate treatment to promote adhesion to the base. This type shall generally be used, unless specified otherwise.

No requirements for nominal thickness are specified for individual types of materials listed in Table 7, however, variations from the nominal thickness supplies shall at no point exceed the limits shown in Table 5 of code.

Thickness shall be measured using a ratchet-type micrometer or dial gauge indicator having two flat parallel measuring surfaces of diameter at least 6 mm and capable of being read to 0.01 mm. When the thickness of a decorative laminated sheet is being measured, the two surfaces shall exert a pressure of 10 to 100 kPa upon each other

The specimen shall be the sheet under test, as received. After checking the gauge for accuracy the thickness of the sheet shall be determined to the nearest 0.02 mtn. It is recommended that the thickness should be measured at a minimum of four points and at a distance of at least 20 mm from the edge of the sheet.

4 Appearance

The following inspection requirements are intended as a general guide, indicating the minimum acceptable quality for laminates supplies as full size sheets. Cut-to- size panels and certain applications involving full size sheets may call for special quality requirements which can be negotiated between the supplier and the purchaser; in such cases the following requirements may be used as a basis for discussion. It should be noted that only a small percentage of sheets in a batch should be of the minimum acceptable quality.

Surface defects

When inspected for surface appearances under standardized conditions of lighting and viewing at a distance half of the levels prescribe.

Edge defects

Visual defects (for example, moisture marks, lack of gloss, etc) can be present on all four edges of the laminate provided that the defect free length and width are not more than 20 mm shorter than the nominal length and width.

Broken corners

One broken corner of <30 mm or two broken corners of <15 mm are allowed. These values refer to the distance between the original corner and the fracture line. Slight chatter marks are allowed.

Warping

The flatness of laminates is dependent on atmospheric conditions within the storage area. Provided that the laminates are stored in the conditions recommended by the manufacturer, they shall not show a departure of the surface from a straightedge of 1 mm length in any position, of more than the limits listed in Table 6 when the laminate is laid concave side up on a flat surface of every property for which a value of requirement

is specified in 5. TWO methods of test are given for the measurement of dimensional stability, impact resistance, and resistance to colour changes in artificial light, formability and resistance to cigarette bunts. When there is a choice of method, material satisfying the requirements of either method shall be deemed to comply with the specification for that property; however, the choice Of method may be agreed between the interested parties available at the manufacturer's end. The method searched shall be stated in the test report.

Length and Width of u Full-Size Laminate The laminate shall be of the nominal size with a tolerance of +-10 mm.

Straightness of Edges: The edges shall be straight within a tolerance of 1.5 mm per meter length of the edge. The edge being measured shall be at least as long as the 1 nun straightedge.

Square ness of the Laminates: The panel shall be rectangular within a tolerance of 1.5 mm per meter length of the edge. The edge being measured shall be at least as long as the 1 m straightedge.

Other Properties: when tested by the appropriate methods, the properties for each type of material shall satisfy the requirements listed in Tables 1 and 7.

COMPLIANCE: In order to comply with the requirements of this standard, materials of each type shall meet the requirements of every property for which a value of requirement is specified in 5. TWO methods of test are given for the measurement of dimensional stability, impact resistance, resistance to colour changes in artificial light, formability and resistance to cigarette burns. When there is a choice of method, material satisfying the requirements of either method shall be deemed to comply with the specification for that property; however, the choice of method may be agreed between the interested parties available at the manufacturer's end. The method selected shall be stated in the test report.

5. Packing & Marking

Packing: The material shall be supplied in packages as agreed to between the purchaser and the supplier.

Marking: The consignment shall be marked suitably with the following information:

a) Indication of the source of manufacture and recognized trade mark, if any;

b) Type and class of the material;

c) Mouth and year of manufacture; and

d) Batch number and code number.

BIS Certification Marking The product may also be marked with the Standard Mark.

The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 19% and the Rules and Regulations made thereunder. The details of conditions under which the license for the Use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6 Laying:

Laminate is easy to clean and relatively durable, although, being plastic, it can melt if exposed to excessive heat. Laminate comes in many styles and can be cut using ordinary saws, making its installation a great do it yourself project. A matte finish will hide wear and tear better than a glossy laminate, which is easily scratched, but may require more cleaning. A matte finish will hide wear and tear better than a glossy laminate, which is easily scratched, but may require more cleaning.

Preparing the laminate:

Lightly sand the surface on which you will install the sheet. Sand the surface to create a rough surface for solid adherence, and wipe away sawdust with a tack cloth or damp. If the surface is covered by paint or varnish, you should sand thoroughly to remove it using coarse or medium coarse sandpaper.

Measure the length and width of the areas where you will install sheet. Use a tape measure to get an accurate measurement of each dimension of the area. If you are installing a full countertop and your walls are not at perfect right angles, you should scribe the sheet first. See Troubleshooting for more information.

Place the sheet on a flat, stable surface. This should be large enough to keep the sheet steady while cutting. Use scrap plywood or similar material that you don't mind damaging with the saw. Don't use concrete or another surface that will damage the saw blade. Mark the measurements on the back of the Formica sheet, adding 1 inch (2.5 cm) to each measurement. Draw your cut lines onto the laminate at the increased measurement, which ensures you don't waste a large piece of laminate due to cutting too small a piece.

Apply masking tape along the lines. This makes it easier to see where to cut, while also reducing the risk of chips. You can also apply additional tape to the surface beneath the sheet to protect it, but you shouldn't cut over a surface you want to keep presentable.

Cut the Formica along straight lines. Ideally, you should use a circular saw, saber saw, back saw, table saw, or laminate shears. A handsaw with at least 10 teeth per inch (4 per cm) will also work, but may be tedious for larger jobs. Use a metal straightedge to ensure a straight cut. If your installation place is curved, you'll need to use a jigsaw or laminate router to make these finer adjustments.

Installing the Formica:

If you are installing laminate on a countertop or other surface with edges, begin with the edge pieces. If you cut them from the laminate yourself, apply the contact cement with a brush or roller to both surfaces. Allow it to set until it feels tacky, according to the manufacturer's directions.

If you are using pre-glued end caps, all you need to do is heat a clothes iron, place the laminate against the edge, and iron back and forth. Let sit for one minute and gently tap it along its length with a rubber mallet or shoe heel. You can now skip to trim the edge strip.

When you are sure you have it placed properly, press it to the surface. Once the two surfaces come into contact, the contact cement is already bonded to 50% or more of its final strength.

Push a dry roller back and forth across the laminate to adhere it completely and to remove air from between the laminate and the surface.

Use a fine file to remove the excess material, applying pressure only on the up strokes. You may use a laminate trimmer or router instead, but if you do you should lubricate the edge with petroleum jelly (Vaseline) first. This minimizes the chance of breakage.

Use a carbide drill bit when trimming laminate. Before continuing, protect your finished edges while you install the remainder of the laminate sheet. Allow it to set according to manufacturer's instructions. As a general rule, the contact cement should be left until it becomes tacky and dry to the touch, but no longer.

Align the laminate as accurately as you can, then continue to adjust it as you move from one end of the surface to the other. Shift the dowels out of the way once you've aligned each section, then press it down to adhere it to the surface. Push a roller across the sheet to eliminate air pockets and strengthen the contact bond. Use a flush trim carbide drill bit. Stop frequently to allow the router to cool, as the laminate will melt if exposed to high heat. Use a fine wood file to methodically file down the sharp edge of the laminate. File downward at an angle along the entire edge.

6 Measurement:

Length and breadth of superficial area of the finished work shall be measured correct to a cm.

Measurement shall be per square meter.

7 Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 37.

Providing and fixing 4 mm thick divine teak quarter cut Veneer conforming to IS: 1328 (type-1) with second class teak wood beading of approved colour, texture sample as approved and as per direction of engineer in charge.

1. Veneered Decorative Plywood

Decorative plywood shall be of two grades namely BWR and MR Decorative Plywood shall be of two types. Type I and type 2 and shall conform to IS 1328.

1 Requirement of Type-I Veneered decorative plywood shall be as under:

(a) Open slits checks or open joints not more than 150 mm in length and 0.5 mm in width shall be permissible provided the same are rectified with a veneer insert bounded with synthetic resin adhesive, as the case may be and further provided that the insert matches with the surrounding veneer in colour as well as figure.

(b) The decorative veneered surface shall be free from torn grain, dead knots discolourisation and sapwood.

(c) The decorative veneered surface shall be selected for figure, texture, colour and grain etc. It shall be free from all manufacturing and wood defects except to the Engineer-in-charge permitted under para 9.2.8.1(a). All veneers shall be matched or mismatched to achieve a decorative effect in colour figure and grain.

2 Adhesive

The adhesive for bonding veneers shall be MR and BWR type synthetic resin adhesive conforming to IS 848 for MR and BWR grade veneered decorative plywood respectively.

3 Dimensions and Tolerances:

3.1 The dimensions of plywood boards shall be as follows:

2400 mm x 1200 mm 2100 mm x 900 mm

2100 mm x 1200 mm 1800 mm x 900 mm

1800 mm x 1200 mm

3.2 Thickness: The thickness of plywood board shall be 3 mm, 4 mm, 6 mm, 9 mm, 12 mm, 19 mm and 25 mm.

Note: Any other dimensions (length, width and thickness) as agreed to between the manufacturer and the purchaser may also be used.

3.3 Tolerances: Tolerances on the nominal sizes of finished boards shall be as follows:

Dimension Tolerance

Length +6 mm

- 0

Width +3 mm

-0 mm

Thickness:

(i) Less than 6 mm + 10 per cent

(ii) 6 mm and above + 5 per cent

Edge straightness 2 mm per 1000 mm

Or 0.2 per cent

Squareness 2 mm per 1000 mm

Or 0.2 per cent

Note : Edge straightness and squareness shall be tested as per Appendix I.

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4 Finish

The decorative plywood shall be uniform in thickness within the tolerances limits specified. The ends shall be trimmed straight and square edge straightness and squareness when tested as per Appendix I shall be within the tolerance specified in 1.3.3.

5 Sampling and Criteria for Conformity

The method for drawing representative samples and criteria for conformity shall be as per IS 7638.

6 Tests

Boards shall be subjected to following tests :

(i) Moisture content: Decorative veneered plywood of either type when tested in accordance with IS

1734 (Pt. I) shall have a moisture content not less than 5 per cent and not more than 15 per cent.

(ii) Water Resistance Test : Three test specimen of size 250 mm x 100 mm shall be prepared for each of he boards selected and submerged in water at 62 +2o C for a period of 3 hours and dried for 8 hours at a temperature of 65 + 2oC and then followed by two more cycles of soaking and drying under same conditions described above. Decorative Veneered plywood of either type shall not show delamination or blister formation.

7 Marking

Each plywood bound shall be legibly and indelibly marked or stamped with the following on the face of board near one corner.

(a) Indication of the source of manufacture

(b) Year of manufacture

(c) Batch no.

(d) Type of plywood

(e) Criteria for which the plywood has been lablled as ECO mark

The decorative veneered plywood may also be marked with standard BIS certification mark.

Item No. 38.

Providing and fixing Wooden Grill louvers made from second class teak wooden Patti 40 x12 mm at center to center distance of 40 mm fixed to 50x20 mm wooden frame with necessary fixing arrangement and screws etc. all complete, at required location in frames/shutters of door/windows as per drawing and as directed by engineer in charge.

1 Measurement:

Length and breadth of superficial area of the finished work shall be measured correct to a cm. Measurement shall be per square meter.

2 Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 39.

Providing and fixing glazing in door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket /teakwood beading etc. complete as per the architectural drawings and the directions of Engineer-in-charge.

(a)With float glass panes of 8.0 mm thickness

Relevant specifications shall be followed as per CPWD DSR item number 21.3.3. In addition the following specifications shall also be followed.

Float Glass

Relevant specifications shall be followed as per CPWD DSR item number 21.3.3. The following shall also be followed.

The glass shall be clear float glass and should be approved by the Engineer in Charge. It shall be clear, float transparent and free from cracks subject to allowable defects. The float glass shall conform to the IS 14900.

Thickness

The thickness of float glass shall depend on the size of panel. The tolerance in thickness shall be as under:

Nominal Thickness (in mm)	Tolerance (in mm)
4.0	± 0.3
5.0	± 0.3
6.0	± 0.3
8.0	± 0.6

Allowable Defects

The allowable defects shall be as per Table 21.3 below:

TABLE 21.3

Sr. No.	Defects	Central	Outer	Remarks
1.	Gaseous inclusion. Max size, mm	3.0	6.0	Separated by at least 30.0 cm
2.	Opaque gaseous inclusion. Max size. Mm	3.0	6.0	Separated by at least 60.0 cm
3.	Knots, dirt and stones, Max size. Mm	1.0	1.0	Separated by at least 30.0 cm
4.	Scratches, Rubs and Crush	Faint	Light	Separated by at least 30.0 cm
5.	Bow, percent. Max	0.5	0.5	See 21.2.4.3
6.	Reams, Strings and lines	Light	Light	See 21.2.4.4
7.	Waviness	Nil	Nil	See 21.2.4.5
8.	Sulphur stains	Nil	Nil	
9.	Corner breakage and chip	Not more than nominal thickness of float glass		

Allowable Cluster of Defects: The allowable cluster of defects mentioned under Sl. No. 1, 2 & 3 of Table 21.3 shall be as per IS 14900.

Tests

Thickness

The thickness of float glass shall be measured with micrometers or a caliper which is graduated to 0.01 mm or with a measuring instrument having an equivalent capacity.

Scratches, Rubs and Crush

Place the sample of float glass in a vertical position approximately 50 cm from the viewer's position and look through it using either day light without direct sunlight or a background light suitable for observing each type of defect.

Intensity of Scratches, Rubs, Crush	Intensity Distance Limit
Faint	Shall not be detectable beyond 50 cm
Light	Detectable between 50-100 cm and not beyond 100 cm

Bow

Depending on the side on which bow is present, stand the sample vertically on a wooden plank. Stretch a thread edge to edge. Measure the longest perpendicular. Distance from the thread to the surface of float glass facing the thread and express it as percentage of the length of float glass from edge along the thread.

Reams, Strings and Lines

Focus a light projector with a 500 W lamp and an objective lens with an approximate 5 cm aperture and about 30 cm focal length on a flat white projection screen placed about 760 cm from the light source in a dark room. Place the float glass in a vertical position parallel to the screen between the light and the screen. Move the glass slowly towards the screen with a vertical oscillating motion. The shadowgraph read out is the distance at which the distortion just blends with the general shadow of the glass on the screen.

TABLE 21.4

Intensity of Reams, Strings and Lines	Intensity Distance Limit
Light	7.5 cm
Medium	5.0 cm
Heavy	2.5 cm

Perspective Distortion: When tested as per test procedure described below it shall not give distorted vision of straight stripe pattern.

Test Procedure for Perspective Distortion

Perspective distortion shall be examined by looking through the specimen glass which may be placed at about 4.5 m distance in such a direction that the incident angle to it is 50 degree (4 mm or above) and by observing a screen set up perpendicularly to the line of vision about 4.5 m further ahead of the specimen over the total width of about middle

part of the specimen from the horizontal direction. The specimen glass shall be kept with the drawn direction at manufacture vertical and, on the surface of the screen, the strip pattern of white and black parallel straight lines of 25 mm width and inclined 45 degrees from the vertical shall be provided and its surface shall be luster less.

Item No. 40.

Providing and fixing glazing in door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket /teakwood beading etc. complete as per the architectural drawings and the directions of Engineer-in-charge .

(b)With float glass panes of 5.0 to 6.0 mm thickness

Relevant Specification as per item no 41.

Item No. 41.

Providing and fixing glazing in door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket /teakwood beading etc. complete as per the architectural drawings and the directions of Engineer-in-charge .

(c)With Toughened glass panes of 12.0 mm thickness

Relevant Specification as per item no 41. The Glass used shall be toughened glass.

Item No. 42.

Extra rate over for providing and fixing toughened glass panes instead of plain float glass as per drawing and as directed by engineer in charge.

1 Material

Toughened or tempered glass is a type of safety glass processed by controlled thermal or chemical treatments to increase its strength compared with normal glass. Tempering puts the outer surfaces into compression and the interior into tension. Such stresses cause the glass, when broken, to crumble into small granular chunks instead of splintering into jagged shards as plate glass (a.k.a. annealed glass) does. The granular chunks are less likely to cause injury.

Toughened glass is physically and thermally stronger than normal glass.[1] The greater contraction of the inner layer during manufacturing induces compressive stresses in the surface of the glass balanced by tensile stresses in the body of the glass. For glass to be considered toughened, this compressive stress on the surface of the glass should be a minimum of 69 mega pascals (10,000 psi). For it to be considered safety glass, the surface compressive stress should exceed 100 mega pascals (15,000 psi). As a result of the increased surface stress, if the glass is ever broken it only breaks into small circular pieces as opposed to sharp jagged shards. This characteristic makes tempered glass safe for high-pressure and explosion proof applications

It is this compressive stress that gives the toughened glass increased strength. This is because annealed glass, which has almost no internal stress, usually forms microscopic surface cracks, and any applied tension gets magnified at the surface, reducing the applied tension needed to propagate the crack. Once it starts propagating, tension gets magnified even more easily, causing it to propagate at the speed of sound in the material. Consequently, annealed glass is fragile and breaks into irregular and sharp

pieces.[3] Any cutting or grinding must be done prior to tempering. Cutting, grinding, and sharp impacts after tempering will cause the glass to fracture.

Toughened glass can be made from annealed glass via a thermal tempering process. The glass is placed onto a roller table, taking it through a furnace that heats it well above its transition temperature of 564 °C (1,047 °F) to around 620 °C (1,148 °F). An alternative chemical toughening process involves forcing a surface layer of glass at least 0.1 mm thick into compression by ion exchange of the sodium ions in the glass surface with potassium ions (which are 30% larger), by immersion of the glass into a bath of molten potassium nitrate. Chemical toughening results in increased toughness compared with thermal toughening and can be applied to glass objects of complex shapes

2. Laying

Glass shall be fixed in proper line and level with first/second class teakwood beading as per specified thickness and as directed. Surrounding gap should be watertight with silicone sealant or as specified.

3 Measurement

Length and breadth of superficial area of the finished work shall be measured correct to a cm. Measurement shall be per square meter.

4 Rate

The rate shall include the cost of all the materials, labours involved in all the operations as described in nomenclature of item and particular specification.

Item No. 43.

Extra rate over for providing and fixing frosted/ribbed glass panes instead of plain float glass as per drawing and as directed by engineer in charge.

Measurements

Length and breadth of superficial area of the finished work shall be measured correct to a cm. Measurement shall be per square meter.

Rate

The rate shall include the cost of all the materials, labours involved in all the operations as described in nomenclature of item and particular specification.

Item No. 44.

Extra for providing and fixing translucent polyester film on glass over plain float glass to give it a look as required as per drawing and as directed by engineer in charge.

Measurements

Length and breadth of superficial area of the finished work shall be measured correct to a cm. Measurement shall be per square meter.

Rate

The rate shall include the cost of all the materials, labours involved in all the operations as described in nomenclature of item and particular specification.

Item No. 45.

Providing and fixing PVC Acoustic & smoke seal to protect rebated timber frame 12 mm profile RP 120 Raven make or equivalent as per drawing and as directed by engineer in charge.

The PVC acoustic and smoke seal shall be co-extruded PVC seal and shall have self-adhesive backing tape provided inbuilt. The PVC used shall be flexible flame retardant PVC. The seal shall be provided to all the corners of the door frame at the hinges and rebates so that progression of sound and smoke can be limited.

The rate shall be for per running meter of seal installed.

Item No. 46.

Providing and fixing EPDM perimeter Bulb type of seal self -adhesive for Gaps as per drawing and as directed by engineer in charge.

The EPDM Gaskets shall be of size and profile as shown in drawings and as called for, to render the glazing, doors, windows, ventilators etc. air and water tight. Samples of gaskets shall be submitted for approval and the EPDM gasket approved by Engineer-in-Charge shall only be used. The contractor shall submit documentary proof of using the above material in the work to the entire satisfaction of Engineer-in- Charge.

The EPDM gasket shall meet the requirements as given in Table 21.5 below:

TABLE 21.5

Sr. No.	Description	Standard Follow	Specification
1	Tensile strength Kg.f/cm2	ASTM-D 412	70 Min.
2	Elongation at break %	ASTM-D 412	250 Min.
3	Modulus 100% Kgf/cm2	ASTM-D 412	22 Min.
4	Compression set % at 0o CC 22 Hrs.	ASTM-D 395	50 Max.
5	Ozone resistance	ASTM-D 1149	No Visible Cracks

Item No. 47.

Providing and fixing expose type Elite brush seal sweeper gasket Enviro make or equivalent as per drawing and as directed by engineer in charge.

Relevant specifications of item no 40 shall be followed. Door Bottom Sweeps are used to seal the gap at the bottom of your door to prevent infiltration of sound, light, drafts, insects, moisture, smoke or fire.

The brush seal sweeper gasket shall be having nylon brush and shall be encased in aluminium casing as per manufacturers specifications and shall be installed to the bottom of the door.

Rate shall be for per running meter brush seal gasket installed.

Item No. 48.

Providing and fixing acoustical Automatic door bottom seal RP8si seal of raven make or equivalent as per drawing and as directed by engineer in charge.

The Automatic Door Bottom should utilizes a flat spring mechanism, which activates when closing the door, lowering a neoprene seal insert against the floor or threshold to create a sound seal. These are for use on the push side of the door. The frame compresses a protruding hinge-side "plunger" as the door closes, to activate the spring. The Automatic Door Bottom then drops a seal in a scissor-like motion from the hinge side, adjusting to the floor from a pivoting point. As the neoprene seal compresses, it forms a tight, secure seal against the saddle or floor. The sweep retracts automatically as the door opens.

These seals shall be provided to the bottom of the doors as mentioned in the drawings and shall be concealed in to the door frame.

Rate shall be for per running meter of bottom seal installed.

Item No. 49.

Providing and fixing 5 mm thick mirror of superior glass (of approved quality) and of required shape and size fixed with second class teakwood beading or with adhesive or with two way tape (3M or equivalent Quality) on to with 6 mm thick hard board ground fixed to wooden cleats with C.P. brass screws and washers complete as per the architectural drawings and the directions of Engineer-in-charge .

The mirror shall be of the approved make and superior quality. The Mirror shall be installed on the surface with adhesive or two way tape of 3M or equivalent quality. Mirror shall be installed on hard board backing fixed to wooden cleats with C.P. brass screws and washers complete and shall be provided with teak wood lipping as per the drawing.

Measurement:
Length and breadth of superficial area of the finished work shall be measured correct to a cm. Area shall be calculated in square meter correct to two places of decimal.

Rate
The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 50.

Providing and fixing Door Closer made of High Quality aluminium extruded section body tubular type universal hydraulic door closer (having brand logo with ISI, IS : 3564, embossed on the body, door weight unto 80 kg , with double speed adjustment, Rack and pinion should be manufactured from steel alloy duly machined and heat-treated, suitable for right-hand and left hand door application, with necessary accessories and screws etc. complete as per drawing and as directed by engineer-in -charge...

Relevant specifications shall be followed as per CPWD DSR item number 9.84. The following shall also be followed.

1 These shall be made of aluminium alloy/zinc alloy and of shape and pattern as approved by the Engineer-in-Charge.

2 These shall generally conform to IS Specifications for door closers (Hydraulically regulated) IS 3564.

3 Aluminium alloy door closer shall be anodized and the anodic coating shall not be less than grade AC 15 of IS 1868. 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 M.S. parts shall be given phosphate treatment in accordance with IS 3618.

4 Sampling and Criteria for Conformity

All the door closer of the same nominal size and shape and from the same batch of manufacture, in one consignment shall constitute a lot. The number of door closers to be taken at random from a lot shall depend upon the size of the lot. (Table 20). The sample shall be tested for construction, finish, dimensions, interchangeability of parts and performance in accordance of Table 20. Any door closer failing in any one or more of these characteristics shall be considered as defective. If in the first sample, the number of defective door closer is less than or equal to corresponding acceptance number, the lot shall be declared as conforming to the requirement of these characteristics. If the number of defective door closer is greater than or equal to the rejection number, the acceptance number but less than the rejection number, lot shall be deemed as not meeting with requirements of these characteristics. If the number of defectives is greater than the acceptance number, but less than the rejection number, a second sample of the size equivalent to that of the first shall be taken to determine the conformity or otherwise of the lot. The number of defective door closers found in the first and the second sample shall be combined and if the combined number of defective thus obtained is less than or equal to the corresponding acceptance number, the lot shall be declared as conforming to the requirements of these characteristics.

Endurance Test- Two door closer in case of lot size 280 or less and five door closers in case of lot size more than 280 shall be selected from those already found satisfactory. These door closers shall be tested for the endurance test.

If all the door closers tested for endurance test satisfy the requirement of this standard, the lot shall be deemed as having satisfied the requirements of endurance test, otherwise not.

TABLE 20

No. of door closers in the lot	Sample	Sample size	Cumulative sample size	Acceptance Number	Rejection Number
up to 50	First Second	8 8	8 16	0 1	2 2
51 to 90	First Second	13 13	13 26	0 1	2 2

5 Performance Requirements

After being fitted in its position when the door is opened through 90°, the same should swing back to angle of 20° ± 5° with nominal speed but thereafter, the speed should get automatically retarded and in case of doors with latches, it should be so regulated that in its final position the door smoothly negotiates with the latch.

6 Measurement:

The door closer as describe in item shall be measured in numbers.

7 Rate:

The rate shall include the cost of all materials and labor involved in all the operations described above.

Item No. 51.

Providing & Fixing S.S. 316 Grade Fire resistance BSEN 1634:1:2000 Certified & Mechanically tested BSEN 1935:2002 Satin Finish S.S. 316 Grade 4 ball bearings Hinges approximate size 102mm X 76mm X 3 mm minimum Weight 260 grm of approved make with AISI 316 Grade ball Bearing S.S. Pin, Cap, and with necessary S.S. Self Tapping Phillips Cross Head Screws etc. complete as per drawing and as directed by engineer-in -charge.

Butt Hinges

These shall be of the following types according to the material used.

(a) Stainless steel 316 garde butt hinges.

Stainless steel 316 garde butt hinges: These shall be manufactured from S.S. 316 sheet as per specified thickness.

These shall be well made and shall be free from flaws and defects of all kinds. All hinges shall be cut clean and square and all sharp edges and corners shall be removed. These shall generally conform to IS 12817.

Hinge Pin: Hinge pin shall be made of mild steel wire. It shall fit inside the knuckles firmly and riveted head shall be well formed so as not to allow any play or shake, and shall allow easy movement of the hinge, but shall not cause looseness.

Knuckles: The number of knuckles in the hinges of different sizes shall be as per IS 12817. The size of knuckles shall be straight and at right angle to the flap. The

movement of the hinges shall be free and easy and working shall not have any play or shake.

Screw Holes: The screw holes shall be clean and counter sunk. These shall be suitable for countersunk head wood screws and of the specified size for different types, and sizes of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of the wood screws. The nos. of screw holes shall as specified in IS 12817.

Sampling and Criteria for Conformity: The number of butt hinges to be selected from a lotshall be depend on size of lot and shall be in accordance with Table 9.11 below. Butt hinges for testing shall be selected at random from at least 10 per cent of the randomly selected packages subjected to minimum of three equal number of hinges being selected from each package. All butt hinges selected shall be checked for dimensions and tolerance requirements. Defects in manufacture and finish shall also be checked and lot shall be considered conforming to the requirement of this specifications, if the number of defective hinges among those tested does not exceed the corresponding number given in Table 9.11.

TABLE 9.11

Scale of Sampling and Criteria for Conformity

SR. No.	Lot size	Sample Size	Permissible No. of Defective hinges
1	2	3	4
1.	Upto 150	5	0
2.	151 to 300	20	1
3.	301 to 500	32	2
4.	501 to 1000	50	3
5.	1001 and above	80	5

Sampling and Criteria for Conformity: The number of butt hinges to be selected from a lot shall depend on the size of lot and shall be in accordance with Table 9.12. Butt hinges for testing shall be taken at random from at least 10 per cent of the package subject to a minimum of three, equal number of hinges being selected from each package. All butt hinges selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirements of this specification if the number of defective hinges among those tested does not exceed the corresponding number given in Table 9.12.

TABLE 9.12 Scale of Sampling and Criteria for Conformity

Sl. No.	Lot size	Sample	Permissible No. of
		size	defective hinges
1	Upto 200	15	0
2	201 to 300	20	1
3	301 to 500	30	2
4	501 to 800	40	2

5	801 and above	55	3

Note: Any hinge which fails to satisfy the requirements of any one or more of the characteristics shall be considered as defective hinge.

Rate

Rate includes the cost of materials and labour involved in all the operations described above. The framework and panelling of each type or glazed panels shall be paid separately. The rate for framework includes the cost of hinges and necessary screws as specified description. However, extra shall be paid for providing moulded beading where specified. Nothing extra shall be paid for plain beading.

Item No. 52.

Providing & Fixing S.S. 316 Grade Satin Finish Fire resistance BSEN 1634:1:2000 Certified & Mechanically tested BSEN 1935:2002 Hinges without bearings approximate size 76mm X 65mm X 2 mm minimum weight 100 grm of approved make with AISI 316 Grade S.S. Pin, Cap, and with necessary S.S. Self Tapping Phillips Cross Head Screws etc. complete as specified as per drawing and as directed by engineer-in -charge.

The relevant specification shall be followed as per the above mentioned item of hinges except that the size of hinges should be taken 76 mm X 65 mm X 2 mm instead of 102 mm X 76 mm X 3 mm.

Item No. 53.

Providing & Fixing S.S. 304 Grade Stainless Steel Satin Finish Round Tower bolt of overall length (excluding Bracket) 300 mm and inner bolt of dia meter 10mm and outer barrel dia meter 15 mm, minimum weight 430 grm. of approved make with necessary Nickel Plated Screws complete as per specified as per drawing and directed by Engineer in charge.

Fitting shall be of stainless steel SS 304 grade or as specified. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws.

The fittings generally used for different type of doors and windows as specified. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-in-Charge.

Screws used for fittings shall be of chromium plated brass screws or stainless steel screws.

Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-in- Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet of 1.2 mm thickness and above shall have counter sunk screw holes to suit counter sunk

head of wood screws. All sharp edges and corners shall be removed and finished smooth.

The height of knob of tower bolt when the door, window etc. is in closed position from the floor level shall be not more than 1.9 metre.

The knobs of stainless steel tower bolts shall be cast and the bolt fixed with knob, steel spring and ball shall be provided between the bolt and the barrel.

Sampling and Criteria for Conformity: It shall be same as specified in above.

The Stainless steel tower bolts as per manufacture's standard and fixed to door as per drawing and as directed by engineer in charge.

Measurement

The Stainless steel tower bolts as describe in item shall be measured in numbers.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above

Item No. 54.

Providing & Fixing Fire resistance BSEN 1634:1:2000 Certified & mechanically tested BSEN 1906:2010 Pair of AISI S.S. 316 Grade Satin Finish hollow Pipe or solid design Mortise Handle with S.S. 316 Grade euro profile escutcheons key hole for Mortise Pin Cylinder, high grade brass bushing for extra fixing strength for intensive use of door with back to back fixing screws system. of approved make with both side active mortise handle and spindle, High Quality Stainless Steel Wood Screws (8 PCS.) for minimum door thickness 30 mm as per drawing and as directed by engineer in charge. The Inner and Outer Rose of Mortise handle and Escutcheons must be of AISI 316 grade only..

Fitting shall be of stainless steel SS 304 grade or as specified. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws.

The fittings generally used for different type of doors and windows as specified. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-in-Charge.

Screws used for fittings shall be of chromium plated brass screws or stainless steel screws.

Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-in- Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

This is a mortice lock having a single spring bolt withdrawn from the outside by using the key and from inside by key and with an arrangement.

The Stainless steel Mortice Handle as per manufacture's standard and fixed to door as per drawing and as directed by engineer in charge.

Measurement:

The Stainless steel tower bolts as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above

Item No. 55.

Providing & Fixing Satin Finish Double Door Lock body , 26 mm brass latch. 52 mm lock with Back Set centre of approximate size 85 X 45 mm, of approved make, minimum Weight 0.880 grm suitable for minimum 30 mm thick Double Door Shutter with necessary fixing screw as specified as per drawing and as per directed by engineer in charge.

The Stainless steel Latch and lock, as per manufacture's standard and fixed to door as per drawing and as directed by engineer in charge.

Measurement:

The latch and lock as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above

Item No. 56.

Providing & Fixing Fire resistance BSEN 1634:1:2000 Certified Satin Finish Single door Mortise Lock body approximate size of back set 50 mm X 85 mm, with 52 mm Lock and 26 mm brass latch , Stainless steel main & Strike plate & including back to back fixing feature suitable for minimum door thickness 30 mm Single door shutter with necessary fixing screw as per specified as per directed by engineer in charge.

The Stainless Latch and lock, as per manufacture's standard and fixed to door as per drawing and as directed by engineer in charge.

Measurement:

The latch and lock as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 57.

Providing & Fixing Satin Finish 5 pin Mechanism, high Quality brass body Mortise Pin Cylinder with 5 high accuracy Computerized Dotted keys of approved make one side key & one side knob suitable for minimum door thickness 30 mm with necessary Fixing Screw as specified and as per drawing and as per directed by engineer in charge.

The Cylinder lock, as per manufacture's standard and fixed to door as per drawing and as directed by engineer in charge.

This is a Cylinder lock having a single spring bolt withdrawn from the outside by using the key and from inside by Knob with an arrangement.

Measurement:

The Cylinder lock as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above

Item No. 58.

Providing & Fixing Fire resistance BSEN 1634:1:2000 Certified Satin Finish Secure Standard 5 pin Mechanism Mortise Pin Cylinder with both Side Keys, with 5 nos high accuracy Brass keys of approved make suitable for minimum door thickness 30 mm with necessary fixing screw as per specified and as per drawing and as per directed by engineer in charge.

The Cylinder lock, as per manufacture's standard and fixed to door as per drawing and as directed by engineer in charge.

This is a Cylinder lock having a single spring bolt withdrawn from the outside by using the key and from inside by Knob with an arrangement.

Measurement:

The Cylinder lock as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 59.

Providing & Fixing Satin Finish Magnetic Door Catcher mounted on floor or wall to stay the door of approved make, minimum Weight 150 grm with necessary nickel plated screw complete, as specified, as per drawing and as directed by engineer in charge..

Fitting shall be of stainless steel SS 304 grade or as specified. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws.

The fittings generally used for different type of doors and windows as specified. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-in-Charge.

Screws used for fittings shall be of chromium plated brass screws or stainless steel screws.

Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-in- Charge. These shall be truly vertical or horizontal as the case may be.

Screws shall be driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-in-Charge. It shall be of brass finished bright, chromium plated or oxidized or as specified. The size of magnetic door stopper shall be determined by the length of its plate. It shall be well made and shall have four counter sunk holes for fixing the door stoppers to the wall by means of wood screws. The body for housing of the door stopper shall be cast in one piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be SS finish. The spring shall be fixed firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin. On the extreme end a rubber piece shall be attached to absorb shock. All parts of the door stopper shall be of good workmanship and finish, burrs and sharp edges removed. It shall be free from surface and casting defects.

Measurement:

The Stainless steel magnetic door stopper as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 60.

Providing & Fixing high Quality Zinc Material Door Stopper length of 75 – 100 mm mm including Rubber of approved make minimum Weight 260 grm with necessary Screws etc. complete as specified, as per drawing as directed by engineer-in-charge.

Fitting shall be of stainless steel SS 304 grade or as specified. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws.

The fittings generally used for different type of doors and windows as specified. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-in-Charge.

Screws used for fittings shall be of chromium plated brass screws or stainless steel screws.

Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-in- Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-in-Charge. It shall be of brass finished bright, chromium plated or oxidized or as specified. The size of magnetic door stopper shall be determined by the length of its plate. It shall be well made and shall have four counter sunk holes for fixing the door stoppers to the wall by means of wood screws. The body for housing of the door stopper shall be cast in one

piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be SS finish. The spring shall be fixed firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin. On the extreme end a rubber piece shall be attached to absorb shock. All parts of the door stopper shall be of good workmanship and finish, burrs and sharp edges removed. It shall be free from surface and casting defects

Measurement:

The Stainless steel door mounted door stopper as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 61.

Providing & Fixing Stainless Steel S.S. 316 Grade C Shaped Handles in Satin Finish, 10 mm dia and centre to centre minimum 96mm size, minimum weight 94 grm with necessary screws etc. complete of approved make as per drawing and as directed by engineer-in-charge.

Fitting shall be of stainless steel SS 304 grade or as specified. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws.

The fittings generally used for different type of doors and windows as specified. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-in-Charge.

Screws used for fittings shall be of chromium plated brass screws or stainless steel screws.

Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-in- Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-in-Charge. It shall be of brass finished bright, chromium plated or oxidized or as specified. The size of magnetic door stopper shall be determined by the length of its plate. It shall be well made and shall have four counter sunk holes for fixing the door stoppers to the wall by means of wood screws. The body for housing of the door stopper shall be cast in one piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be SS finish. The spring shall be fixed firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin. On the extreme end a rubber piece shall be attached to absorb shock. All parts of the door stopper shall be of good workmanship and finish, burrs and sharp edges removed. It shall be free from surface and casting defects

Sampling and Criteria for Conformity : The number of floor door stoppers to be selected from each lot shall depend on the size of the lot and shall be in accordance with col. 1

and 2 of Table 9.17. These stoppers shall be selected at random from at least 10 percent of the randomly selected packages subject to a maximum of three equal number of stoppers being selected from each such package.

All the floor stoppers selected shall be checked for dimensional requirement, material, manufacture and finish. Any of door stopper which fails to satisfy any one or more of these requirement shall be considered as defective door stopper.

A lot shall be considered as conforming to the requirements of this specifications if the number of defective floor door stoppers among these tested does not exceed the corresponding number given in col. 3 of Table 17. Otherwise it shall be considered as not conformity to the requirements of this specification.

TABLE 17

Scale of Sampling and Criteria for Conformity

Lot Size	Sample Size	Permissible number of defective floor Door stoppers
(1)	(2)	(3)
Upto 100	5	0
101 to 300	0	1
301 to 500	32	2
501 to 1000	50	3
1001 and above	80	5

Measurement:

The Stainless steel floor mounted door buffer as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 62.

Providing & Fixing S.S. 304 Grade Stainless Steel Satin Finish Round Tower bolt of overall length (excluding Bracket) 100 mm and inner bolt of dia meter 10mm and outer barrel dia meter 15 mm, minimum weight 150 grm of approved make with necessary nickel Plated Screws complete as per specified as per drawing and directed by Engineer in charge.

The relevant specifications shall be same as 300 mm round tower bolt mentioned above except that length and weight shall be as per manufacture's standard and fixed to door as per drawing and as directed by engineer in charge.

Measurement:

The Stainless steel tower bolts as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above

Item No. 63.

Providing and fixing stainless steel (SS 304 grade) adjustable friction windows stays of approved quality with necessary stainless steel screws etc. to the side hung windows as per direction of Engineer-in- charge complete.

255 X 19 mm.

Relevant specifications shall be followed as per CPWD DSR item number 21.11.2 and fixed to window as per drawing and as directed by engineer in charge.

Measurement:

The Stainless steel window casement as describe in item shall be measured in numbers.

Rate:

The rate shall include the cost of all materials and labour involved in all the operations described above.

Item No. 64.

Providing and fixing Satin Finish soft closing Clip on hinges of M.S.materials, Opening Angle should be 110 Degree or as required of Approved makes for cupboard shutters, kichen cabinets etc. with necessary concealed SS Screws complete, as spcified in drawing and as approved by Engineer in charge.

General:

The Clip on hinges shall be soft closing type and shall be made with MS material and coated with High Quality Nickle coating as per manufactures specifications. The Hinges shall be of the approved makes as specified in Approved make list. The hinges shall be installed on to the cabinet using CP brass wood screws.

Measurement:

Measurement shall be of per Number of hinge installed.

Rate:

Rate shall include all material, labour, tools and tackles required to complete the work as per item description.

Item No. 65.

Providing and Fixing Stainless Steel S.S. 304 Grade multipurpose Cabinet / Wardrobe Lock heavy duty for minimum 25 mm Door thickness with keys of approved make with necessary screws etc. complete as approved drawing and as per direction of Engineer in charge.

General

The lock shall be of makes from approved make list. The lock shall be suitable to fix in the Wardrobe shutter. The lock Plate shall be fixed on to the second shutter. The lock should be supplied with minimum 3 sets of keys

Measurement:

Measurement shall be of per Lock installed.

Rate:

Rate shall include all material, labour, tools and tackles required to complete the work as per item description.

Item No. 66.

Providing and Fixing Stainless Steel S.S. 304 Grade multipurpose Drawer Lock heavy duty with key of approved make with necessary screws etc. complete as approved drawing and as per direction of Engineer in charge.

General

The lock shall be of makes from approved make list. The lock shall be suitable to fix in the Drawer. The lock should be supplied with minimum 3 sets of keys

Measurement:

Measurement shall be of per Lock installed.

Rate:

Rate shall include all material, labour, tools and tackles required to complete the work as per item description.

Item No. 67.

Providing and fixing Corrosion Resistance Premium Quality Zinc coated soft close Drawer Channel pair 500mm long, heavy duty Metal Body & Precision Ball Bearings for higher Durability with necessary screws etc. complete as per directions of Engineer-in-charge.

General:

The Drawer channels shall be corrosion resistant and with premium quality zinc coating. The length of the channel shall be 500mm. The channels shall be of the approved makes as specified in Approved make list. The channels shall be installed on to the cabinet using CP brass screws.

The channel shall have heavy duty Metal body sliding on precision ball bearings of high durability.

Measurement:

Measurement shall be of per Pair installed.

Rate:

Rate shall include all material, labor, tools and tackles required to complete the work as per item description.

Item No. 68.

Providing and fixing aluminium Grip profile handle with necessary screws etc. complete as approved drawing and as per direction of Engineer in charge.

General:

The Grip Profile shall be of Aluminum and of thickness suitable to fix on to the shutters of kitchen cabinets. The width of the profile shall match to the thickness of the cabinet shutter.

The profile shall be fixed to the shutter as per the methodology specified by the manufacturer with adhesive or CP screw. Screw should not be visible if used.

Measurement:

Measurement shall be of per running meter length installed.

Rate:

Rate shall include all material, labor, tools and tackles required to complete the work as per item description.

Item No. 69.

Providing & Fixing Fire Resistance BSEN 1634:1:2000 Certified S.S. 316 Grade Satin Finish 1.5 mm thick Hollow Pipe 'D' Shape Pull Handle with dia 32 mm and centre to centre distance 600mm high Grade Brass Bushing should be for Extra Fixing strength including necessary fixing Accessories of Approved make complete as specified as per drawing and as per directed by engineer in charge.

Relevant specifications shall be followed as per item number 63 except that 600 mm D shaped Handles of the size mentioned in BOQ shall be installed as per the drawing.

Item No. 70.

Providing & Fixing Fire Resistance BSEN 1634:1:2000 Certified S.S. 316 Grade Satin Finish 1.5 mm thick Hollow Pipe 'D' shape Pull Handle with dia 22 to 25 mm and centre to centre distance 300mm high Grade Brass Bushing should be for Extra Fixing strength including necessary fixing Accessories of Approved as specified as per drawing and as per directed by engineer in charge..

Relevant specifications shall be followed as per item number 63 except that 300 mm D shaped Handles of the size mentioned in BOQ shall be installed as per the drawing.

Item No. 71.

Providing and fixing Magnet Catcher for wardrobe/ cabinet shutters of approved make with necessary screws etc. complete as approved drawing and as per direction of Engineer in charge.

For shutter shall be of the size as per required of Approved make with necessary concealed size complete, as specified in drawing and as approved by Engineer in charge.

Item No. 72.

Providing and fixing sliding Top & Bottom Track set of approved make suitable for wooden sliding door of total weight up to 100 kg. with all hardware as per architectural drawing and as directed by engineer in charge. (Including Top Roller -,Bottom Roller -,Heavy duty aluminium top track profile of suitable size for the door up to Rigid aluminium flush bottom track profile 25x19x3;conceled bottom guide 100x32x3;concealed intermediate hanger 100x32x3 with roller made of wool pile or Nylon; end bottom guide 100x32x3;aluminium drop bolt 200x36x2 spender dia 10 mm; end carrier set 100x32x3; etc.as per manufacturers specifications and as per approval of Engineer-In-Charge- One Complete set for one door of Minimum 1.5 meter width. Number of rollers and rail length to be provided accordingly.

General:

Sliding door set shall be installed as per the item description..

Measurement:

Measurement shall be of per Set installed.

Rate:

Rate shall include all material, labor, tools and tackles required to complete the work as per item description.

Item No. 73.

Providing & Fixing Satin Finish Patch Lock of High Quality Aluminium body including Euro Profile Pin Cylinder of Brass, Spring-Loaded Push Pins for easy installation & Firm Fittings with S.S. 304 Grade Cover, Suitable for Glass Door, Maximum Door Weight 120 Kg. & Door Width up to 1200 mm of Approved make with necessary fixing Accessories complete as per specified and as per drawing and directed by engineer in charge.

General:

The patch lock shall be fixed as per the item description

Measurement:

Measurement shall be of per set installed.

Rate:

Rate shall include all material, labor, tools and tackles required to complete the work as per item description.

Item No. 74.

Providing & Fixing Fire resistance BSEN 1634:1:2000 Certified Satin Finish Dead Bolt with back set approximate size of 50 mm and Bolt part should be

high Quality Zinc with size 52 mmX 10 mm, minimum Weight should be approximate 441 grm. including 2.5 mm thick Stainless Steel main & 1.2 mm thick Strike Plate of Approved make suitable for minimum 30 mm thick Single door Shutter with necessary fixing screws as specified as per drawing and as directed by engineer in charge.

General:

Relevant specifications shall be followed as per item 58 except that only dead bolt back set to installed. The product shall be as per manufacturers specifications..

Measurement:

Measurement shall be of per set installed.

Rate:

Rate shall include all material, labor, tools and tackles required to complete the work as per item description.

Item No. 75.

Providing and fixing carbon steel galvanized (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm²), counter sunk head, comprising of 10 m dia polyamide PA 6 grade sleeve, including drilling of hole in frame, concrete/ masonry, etc. as per direction of Engineer-in-charge.

(a) 10 x 80 mm

Relevant specifications shall be followed as per DSR Item no 10.27.2

Item No. 76.

Filling the gap in between frame & adjacent RCC/ Brick/ Stone work by providing weather silicon sealant over backer rod of approved quality as per architectural drawings and direction of Engineer-in-charge complete. Up to 5mm depth and 5 mm width

Relevant specifications shall be followed as per item number 21.8.1. In addition, the following specifications shall also be followed.

SEALANT

The sealants of approved grade and colour shall only be used. The silicone for perimeter joints (between Aluminium section and RCC/Stone masonry) shall be of make approved by the Engineer in Charge.)

Method of Application

Surface Preparation

Clean all joints and glazing pockets by removing all foreign matter and contaminants such as grease, oil, dust, water, frost, surface dirt, old sealants or glazing compounds and protective coatings.

Masking

Areas adjacent to joints shall be masked to ensure neat sealant lines. Masking tape shall not be allowed to touch clean surfaces to which the silicone sealant is to adhere. Tooling shall be completed in one continuous stroke immediately after sealant application and before a skin forms and masking shall be removed immediately after tooling.

Application

Install backer rod of appropriate size and apply silicone sealant in a continuous operation using a positive pressure adequate to properly fill and seal the joint. The silicone sealant shall be tooled with light pressure to spread the sealant against backing material and the joint surfaces before a skin forms. A tool with convex profile shall be used to keep the sealant within the joint. Soap or water shall not be used as a tooling aid. Remove masking tape as soon as silicone joint is tooled.

Tolerance

A tolerance of + 3 mm shall be allowed in the width of silicone joints. The depth of the joints at throat shall not be less than 6 mm.

Item No. 77.

Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered/Gypsum or any other wall/ ceiling surface as required to prepare the surface even and smooth complete.

1 Materials

Cement based putty of approved brand and manufacture shall be used. Only ready mixed putty as received from the manufacturer without any admixture shall be used.

2 Commencing Work

Cement based putty shall not be started until the Engineer-in-Charge has inspected the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work. Cement based putty shall generally be taken in hand after practically finishing all other building work. The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the Putty work being started.

3 Preparation of Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

4 Application

Before starting painting work order to achieve a superior finished surface, putty/ paste fillers shall be used on, all surfaces to be painted to fill pores, dents etc. The putty/paste fillers shall be approved quality and manufacture and shall be applied to the surface with a knife or other sharp edged tool after the priming coat as well after each under coat. The surface, after filling with putty/paste filler, shall be rubbed down with fine paper and dusted off before the application of the subsequent coat. Paste wood filler when set shall be wiped across the grain of the wood and then with the grain to secure a clean surface. Surface to be stained shall be covered with a uniform coat of stain wiped off if required. Each coat shall be allowed to dry completely and lightly rubbed with fine grade pumice stone sand paper before next coat is applied. Each coat shall vary in shade and well approved to Engineer in charge.

5 The specifications in respect of scaffolding, protective measures, measurements and rate shall be as described in painting.

Item No. 78.

Applying priming coats with primer of approved brand and manufacture, having low VOC (Volatile Organic Compound) content With ready mixed pink or grey primer on wood work (hard and soft wood) having VOC content less than 50 grams/ litre

Material

The primer shall be ready mixed primer of approved brand and manufacture.

Cement primer coat is used as a base coat on wall finish of cement, lime or lime cement plaster or on non-asbestos cement surfaces before oil emulsion distemper Paints are applied on them. The cement primer is composed of a medium and pigment which are resistant to the alkalies present in the cement, lime or lime cement in wall finish and provides a barrier for the protection of subsequent coats of oil emulsion distemper Paints.

Wood work primer be prepared from a mixture of red lead, white lead and double boiled linseed oil in the ratio of 0.7 kg : 0.7 kg : 1 litre.

Steel work primer be prepared from a mixture of red lead, raw linseed oil and turpentine in the ratio of 2.8 kg : 1 litre : 1 litre.

Primer coat shall be preferably applied by brushing and not by spraying. Hurried priming shall be avoided particularly on absorbent surfaces. New plaster patches in old work should also be treated with cement primer before applying oil emulsion Paints etc

Primer for plaster/wood work/Iron & Steel/Aluminium surfaces shall be as specified below in Table:

Sr.no	Surfaces	Prime to be used
1. 2. 3.	Wood work (hard and soft wood) Resinour wood and plywood (A) Aluminiumand light alloys (B) Iron, Steel and Galvanized steel	Pink conforming to IS 3536 Aluminium primer conforming to IS 3585 Zinc chromate primer conforming to IS 104 Red Oxide Zinc chromate

4.	Cement/Conc/RCC/brick work, Plastered surfaces, non-asbestos surfaces to receive Oil bound distemper or Paint finish.	Primer conforming IS 2074 Cement primer conforming to IS 109

The specifications for the base vehicle and thinner for mixed on site primer shall be as follows:

(a) White Lead : The White lead shall be pure and free from adulterants like barium sulphate and whiting. It shall conform to IS 103.

(b) Red Lead : This shall be in powder form and shall be pure and free from adulterants like brick dust etc. It shall conform to IS 102.

(c) Raw Linseed Oil : Raw linseed oil shall be lightly viscous but clear and of yellowish colour with light brown tinge. Its specific gravity at a temperature of 30 degree C shall be between 0.923 and 0.928.

Note : The oil shall be mellow and sweet to the taste with very little smell. The oil shall be of sufficiently matured quality. Oil turbid or thick, with acid and bitter taste and rancid odour and which remains sticky for a considerable time shall be rejected. The oil shall conform in all respects to IS 75. The oil shall be of approved brand and manufacture.

(d) Double Boiled Linseed Oil : This shall be more viscous than the raw oil, have a deeper colour and specific gravity between 0.931 and 0.945 at a temperature of 30 degree C. It shall dry with a glossy surface. It shall conform in all respects to IS 77. The oil shall be of approved brand and manufacture.

Turpentine : Mineral turpentine i.e. petroleum distillate which has the same rate of evaporation as vegetable turpentine (distillate product of oleeresin of conifers) shall be used. It shall have no grease or other residue when allowed to evaporate. It shall conform to IS 533.

All the above materials shall be of approved manufacture and brought to site in their original packing in sealed condition.

1 Scaffolding

1.1 Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being white washed.

1.2 For all exposed brick work or tile work, double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

Note : In case of special type of brick work, scaffolding shall be got approved from Engineer-in-Charge in advance.

1.3 Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls.

2 Preparation of the Surface

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

2.1 Wooden Surface

The wood work to be painted shall be dry and free from moisture.

The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material conforming to IS 345 with same shade as Paint shall be used where specified. The surface treated for knotting shall be dry before Paint is applied. After obtaining approval of Engineer-in-Charge for wood work, the priming coat shall be applied before the wood work is fixed in position. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier's putty or wood putty. Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in stopping and the latter is therefore liable to crack.

2.2 Iron & Steel Surface :

All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed.

All dust and dirt shall be thoroughly wiped away from the surface.

If the surface is wet, it shall be dried before priming coat is undertaken.

Treatment on Steel for Aggressive Environment

A second coat of ready mixed red oxide zinc chromate primer may be applied where consi- dered necessary in aggressive environment such as near Industrial Establishment and Coastal regions where the steel members are prone to corrosion. The second coat (which shall be paid for separately) is to be applied after placing the member in position and just before applying Paint. The second coat of primer is not necessary in case of painting with synthetic enamel Paint as it is applied over an under coat of ordinary Paint.

2.3 Plastered Surface

The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall then be taken in hand. Before primer is applied, holes and undulations, shall be filled up with plaster of paris and rubbed smooth.

3 Application

The primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be

finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before oil emulsion Paint is applied.

4 Protective Measures

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be cement painted, shall be protected from being splashed upon. Splashing and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fittings and fixtures shall be recoverable from the contractor.

5 Measurements

5.1 Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals.

5.2 Measurements for Jambs, Soffits and Fills etc. for openings shall be as described above.

6 Rate

The rate shall include all material and labour involved in all the operations described above with tools and scaffolding.

Item No. 79.

Applying priming coats with primer of approved brand and manufacture, having low VOC (Volatile Organic Compound) content with water thinnable cement primer on wall, ceiling and partitions surface having VOC content less than 50 grams/litre

Relevant Specification for above item NO 80.

Item No. 80.

Painting with premium acrylic emulsion paint of interior grade, having VOC (Volatile Organic Compound) content less than 50 grams/ litre of approved brand and manufacture, including applying additional coats wherever required to achieve even shade and colour. Two coats

1 Materials

Paints, oils, varnishes etc. of approved brand and manufacture shall be used. Only ready mixed Paint (Interior grade) as received from the manufacturer without any admixture shall be used.

If for any reason, thinning is necessary in case of ready mixed Paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer-in-Charge shall be used.

Approved Paints, oil or varnishes shall be brought to the site of work by the contractor in their original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empties shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

2 Commencing Work

Painting shall not be started until the Engineer-in-Charge has inspected the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work. Painting of external surface should not be done in adverse weather condition like hail storm and dust storm.

Painting, except the priming coat, shall generally be taken in hand after practically finishing all other building work.

The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the Paint work being started.

3 Preparation of Surface

The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

4 Application

4.1 Before pouring into smaller containers for use, the Paint shall be stirred thoroughly in its containers, when applying also, the Paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform.

4.2 The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grains of wood. The crossing and laying off consists of covering the area over with Paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

4.3 Where so stipulated, the painting shall be done by spraying. Spray machine used may be (a) high pressure (small air aperture) type, or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

4.4 Spraying should be done only when dry condition prevails. Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by thorough ventilation. Each coat except the last coat, shall be lightly rubbed down with sand paper or fine pumice stone and cleaned off dust before the next coat is laid.

4.5 No left over Paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.

4.6 No hair marks from the brush or clogging of Paint puddles in the corners of panels, angles of mouldings etc. shall be left on the work.

4.7 In painting doors and windows, the putty round the glass panes must also be painted but care must be taken to see that no Paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting. However, bottom edge of the shutters where the painting is not practically possible,

need not be done nor any deduction on this account will be done but two coats of primer of approved make shall be done on the bottom edge before fixing the shutters.

5 Brushes and Containers

After work, the brushes shall be completely cleaned of Paint and linseed oil by rinsing with turpentine. A brush in which Paint has dried up is ruined and shall on no account be used for painting work. The containers when not in use, shall be kept closed and free from air so that Paint does not thicken and also shall be kept safe from dust. When the Paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean, and can be used again.

6 Measurements

6.1 The length and breadth shall be measured correct to a cm. The area shall be calculated in sqm (correct to two places of decimal), except otherwise stated.

6.2 Small articles not exceeding 10 sq. decimetre (0.1 sqm) of painted surfaces where not in conjunction with similar painted work shall be enumerated.

6.3 Painting up to 10 cm in width or in girth and not in conjunction with similar painted work shall be given in running meters and shall include cutting to line where so required.

Note : Components of trusses, compound girders, stanchions, lattices and similar work shall, however, be given in sq. meters irrespective of the size or girth of members. Priming coat of painting shall be included in the work of fabrication.

6.4 In measuring painting, varnishing, oiling etc. of joinery and steel work etc. The coefficients as indicated in following tables shall be used to obtain the area payable. The coefficients shall be applied to the areas measured flat and not girthed.

TABLE

Equivalent Plain Areas of Uneven Surface

I. Wood work doors, windows Etc.

1. Panelled or framed and braced doors, windows etc. — Measured flat (not girthed including) Chowkhat or frame, Edges, chocks, cleats, etc. shall be deemed to be included in the item. — 1.30 (for each side)

2. Ledged and battened or ledged, - battened and braced doors, windows etc. — -do- — -do-

3. Flush doors etc. — -do- — 1.20 (for each side)

4. Part panelled and part glazed or gauzed doors, window etc. (Excluding painting of wire gauze portion) — -do- — 1.00 (for each side)

5. Fully glazed or gauzed doors, windows etc. (Excluding painting of wire gauze portion) — -do- — 0.80 (for each side)

6. Fully venetioned or louvered — -do- — 1.80 (for each side)

doors, windows etc.

7. Trellis (or Jaffri) work one way or two way | Measured flat overall, no deduction shall be made for open spaces, sup- porting members shall not be measured separately | 2 (for painting all over)

8. Carved or enriched work | Measured flat | 2 (for each side)

9. Weather boarding | Measured flat (not girthed supporting frame work shall not be measured separately | 1.20 (for each side)

10. Wood shingle roofing | Measured flat (not girthed) | 1.10 (for each side)

11. Boarding with cover fillets and match boarding | Measured flat (not girthed) | 1.05 (for each side)

12. Tile and slate battening | Measured flat overall no deductions shall be made for open spaces | 0.80 (for painting all over)

II. Steel work doors, windows Etc.

13. Plain sheeted steel doors or windows | Measured flat (not girthed) including frame edges etc. | 1.10 (for each side)

14. Fully glazed or gauzed steel doors and windows (excluding painting of wire gauze portion) | -do- | 0.50 (for each side)

15. Partly panelled and partly glazed or gauzed doors and windows (excluding painting of wire gauze portion) | -do- | 0.80 (for each side)

16. Corrugated sheeted steel doors or windows | -do- | 1.25 (for each side)

17. Collapsible gates | Measured flat | 1.50 (for painting all over)

18. Rolling shutters of interlocked laths | Measured flat (size of opening) all over; jamb guides, bottom rails and locking arrangement etc. shall be in- cluded in the item (top cover shall | 1.10 (for each side)

	be measured separately)		
III. General			
19. Expanded metal, hard drawn steel wire fabric of approved quality, grill works and gratings	Measured flat overall; no deduction shall be made for open spaces; supporting members shall not be measured separately	1 (for Paint all over)	in guard bars, balustrades, railing
partitions and MS Bars in windows frames.			
20. Open palisade fencing and gates including standards, braces, rails stays etc. in timber or steel	-do- (see note No. 12)	1 (for Paint all over)	
21. Corrugated iron sheeting in roofs, side cladding etc.	-do-	Measured flat (not girthed)	1.14 (for each side)
22. AC corrugated sheeting in roofs, side cladding etc.	-do-	1.20 (for each side)	
23. AC semi corrugated sheeting in roofs, side cladding etc. or	-do-	1.10 (for each side)	Nainital pattern using plain sheets
24. Wire gauze shutters including painting of wire gauze	-do-	1.00 (for each side)	

Explanatory Notes for Table

(1) Measurements for doors windows etc., shall be taken flat (and not girthed) over all including chowkhuts or frames, where provided. Where Chowkhuts or frames are not provided, the shutter measurements shall be taken.

(2) Where doors, windows etc., are of composite types other than those included in Table 1 the different portion shall be measured separately with their appropriate coefficients, the centre line of the common rail being taken as the dividing line between the two portions.

(3) The coefficients for door and windows shall apply irrespective of the size of frames and shutter members.

(4) In case steel frames are used the area of doors, windows shutters shall be measured flat excluding frames.

(5) When the two faces of a door, window etc. are to be treated with different specified finishes, measurable under separate items, the edges of frames and shutters shall be treated with the one or the other type of finish as ordered by the Engineer-in-Charge and measurement of this will be deemed to be included in the measurement of the face treated with that finish.

(6) In the case where shutters are fixed on both faces of the frames, the measurement for the door frame and shutter on one face shall be taken in the manner already described, while the additional shutter on the other face will be measured for the shutter only excluding the frame.

(7) Where shutters are provided with clearance at top or/and bottom each exceeding 15 cm height, such openings shall be deducted from the overall measurements and relevant coefficient shall be applied to obtain the area payable.

(8) Collapsible gates shall be measured for width from outside to outside of gate in its expanded position and for height from bottom to top of channel verticals. No separate measurements shall be taken for the top and bottom guide rails rollers, fittings etc.

(9) Coefficients for sliding doors shall be the same as for normal types of doors in the table.

Measurements shall be taken outside to outside of shutters, and no separate measurements shall be taken for the painting guide rails, rollers, fittings etc.

(10) Measurements of painting as above shall be deemed to include painting all iron fittings in the same or different shade for which no extra will be paid.

(11)The measurements of guard bars, expanded metal, hard drawn steel wire fabric of approved quality, grill work and gratings, when fixed in frame work, painting of which is once measured else where shall be taken exclusive of the frames. In other cases the measurements shall be taken inclusive of the frames.

(12) For painting open palisade fencing and gates etc., the height shall be measured from the bottom of the lowest rail, if the palisades do not go below it, (or from the lower end of the palisades, if they project below the lowest rail), upto the top of rails or palisades whichever are higher, but not up to the top of standards when the latter are higher than the top rails or the palisades.

6.5 Width of moulded work of all other kinds, as in hand rails, cornices, architraves shall be mea- sured by girth.

6.6 For trusses, compound girders, stanchions, lattice girders, and similar work, actual areas will be measured in sq. meter and no extra shall be paid for painting on bolt heads, nuts, washers etc. even when they are picked out in a different tint to the adjacent work.

6.7 Painting of rain water, soil, waste, vent and water pipes etc. shall be measured in running meters of the particular diameter of the pipe concerned. Painting of specials such as bends, heads, branches, junctions, shoes, etc. shall be included in the length and no separate measurements shall be taken for these or for painting brackets, clamps etc.

6.8 Measurements of wall surfaces and wood and other work not referred to already shall be recorded as per actual.

6.9 Flag staffs, steel chimneys, aerial masts, spires and other such objects requiring special scaffolding shall be measured separately.

7 Precautions

All furnitures, fixtures, glazing, floors etc. shall be protected by covering and stains, smears, splashings, if any shall be removed and any damages done shall be made good by the contractor at his cost.

WALL PAINTING WITH ACRELIC PLASTIC EMULSION PAINT

0.1 The plastic emulsion Paint is not suitable for application on external, wood and iron surface and surfaces which are liable to heavy condensation. These Paints are to be used on internal surfaces except wooden and steel.

0.2 Plastic Emulsion Paint as per IS 5411 of approved brand and manufacture and of the required shade shall be used.

0.3 Painting on New Surface

0.3.1 The wall surface shall be prepared as specified above.

0.3.2 Application : The number of coats shall be as stipulated in the item. The Paint will be applied in the usual manner with brush, spray or roller. The Paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer’s instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

0.3.3 Precautions

(a) Old brushes if they are to be used with emulsion Paints, should be completely dried of turpentine or oil Paints by washing in warm soap water. Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the Paint from hardening on the brush.

(b) In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing of surfaces treated with emulsion Paints shall not be done within 3 to 4 weeks of application.

0.3.4 Other details shall be as specified above as they are applicable.

8 Rate

Rates shall include cost of all labour and materials involved in all the operations described above with tools and scaffolding.

Item No. 81.

Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete. On steel work

Relevant specifications shall be followed as per CPWD DSR item number 13.52.1. In addition, the following shall also be followed.

1 Material

Epoxy Paint shall be (conforming to IS 2339) of approved brand and manufacture. The Paint comes in compact dual container with the paste and the medium separately. The two shall be mixed together to proper consistency before use.

2 Preparation of Surface

All rust and scales shall be removed by scraping or brushing with steel wire brushes and then smoothened with sand paper. The surface shall be thoroughly cleaned of dust.

3 Application

The number of coats to be applied shall be as given in the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted off before the next coat is applied. The finished surface shall present an even and uniform appearance.

As paste is likely to settle in the container, care shall be taken to frequently stir the Paint during used. Also the Paint shall be applied and laid off quickly, as surface is otherwise not easily finished.

Other details, measurements and rates shall be as specified in painting.

Item No. 82.

Providing and applying two coats of fire retardant paint on cleaned wood / ply / steel surface @ 3.5 sqm per litre per coat including preparation of base surface as per recommendations of manufacturer to make the surface fire retardant.

1 Material

fire retardant Paint shall be of approved brand and manufacture. The Paint comes in compact dual container with the paste and the medium separately.

The two shall be mixed together to proper consistency before use.

2 Preparation of Surface

All rust and scales shall be removed by scraping or brushing with steel wire brushes and then smoothened with sand paper. The surface shall be thoroughly cleaned of dust.

3 Application

The number of coats to be applied shall be as given in the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted off before the next coat is applied. The finished surface shall present an even and uniform appearance.

As paste is likely to settle in the container, care shall be taken to frequently stir the Paint during used. Also the Paint shall be applied and laid off quickly, as surface is otherwise not easily finished.

Other details, measurements and rates shall be as specified in painting.

Item No. 83.

Providing and applying Melamine polishing with "Asian paints Melamine Gold" or "Timber tone Melamine" of ICI Dulux or "Wudfin of Pidilite Industries Limited", on wood & veneer works (two or more coats) including preparation of surface and staining to the approved colour and shade as per the manufacturers specifications including scaffolding, curing, cleaning the surfaces and other incidental work to be done etc. complete at all floors for any height as directed by engineer in charge.

Material:

The melamine polish is two component acid catalyzed wood finish shall be of best quality and make such as Asian Paints, Nerolac, Burger or equivalent, as approved. It shall give silken, smooth finish. It offers excellent non yellowing and stain resistant property. The Melamine polish shall have shade and shine, either Mat or glossy. It shall be two component polish consisting of a base and hardener. It shall be capable of protecting wood from moisture, heat, cold, scratches, stains, cigarette burns etc. It shall be applied using brush or spray gun. It shall require lesser time to dry and there shall be no cracks or pealing of the polish. There shall not be any undulation on the finished surface nor cracks at joints. It shall be durable and flexible to absorb cracks. It shall have resistant to scrubs, light rays, heat etc.

Preparation of Surface: The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand and well dusted. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glazier’s putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1.5 Kg of whiting per liter of spirit. The surface shall again be rubbed

down perfectly smooth with glass paper and wiped clean.

Application: The number of coats of polish to be applied shall be as described in the item. A pad of woolen cloth covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with the polish and rubbed hard on the wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. Sand the surface with the emery paper no 180, apply wood filler and allow it to dry for 2-3 hours. Again sand the surface with the emery paper no 180, apply melamine sealer and allow it to dry for 2-3 hours. Sand the surface with the emery

paper no 320, wipe off the dust and dirt. Apply melamine polish mat or gloss as required two or three coat and finishing with spray coat.

Measurement shall be per Sqm and rate shall be inclusive of all material, labour, tools and tackles required to complete the work as per the item description and to the satisfaction of Engineer-In-Charge.

Item No. 84.

P**roviding and applying PU polish Exterior grade solvent based/ Water Based on wood work of approved makes, on natural wood & natural veneer works (two or more coats) including Two coats of sealer and two to three coats of PU polish including surface preparation, sanding, scrapping etc and staining to the required colour and shade as per the manufacturers specifications and the directions of the Engineer-in-Charge including the cost of the Surface Filler, Sealer and Polish.**

Relevant specifications shall be followed as per item number 83 and as per item description.

Item No. 85.

Varnishing with varnish of approved brand and manufacture: Two or more coats of glue sizing with copal varnish over an under coat of flatting varnish

Relevant Specification above item no 83.

Item No. 86.

Providing and Fixing of Flocked Carpet rolls flooring having a density of 70 mn fibres of nylons 6.6 per sqm firmly anchored into a waterproof backing and having an average recycled content of 20%. The carpet must inhibit the growth of Bacteria and Fungi. The Carpet must be Zero Emission carpet (Emission below detection limit after 28 days in accordance to ISO 16000-9 requirements). Fire Test EN-13501, Appearance Retention Hexapod ISO 140-8, Friction Slip resistance Test EN 14041 Class DS, Sanitized anti- microbial treatment with resilient water proof backing. The carpet should be anti stactic and thickness shall be 4.3 mm/ with approximate weight of 1.8 kg/ sqm. The carpet should be a acoustical property Impact sound Lw = 20 dB, Sound absorption = 0.10, as per ISO 354. The rate shall be inclusive of fixing at site as per the drawings and direction of Engineer in charge complete in all respect.

1. General

The Flocked Carpet rolls flooring having a density of 70 mn fibres of nylons 6.6 per sqm firmly anchored into a waterproof backing and having an average recycled content of 20%. The carpet must inhibit the growth of Bacteria and Fungi. The Carpet must be Zero Emission carpet (Emission below detection limit after 28 days in accordance to ISO 16000-9 requirements). Fire Test EN-13501, Appearance Retention Hexapod ISO 140-8,

Friction Slip resistance Test EN 14041 Class DS, Sanitized anti- microbial treatment with resilient water proof backing. The carpet should be anti stactic and thickness shall be 4.3 mm with approximate weight of 1.8 kg/ sqm

2. Fixing:

The carpet shall be laid and fixed on pre-leveled IPS flooring or any other flooring. The carpet shall be stuck on to the floor using suitable adhesive of approved brand.

3. Measurement

Surface area of the laid carpet surface should be measured in square meters correct to two places of decimal. Nothing extra shall be paid.

4. Rate

Rates shall include cost of all labour and materials involved in all the operations described above with tools and scaffolding.

Item No. 87.

Providing and fixing Engineered wooden flooring 15 mm up to 3 mm top layer, core layer pine wood oak london of Mikasa or equivalent with necessary T-profile and reducer fixing with under layer 2 mm thick High Density polyurethane foam having density of approx. 90 kg/cum and 2 mm thick rubber sheet as per manufacureres specifications and as directed by engineer in charge..

Providing and fixing 25 mm wooden planking, tongued and grooved in flooring, including fixing with Galvanized iron screws complete with, Second class teak wood on stage in 330 seater class room-

Planking to be fixed over Shock Absorbent foam over Water MR grade Plywood confirming to IS 710 of necessary thickness and Teak wood wooden framing. Cost of Foam, Plywood and Teak wood framing will be paid under relevant items.

(a) Second class teak wood

Seasoning and Preservation

All timber used for timber floors shall be thoroughly seasoned in accordance with IS 1141. After seasoning the timber shall be treated with preservative in accordance with IS 401. Seasoning and preservative treatment shall be paid for separately unless otherwise specifically included in the description of the item of flooring.

Supporting Joists

Main beams and joists of the class of wood sections specified in the description of the item for beams and joists, or as instructed by the Engineer-in-Charge shall be fixed in position to dead levels.

The width of the joints shall not be less than 50 mm. The arrangement and spacing of beams joists etc. shall be as per design furnished.

Boards

It shall be of the class of timber and thickness specified in the description of the item. The timber shall be as specified. Only selected boards of uniform width shall be used. Unless otherwise specified or shown in the drawings, the width of boards selected shall not be less than 100 mm nor more than 150 mm. The same width of boards shall not be maintained throughout except where the width of the room is not an exact multiple of the boards. In the latter case, the difference shall be equally adjusted between the two end boards (adjacent to walls). The length of the boards shall not exceed 3 meter anywhere. Ordinarily, the minimum length of boards shall be such that the boards shall rest at least on three supports, except where otherwise required by the pattern specified in the drawings or as directed by the Engineer-in-Charge.

The boards shall be planed true on the top face only unless otherwise specified in the description of the item. Where the bottom face is exposed and it is also required to be planed, then such planning shall be paid for extra.

Unless otherwise described in the item, the longitudinal joints of planks shall be tongued and grooved to a minimum depth of 12 mm while the heading joints shall be of the square butt type and shall occur over the center line of the supporting joists. Heading joists in adjacent boards shall be placed over the same joists.

Iron Screws

Iron screws shall be of the slotted counter sunk head type, of length not less than the thickness of planks plus 25 mm, subject to a minimum of 40 mm, and of designation No. 9 conforming to IS 451.

Fixing

The Planks will be fixed over shock absorbent foam of required thickness over a plywood sheet fixed to wooden framing. The joists of the wooden framing on which the planks shall be fixed shall be checked and corrected to levels. The end boards shall be accurately fixed with the sides parallel and close to the walls. Each adjoining board shall be carefully jointed and shall be tightened in position and screwed. For fixing the boards to the joists, two screws shall be used at each end of the boards and one screw at each of the intermediate joists in a zig zag manner. The screws shall be countersunk and screw holes filled with approved stopping.

The junction between timber flooring and adjacent flooring shall be formed by inserting a metal strip (brass or aluminum) at the junction. The metal strip shall be fixed to the end of the planks by screws.

The strips shall be paid for extra.

The flooring shall be truly level and plane. The joints shall be truly parallel and or perpendicular to the walls, unless otherwise specified. The floor shall be planned in both directions and made perfectly even, true and smooth.

Finishing

The surface of the floor shall be bees waxed or finished otherwise as directed by the Engineer-in-Charge. The lower face shall be painted or treated with wood preservative as directed. The finishing shall be paid for separately unless specifically included in description of the flooring item.

Measurements

Length and breadth of superficial area of the finished work shall be measured correct to a cm. The area shall be calculated in square meter correct to two places of decimal. No deduction shall be made nor extra paid for voids not exceeding 0.20 square meter. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square meter. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Shop drawings to be submitted and approval from Design Consultant to be taken by Contractor before execution.

Providing and fixing 6 mm to 12 mm thick High Density polyurethane foam having density of approx. 90 kg/cum. fixed to Ply wood sheet or Concrete floor with suitable adhesive to act as cushioning foam below the wooden flooring.

Item No. 88.

Providing and fixing Engineered wooden skirting 2400x80x20 mm up to 3 mm top layer, core layer pine wood oak london of Mikasa or equivalent with necessary T- profile and reducer fixing with underlayer 2 mm thick High Density polyurethane foam and 2 mm thick rubber sheet as per manufacureres specifications and as directed by engineer in charge.

Relevant specifications shall be followed as per item number 87 except that the wood shall be used in Skirting. Rate shall be for per RMT.

Item No. 89.

Dismantling tile work in floors and roofs laid in cement mortar including stacking material within 50 metres lead. For thickness of tiles 10 mm to 25 mm

DISMANTLING AND DEMOLISHING

TERMINOLOGY

(i) Dismantling: The term 'Dismantling' implies carefully separating the parts without damage and removing. This may consist of dismantling one or more parts of the building as specified or shown on the drawings.

(ii) Demolition: The term 'Demolition' implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the drawings.

GENERAL

This chapter relates to buildings only.

Precautions

All materials obtained from dismantling or demolition shall be the property of the Government unless otherwise specified and shall be kept in safe custody until they are handed over to the Engineer-in-Charge/ authorized representative.

The demolition shall always be well planned before hand and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer-in-Charge before starting the work.

Due care shall be taken to maintain the safety measures prescribed in IS 4130.

Necessary propping, shoring and or under pinning shall be provided to ensure the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever specified, temporary enclosures or partitions and necessary scaffolding with suitable double scaffolding and proper cloth covering shall also be provided, as directed by the Engineer-in-Charge.

Necessary precautions shall be taken to keep noise and dust nuisance to the minimum. All work needs to be done under the direction of Engineer-in-Charge. Helmets, goggle, safety belts etc. should be used whenever required and as directed by the Engineer-in-Charge.

The demolition work shall be proceeded with in such a way that it causes the least damage and nuisance to the adjoining building and the public.

Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or by demolishing roofs, masonry etc. shall be carefully removed first. Chisels and cuters may be used carefully as directed. The dismantled articles shall be removed manually or otherwise, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-in-Charge.

Where existing fixing is done by nails, screws, bolts, rivets, etc., dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.

Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-in-Charge within a lead of 50 metres. All unserviceable materials, rubbish etc. shall be disposed off as directed by the Engineer-in-Charge.

The contractor shall maintain/disconnect existing services, whether temporary or permanent, where required by the Engineer-in-Charge.

No demolition work should be carried out at night especially when the building or structure to be demolished is in an inhabited area.

Screens shall be placed where necessary to prevent injuries due to falling pieces.

Water may be used to reduce dust while tearing down plaster from brick work.

Safety belts shall be used by labourers while working at higher level to prevent falling from the structure.

First-aid equipment shall be got available at all demolition works of any magnitude.

RECOMMENDATIONS FOR DEMOLITION OF CERTAIN SPECIAL TYPES AND ELEMENTS OF

STRUCTURES

Roof Trusses

If a building has a pitched roof, the roof structure should be removed to wall plate level by hand method. Sufficient purlins and bracing should be retained to ensure stability of the remaining roof trusses while each individual truss is removed progressively.

Temporary bracing should be added, where necessary, to maintain stability. The end frame opposite to the end where dismantling is commenced, or a convenient intermediate frame should be independently and securely guyed in both directions before work starts.

On no account should the bottom tie of roof trusses be cut until the principal rafters are prevented from making outward movement.

Heavy Floor Beams

Heavy bulks of timber and steel beams should be supported before cutting at the extremities and should then be lowered to a safe working place.

Jack Arches

Where tie rods are present between main supporting beams, these should not be cut until after the arch or series of arches in the floor have been removed. Particular care should be exercised and full examination of this type of structure undertaken before demolition is commenced (see Fig. 15.1). The floor should be demolished in strips parallel to the span of the arch. rings (at right angles to the main floor beams).

Brick Arches

Expert advice should be obtained and at all stages of the demolition, the closest supervision should be given by persons fully experienced and conversant in the type of work to ensure that the structure is stable at all times.

As much dead load as possible may be removed provided it does not interfere with the stability of the main arch rings but it should be noted that the load-carrying capacity of many old arches relies on the filling between the spandrels. On no account should the restraining influence of the abutments be removed before the dead load of the sprandrel fill and the arch rings are removed.

The normal sequence of demolition is as shown in Fig. 15.2-A, namely:

(a) Remove spandrel in filling down to the springing line,

(b) Remove the arch. rings and

(c) Remove the abutment.

Special temporary support shall be provided in the case of skew bridges.

A single span arch. can be demolished by hand by cutting narrow segments progressively from each springing parallel to the span of the arch until the width of the arch has been reduced to a minimum which can then be collapsed (see Fig. 15.2B).

Where it is impossible to allow debris to fall to the ground below, centering designed to carry the load should be erected and the arch demolished progressively. The design of the centering should make appropriate allowance for impact.

Where deliberate collapse is feasible the crown may be broken by the demolition ball method working progressively from edges to the centre (see Fig. 15.2C).

Collapse of the structure can be effected in one action by the use of explosives. Charges should be inserted into boreholes drilled in both arch and abutments. This method is the most effective for demolition of tall viaducts.

In multi-span arches before individual spans are removed, lateral restraint should be provided at the springing level. Demolition may then proceed as for a single span, care being taken to demolish the spandrels down to the springing line as the work proceeds (see Fig. 15.2D). Where explosives are used it is preferable to ensure the collapse of the whole structure in one operation to obviate the chance of leaving unstable portions standing.

Cantilevers (Not part of a Framed Structure)

A cantilever type of construction depends for its stability on the super imposed structure. Canopies, cornices, staircases and balconies should be demolished or supported before the tailing down load is removed.

In-situ Reinforced Concrete

Before commencing demolition, the nature and condition of the concrete, the condition and position of reinforcement, and the possibility of lack of continuity of reinforcement should be ascertained.

Attention should be paid to the principles of the structural design to determine which parts of the structure depend on each other to maintain overall stability.

Demolition should be commenced by removing partitions and external non-load bearing cladding. It should be noted that in some buildings the frame may rely on the panel walls for stability.

Where hard demolition methods are to be used, the following procedures should be used.

(a) Reinforced Concrete Beams

For beams, a supporting rope should be attached to the beam. Then the concrete should be removed from both ends by pneumatic drill and the reinforcement exposed. The reinforcement should then be cut in such a way as to allow the beam to be lowered under control to the floor (see Fig. 15.3A).

(b) Reinforced Concrete Columns

For columns, the reinforcement should be exposed at the base after restraining wire guy ropes have been placed round the member at the top. The reinforcement should then be cut in such a way as to allow the column to be pulled down to the floor under control. (see Fig. 15.3B for sequence of operations).

(c) Reinforced Concrete Walls

Reinforced concrete walls should be cut into strips and demolished as for columns (Fig. 15.3C).

MEASUREMENTS

All work shall be measured net in the decimal system, as fixed in its place, subject to the following limits, unless otherwise stated hereinafter.

(a) Dimensions shall be measured correct to a cm.

(b) Areas shall be worked out in sqm correct to two places of decimal.

(c) Cubical contents shall be worked out to the nearest 0.01 cum.

Parts of work required to be dismantled and those required to be demolished shall be measured separately.

Measurements of all work except hidden work shall be taken before demolition or dismantling and no allowance for increase in bulk shall be allowed.

Specifications for deduction for voids, openings etc. shall be on the same basis as that adopted for new construction of the work.

Work executed in the following conditions shall be measured separately.

(a) Work in or under water and/or liquid mud

(b) Work in or under foul position.

Roofs

(i) Roof coverings generally including battens boarding, mats, bamboo jaffari or other subsidiary supports shall be measured in square metres except lead sheet roof covering which shall be measured in quintals (15.2.3) and stone slab roof covering which shall be measured in cubic metres.

(ii) Ridges, hips and valleys shall be girthed and included with the roof area. Corrugated or semi corrugated surfaces shall be measured flat and not girthed.

(iii) Mud phuska on roofs shall be measured in cubic metres.

(iv) Lead sheets in roofs shall be measured in quintals and hips, valleys, flashings, lining to gutter etc. shall be included in this weight.

(v) R.B. or R.C.C. roofs shall be measured as specified in 15.3.11.

(vi) Supporting members, such as rafters, purlins, beams joists, trusses etc. of wood shall be measured in cubic metres and steel or iron sections, in quintals.

Ceiling

(i) The stripping of ceilings shall be measured in square metres.

(ii) Dismantling of supporting joists, beams, etc. shall be measured in cubic metres or in quintals as specified in 15.3.6(vi).

(iii) Height above floor level, if it exceeds 3.5 m shall be paid for separately.

Flooring and Pavings

Dismantling of floors (except concrete and brick floors) shall be measured in square metres.

Supports such as joints, beams etc. if any shall be measured as per 15.3.6(vi). Concrete and bricks paving shall be measured as per 15.3.9.

Concrete and Brick Roofs and Suspended Floors

Demolition of floors and roofs of concrete or brick shall be measured in cubic metres. Beams cantilevers or other subsidiary supports of similar materials, shall be included in

the item. In measuring thickness of roofs provide with water proofing treatments with bitumen felts, the thickness of water proofing treatment shall be ignored.

Walls and Piers

(i) Taking down walls and independent piers or columns of brick, stone or concrete shall be measured, in cubic metres. All copings, corbels, cornices and other projections shall be included with the wall measurements.

(ii) In measuring thickness of plastered walls, the thickness of plaster shall be ignored.

(iii) Ashlar face stones, dressed stone work, pre-cast concrete articles, etc. if required to be taken down intact shall be so stated and measured separately in cubic metres.

(iv) Cleaning bricks stacking for measurements including all extra handling and removal and disposing off the rubbish as stated shall be enumerated in thousand of cleaned bricks.

(v) Cleaning stone obtained from demolished/dismantling stone masonry of any description including ashlar facing dressed stone work, stone slabs or flagging and pre-cast concrete blocks including all extra handling and disposing off the rubbish as stated shall be measured in cubic metres of cleaned stone.

(vi) Honey comb works or cavity walls of bricks stone or concrete shall be measured as solid.

Reinforced Concrete and Brick Work

Reinforced concrete structures and reinforced brick roofs and walls shall be measured in cubic metres and if reinforcement is required to be salvaged, it shall be so stated. Where reinforcement is required to be separated, scraped and cleaned, the work shall be measured separately in quintal of salvaged steel.

Partitions, Trellis Work etc.

Partitions or light walls, of lath and plaster, trellis work, expanded metal, thin concrete or terracotta slabs and other similar materials including frame work if any shall be measured in square metres stating the over all thickness.

Wood Work

All wood work including karries average 40 sq cm or over in section, shall be measured in cubic metres, while that under 40 sq cm in section, in running metres. Ballies shall be measured in running metres.

Boarding including wooden chajjas and sun shades along with supports shall be measured in square metres in its plane.

Steel and Iron Work

(i) All steel and iron work shall be measured in quintals. The weight shall be computed from standard tables unless the actual weight can readily be determined.

(ii) Riveted work, where rivets are required to be cut, shall be measured separately.

(iii) Marking of structural steel required to be re-erected shall be measured separately.

(iv) In framed steel items, the weight or any covering material or filling such as iron sheets and expanded metal shall be included in the weight of the main article unless such covering is not ordered to be taken out separately.

Doors and Windows

Dismantling of doors, windows, clerestory windows, ventilators etc. (wood or metal) whether done separately or along with removal of wall by making recess in the wall shall be enumerated. Those exceeding 3 sqm each in area shall be measured separately. The item shall include removal of chowkhats architraves, holdfasts and other attachments.

If only shutters are to be taken out it shall be measured separately.

Pipes and Sewer Lines

(i) Water pipe lines including rain water pipes with clamps and specials, sewer lines (salt glazed ware or concrete) etc. shall be described by their diameter and length measured in running metres inclusive of joints.

(ii) If the joints, special and fittings etc. are required to be separated, it shall be so stated and enumerated.

(iii) Pucca drains shall be measured under relevant items.

(iv) Valve cistern, public fountain platform, fire hydrants, etc. shall be enumerated.

(v) Manholes and inspection chambers shall be enumerated stating the size and depth of manhole/inspection chamber. They shall be classified into different groups depending upon the depth, in unit of half and one metre depth. The depth of the manhole shall be the distance between the top of manhole cover and invert level of the drain.

(vi) Ventilating shafts, gully traps, flushing cisterns and other appurtenant items of work shall be enumerated.

Posts or Struts

Posts or struts (wood, steel or RCC) section including taking out embedded portion shall be measured in running metres.

Fencing Wire Mesh

Wire mesh fencing of any type with frame shall be measured in square metres.

Glazing

Taking out any portion of serviceable glass except polished plate, from old sashes, skylights, etc. (any thickness, weight or size) raking out old putty, etc. shall be measured in square metres. Irregular circular panes shall be measured as rectangle or square enveloping the same. The width and height being measured correct to the nearest 0.5 cm.

Road Work

(i) Different types of road surfaces shall be measured separately.

(ii.) Road surfaces metalling or soling (base) shall be measured in square metres.

(iii) Concrete paving shall be measured as in 15.3.8 or 15.3.9 as the case may be.

RATES

The rate shall include the cost of all labour involved and tools used in demolishing and dismantling including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable material properly and disposing off unserviceable material within a distance of 50 metres. The rate shall also include for temporary shoring for the safety of portions not required to be pulled down, or of adjoining property, and providing temporary enclosures or partitions, where considered necessary.

Item No. 90.

Dismantling stone slab flooring laid in cement mortar including stacking of serviceable material and disposal of unserviceable material within 50 metres lead.

Relevant Specification shall be followed as per item number 89.

Item No. 91.

Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand):

a) 25 mm thick

Relevant specifications shall be followed as per CPWD DSR item number 11.26.1. In addition the below specifications shall also be followed.

Kota Stone Slabs

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer-in-Charge.

The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-in-Charge.

Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the description of the item. Tolerance of ±2 mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of ± 5 mm for hand cut slabs and ± 2 mm for machine cut slabs shall be allowed.

Laying

Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as given in the description of the item.

The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab shall be not less than 12 mm.

The slabs shall be laid in the following manner:

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the marble slabs as given in the description of the item.

The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge. Joint thickness shall not be more than 1 mm.

Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins/streaks or as directed by the Engineer-in-Charge.

The slabs shall be matched as shown in drawings or as instructed by the Engineer-in-Charge.

Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.

Marble slabs flooring shall also be laid in combination with other stones and/or in simple regular pattern/design as described in item of work and/or drawing.

Polishing and Finishing

Slight unevenness at the meeting edges of slabs shall then be removed by fine chiselling and finished in the same manner as specified in 11.10.3 except that cement slurry with or without pigments shall not be applied on the surface before each polishing.

Measurements

Marble stone flooring with different kind of marble shall be measured separately and in square metre correct to two places of decimal. Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for laying the floor at different levels in the same room. Steps and treads of stairs paved with marble stone slabs shall

also be measured under the item of Marble Stone flooring. Extra shall, however, be paid for such areas where the width of treads does not exceed 30 cm. Nosing for treads shall be measured in running metre and paid for extra. The width of treads shall be measured from the outer edge of the nosing, as laid, before providing the riser.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above. However, extra shall be paid for making special type of pattern/design/flowers as per drawings.

No deductions shall be made in rate even if flooring is done without any pattern/design.

Item No. 92.

Providing and laying vitrified floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS : 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), including grouting the joints with white cement and matching pigments etc., complete.

(a) : Size of Tile 600x600 mm

Relevant specifications shall be followed as per CPWD DSR item number 11.41.2. In addition the below specifications shall also be followed.

Vitrified Tiles

The tiles shall be of approved make and shall generally conform to IS 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The tiles shall be tested as per IS 13630.

Classification and Characteristics of pressed vitrified tiles shall be as per IS 13712.

The tiles shall be square or rectangular of nominal size. Table 12 of IS 15622 give the preferred sizes. Thickness shall be specified by the manufacturer. It includes the profiles on the visible face and on the rear side.

Manufacturer/supplier and party shall choose the work size of tiles in order to allow a nominal joint width upto 2mm for unrectified floor tiles and upto 1mm for rectified floor tiles. The joint in case of spacer lug tile shall be as per spacer. The tiles shall conform to table10 of IS 15622 with water absorption 3 to 6%

(Group BII).

Preparation of Surface and Laying

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm.

Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square metre over an area upto one square metre. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. In bath, toilet W.C. kitchen and balcony / verandah flooring, suitable tile drop or as shown in drawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints.

Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.

After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

Measurements

Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster and the area calculated in square metre correct to two places of decimal. Where coves are used at the junctions, the length and breadth shall be measured between the lower edges of the coves.

No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre.

Areas, where glazed tiles or different types of decorative tiles are used will be measured separately.

Rate

The rate for flooring shall include the cost of all materials and labour involved in all the operations described above, For tiles of sizes upto 0.16 sqm. unless otherwise specified in the description of the item. Nothing extra shall be paid for the use of cut (sawn) tiles in the work.

Extra over and above the normal rate for white tiles shall be paid where coloured or any other type of decorative tiles have been used.

Item No. 93.

Supply and installation of Signage plate for Cabin/Class room/Meeting Rooms Names of Size 300 mm x 120mm x 1.5 mm in SS 304 Matt finish having Letters engraved in the SS plate in Black vinyl steam pressed to get a clean finish and having font size of name atleast 20 mm and font size of designation 16 mm fixed on to the wall or Door surface with high quality adhesive tape of 3M or equivalent complete to the satisfaction of Engineer In Charge.

The Signage plate shall be for Cabin/ Classrooms/ Meeting rooms and other such office spaces. The signage shall be installed on to the wall or door surface using high quality two sided adhesive tape of 3M or equivalent. The plate shall be in SS 304 and the name shall be engraved in to the plate and then filled with Black Vinyl which shall be steam pressed in to the engraved portion to give a finished and clean look. No air bubbles shall be there in the pressed vinyl sheet. The plate shall be made as per the drawings released for execution.

The rate shall be for per number of plate.

Item No. 94.
Supply and installation of Signage plate for Toilets (Male/Female/Divyang/Pantry) of Size 120 mm x 120mm x 1.5 mm in SS 304 Matt finish having Letters engraved in the SS plate in Black vinyl steam pressed to get a clean finish and having font size of name atleast 30 mm fixed on to the wall or Door surface with high quality adhesive tape of 3M or equivalent complete to the satisfaction of Engineer In Charge.

Relevant specifications shall be used as per item number 97.

Item No. 95.
Supply and installation of Signage plate for FIRE EXIT SIGNAGE of Size 300 mm x 120mm x 1.5 mm in SS 304 Matt finish having Letters engraved in the SS plate in Black vinyl steam pressed to get a clean finish and having font size of name atleast 40 mm fixed on to the wall or Door surface with high quality adhesive tape of 3M or equivalent complete to the satisfaction of Engineer In Charge.

Relevant specifications shall be used as per item number 97.

Item No. 96.
Supply and installation of Directional Signage plate (Arrows) of Size 120 mm x 120mm x 1.5 mm in SS 304 Matt finish having Letters engraved in the SS plate in Black vinyl steam pressed to get a clean finish and having Arrow Size 100 mm x 75 mm fixed on to the wall or Door surface with high quality adhesive tape of 3M or equivalent complete to the satisfaction of Engineer In Charge.

Relevant specifications shall be used as per item number 97.

Item No. 97.
Supplying and Fixing aluminium profile shutters for overhead cabinets including finishing of the shutters frame with powder coated finish of minimum 50 micron of color as per the Architects selections. The Shutter profile shall have in built handle provision for the bottom shutter profile as per Architect selection, design and drawing. The rate shall be inclusive of all the cleats, screws, EPDM gaskets, Silicone Sealants, fabrication as per drawing, fixing at site etc required for the shutter. (Soft Close hinges and Glass infill shall be paid separately).

The aluminium profile used shall be of approved make and shall be finished with Powder coated finish to the satisfaction of the Architect. The Bottom frame of the profile shutter shall have the provision of Grip handle. The rate shall be for per square meter of the shutter and the measurement shall be of the profile shutter frame.

Item No. 98.
Supplying and fixing of Approved quality back painted glass with Glass 12 mm thick for horizontal and vertical surfaces from Approved make list painted with high quality low VOC paint to provide a uniform and glossy finish to the painted suface when seen through the glass. The finish and the paint color shall be as per selection of Architect. The back painted glass shall be prepared using approved quality paint and shall be sprayed on to the glass and baked as per manufacturers specifications to get proper finish and quality of the back painted glass. Rate shall be inclusive of fixing of the glass on the the wall panelling or on to the shutters as per the design and sizes mentioned in the drawing.

The Glass used shall be of approved make and thickness as per item description. The glass shall be back painted using approved quality paint as per manufacturer's specifications. The Baking process for the back painted glass shall be as per the manufacturers specifications. The Glass shall be fixed on to the surface using approved quality adhesives.

Rate shall be for per square meter of the glass installed at site.

Item No. 99.
Supplying and fixing of Approved quality back painted glass with Glass 6 mm thick for cabinet shutters from Approved make list painted with high quality low VOC paint to provide a uniform and glossy finish to the painted suface when seen through the glass. The finish and the paint color shall be as per selection of Architect. The back painted glass shall be prepared using approved quality paint and shall be sprayed on to the glass and baked as per manufacturers specifications to get proper finish and quality of the back painted glass. Rate shall be inclusive of fixing of the glass on the the wall panelling or on to the shutters as per the design and sizes mentioned in the drawing.

Item No. 100. Supplying and fixing of 12 mm thick Corian slab in single piece on table top including fixing the same on the table using approved quality adhesive including finishing all the edges of the table top to half round or chamfered edge as per the Architects directions and to the satisfaction of the Architect/ Engineer IN Charge. The rate shall be inclusive of all the tools and tackles and other accessories required for the same.

Relevant specifications shall be followed as per item number 98 above.

Item No. 101.

Providing and Fixing of Acoustic Movable partiton with Fabric Finish of approved make having thickness of 100 mm with minimum STC value of 44 or above having internal built consisting of Retractable Mechanism to move Top and Bottom Seal Manually Operated by a Handle inserted in the Panel Stile, Rotating the handle clockwise / anticlockwise shall simultaneously Extend or Retract the Top and Bottom Seals through gear Mechanism which shall firmly hold the Seals in the Retracted or Extended mode. The panel Trims will be standard series with exposed Aluminium trims of 15mm thickness finished in 6063 - T5 Anodized Aluminium shall be used. Each panel will have top and bottom Rubber Retractable seal with Concave / Convex Vertical Interlocking profiles. Vinyl Seal of Butane Rubber will be used at top and bottom and as well as Closure Seals for the Operable wall system. Retractable seal drop will be 20 mm. Each Panel shall be suspended on Extruded 6063 - T5 Anodized Aluminium Track, Steel Cold Ball Bearing Rollers / Trolley of material nylon wheel made with the base Material of POM 45 tempered steel , maintenance free with multiple Bal bearing. The individual element is adjustable in height without opening of the ceiling. 100 mm thick Panels will be made from 12mm MDF / Clipboard Panels hung in Acoustic Isolation from the frame and allowed to vibrate independently of the frame. The Panels must be filled with Acoustic material Rockwool of 64Kg/m3 density & Sound Damping layer of 2 mm thick high density material to achieve Sound STC of 44 dbA as per site condition. The width of panel will be from 800 mm to 1200 mm maximum, as per site condition. The panel faces shall be finished with selected material as per architects selection and color. Partitions shall be top supported, manually operated panels stacked in an area nominated in the plans. When closed, the operable wall shall provide a complete sound retardant barrier. No floor track shall be used. The panels will be stacked as per the agreed method of One Side Stacking OR two Side Stacking in accordance with the architectural plan. The Required MS Framing work for the movable partion is included in the cost. The Contractor shall submit shop drawings for the movable partition for approval before commencement of work at site.

The supply and installation shall be done as per the item description. The rate shall be for per square meter installed. Contractor to provide shop drawing for the same for approval and shall commence work only after approval from Architect.

Item No. 102.

Providing and fixing horizontal level Armstrong Cellio or Equivalent Open cell GI lay -in ceiling tiles with bevelled tegular edges with border panels forming board edge of size 600x600x38mm (Nominal) hav ing cell size of 150x150mm made of 120 gsm galv anized steel as per IS 277 (2003) suitable f or architectural finishes in 0.35mm thickness as per in IS:513 (1994)in Global white color. The tile shall be electrostatically poly ester powder coated using RoHS compliant powder hav ing coating thickness ranging f rom 60-80 microns. The powder coating shall pass Salt Spray Test f or 750 hours as per ASTM B117, QUV –A Test f or 1000 hours as per ASTM G-154 – (Cy cle – 1) and Humidity test f or 1000 hours as per DIN 50017. The powder coating shall hav e an adhesion of GT0 as per EN ISO 2409. The shade v ariation across batches shall be delta E<1 using Excite/BYK Gardner instrument and gloss lev el of 25±5% at 60° as per ASTM D523. Tile shall hav e a Fire Perf ormance class A1 as per EN- 13964. SUSPENSION: The tile shall be laid on approved suspensiton system with 15 mm wide T - section f langes colour global white (matching to tile colour) hav ing double stroke rotary stitching on all T sections i.e. the Main Runner, 1200 mm & 600 mm Cross Tees with a web height of 38mm (all sections). The def lection loading of the sy stem shall be 12.5 kg/m2 (as per standard installation lay out mentioned below) and main beam tested as per ASTM C635 (Def lection limit less than L/360) with a def lection loading of 15kg/m. The end details of the cross tee shall be made of pre hardened steel clip f ixed to the ends of the cross tee to prov ide double locking between "cross tee to cross tee" and "cross tee to main beam". All main beam to main beam and cross tee to cross tee connection shall hav e a pull out strength of more than 100kg. The T Sections shall be made of hot dipped galv anized steel 90 gsm and pre-painted steel with baked poly ester paint of 0T bending capability . The Tile & Grid sy stem used together shall carry a 10 y ear warranty against manuf acturing def ect and manuf acturer shall prov ide a warranty certif icate. The Tile & Grid shall hav e the manuf acturers name embossed/printed on it. The supply shall be backed by a Manuf acturing Test Certif icate. INSTALLATION: To comprise main runner spaced at 1200mm securely f ixed to the structural soffit using approved suspension sy stem (specif ications below) at 1200mm maximum. The First/Last suspension system at the end of each main runner shall not be greater than 450mm f rom the adjacent wall along with the f irst and the last main beam shall be at less than 600mm f rom the wall. Flush f itting 1200mm long cross tees to be interlocked between main runners at 600mm to f orm 1200 x 600 mm module. Cut cross tees longer than 600mm require independent support. 600 x 600mm module to be f ormed by f itting 600mm long f lush f itting cross tees centrally between the 1200 mm cross tees. Perimeter trim to be Armstrong wall angles of size 3000x19x19mm, secured to walls using screws at 450mm centre to centre maximum. All border cut tiles shall be laid, using lay -in end cap f or installation to hav e a Microlook ef f ect on perimeters. Installation shall be carried out as per Armstrong recommended procedure. SUSPENSION SYSTEM accessories manuf actured and supplied by Armstrong consisting of M6 Anchor Fasteners with hanger hole, pre Straightened Hanger wire of dia – 2.5 mm of

1.80 m length hav ing a tensile strength of 344-413 MPa and a minimum loading strength of 110 kgs. Additionally , adjustable hook clips made of 0.7mm thick Grade 1 C55 galv anized spring steel of dimension 100 x 20mm and 4 mm aquiline wire to be used for level adjustment during installation purpose in main runners. The contractor shall submit shop drawings for approval before proceeding for the work.

The supply and installation shall be done as per the item description. The rate shall be for per square meter installed. Contractor to provide shop drawing for the same for approval and shall commence work only after approval from Architect.

Item No. 103.

Supply & installation of Salon Slats ceiling of Surco Plus or equivalent , made of pinewood E1 grade fiberboard, melamine/veneer laminated finish, groove perforated slats L32-2 - (2mm grooves @ 32mm centers with 15% open area) , backlined with Soundtexblack acoustical fleece of 0.27mm thick, surface density 63g/m2,tongue-groove edge for a seamless look, 5-test fire retardant grade, size 192 x2440x16mm, volume density of base board 700Kg/m3, weight 10.5Kg/m2 installed by using Anutone Strut ceiling suspension system.
The Strut ceiling framework system shall include proper Strut , fully knurled, sectional thickness 0.55mm, length 3600mm, unequal flanges of 20 & 30mm and web of 25mm, fixed along the perimeters of the wall with nylon sleeves and suitable fasteners at every 300mm centers. Then suspend Strut , fully knurled, sectional thickness 0.8mm, length 3600mm, equal flanges of 15mm and web 45mm from the soffit at 1200mm centers with Strut, fully knurled, Suspender angle with sectional thickness 0.55mm, unequal flanges of 25 & 10mm such that the 45 mm strut rests on the 25 mm Strut as per manufacturers fixing detail. Strut , fully knurled, sectional thickness 0.55mm, length 3600mm, web 50mm, depth of 25mm and equal flanges 15mm is fastened to the Strut 45mm perpendicularly at 600mm centers and inserted inside the Strut 25 mm at the perimeter. Anutone Strut 18,aluminium core cross channel, thickness 0.5mm, length 2400mm, web 15mm & 27mm, depth 18mm and flanges of 7mm with suitable edge & ccentre brackets is then fixed perpendicular to the Strut CC25 with the help of fasteners at every 400mm centers. Saloon Slats , of size 192x 2440x16mm in then fixed perpendicular to Strut 18 with suitable edge & centre brackets.
Contractor to provide expansion joints of 3mm at every 4.88m length wise and 4.992m width wise.

The supply and installation shall be done as per the item description. The rate shall be for per square meter installed. Contractor to provide shop drawing for the same for approval and shall commence work only after approval from Architect.

SPECIFICATIONS FOR ALUMINUM PARTION AND FAÇADE WORKS
(BOQ Item Number 104 to 125)

1. General Requirements

1.1 Scope

1.1.1 Introduction

The project covered by this specification is the proposed development called Permanent campus for Nalanda university. The façade works are mainly at ground, first and second floor. It is mainly at Exterior and Interiors. Following are the façade types to be covered in this specification.

System Ref	Façade Type	Location
CW1	Stick Frame System	Ground and First Floor
CW2	Double Height Curtain Wall	Second Floor
SK1	Skylight	Roof
IP1	Interior Solid Partition	Ground and First
IP2	Interior Glass Partition	Ground and First

1.1.2 Generally

This Specification shall be read in conjunction with all other related Specifications.

The scope shall be designed, engineered, documented, tested, statutorily approved, manufactured, delivered, installed, commissioned, and warranted.

The work of this Section is performance based, and shall be developed, tested and warranted to comply with the design intentions indicated on the Drawings, specified performance criteria and requirements, and relevant statutory and project requirements. Drawings indicate generic design principles and intentions only.

1.1.3 Language

The Tender Drawings and Specification are written in English.

The Façade Contractor is to provide a Project Manager, Design Manager and Quality Control Manager able to communicate in English. This is to ensure that the technical requirements of International Design Standards referred to herein, written in English, are fully complied with.

All calculations, drawings and technical documents (quality plans, company profiles, technical data, test report, etc.) shall be written in English.

1.1.4 Façade Components

The Facade Contractor shall provide labour, materials, equipment, and related items and shall also design, engineer, test, fabricate, deliver, install, maintain and guarantee a complete, watertight exterior and interior wall system, and all the works described herein, including but without being limited to the following:

- Glass, metal sheets, mullions, transoms, glazing accessories, thermal break material, gaskets, acoustic buffers, sealants, flashings, vents, doors, hardware, ironmongery, multi-point locks, opening limit devices, louvers, blanked off panels, bird screens, cleats, fixings, components to prevent galvanic action, interior aluminium trimming.

- Lightning protection.

- Cornice, soffit panels and other works connected with roof and within the scope of Contract.

- All other cladding systems including but not limited to aluminium, stainless steel, stone and all associated components and fixings.

- All cast-in anchors, cast-in plates and other cast-in items associated with the facade shall be designed, supplied by the Facade Contractor, and installed by the Main Contractor. The Facade Contractor shall be responsible for shop drawings, supply and surveying before and after concreting / casting of all cast-in items. Where cast-in items are omitted, the Façade Contractor shall be responsible for any redesign, approvals, testing and installation of revised fixings.

- All fire-safing material, smoke seals, sound and thermal insulation, vapour retardant panels, fixings, anchorages, and associated seals shall be included. Interior partition closures, cement board walling, tapes and foam shall be supplied and installed by the Façade Contractor.

- All secondary steel frames or other support systems for facade cladding, soffits, canopies, external architectural features, lightning rod, and bracket provisions are to be supplied and installed by the Façade Contractor.

- Should the electrical conduits for signage and lighting be integrated into the façade system, these conduits shall be supplied and installed by the Façade Contractor. Lightning protection tabs to facilitate electrical continuity between façade panels shall be provided and installed by Façade Contractor. Earthing tabs shall be provided by the Façade Contractor, while provisions of locations to the base structure shall be coordinated with the E&M Contractor and Main Contractor. Earthing connections shall be the responsibility of the E&M Contractor.

- The following works are provided by the E/M Contractor: connection of gutters and flashed areas to drainage pipes, light mountings, lightning protection harness/systems, wiring, and lights do not attach to curtain wall. However, the Façade Contractor is responsible for the interfacing seal to ensure a good weather performance.

1.1.5 Interfaces

The Facade Contractor is required to make provision for interfacing and coordinating with other trades, services and systems on site being carried out under separate contracts. The trades that are to be considered are listed but not limited to the following:

- Primary and secondary structures (reinforced concrete and steel)

- All building mechanical and electrical systems (HVAC, Plumbing and Drainage, Fire Services, LV, ELV, lighting, etc.)

- Internal partitions, balustrades and wall finishes

- Internal floor finishes including raised floors

- Internal suspended ceilings and other ceiling finishes

- All integrated, non-integrated, illuminated and non-illuminated signage and other information display systems

- External paving and landscaping

- All roofing and weather proofing works

- Façade works undertaken by other contractors (as applicable)

1.1.6 Other Items

Engineering calculations, drawings, and materials/suppliers/sub-contractor's submittals together with tender submission shall be submitted.

Engineering calculations with A3 & A4 size drawings for all structural components of the curtain wall & façade, stamped and signed by a Qualified Engineer, and reviewed and endorsed by the Architect and Façade Consultant. Review and endorsement by the Architect and Façade Consultant on such engineering calculations and structural component drawings shall not relieve the façade contractor's liability under this sub-contract.

Samples, mock-ups and test units for visual mock-up and performance testing of the curtain wall, windows, and cladding systems.

All protective materials during transportation, installation, and prior to completion of the curtain wall and cladding systems.

Method statements for installation of all systems during tender, and the first design shop drawing submission. Method statements shall outline any requirements for the use of any temporary or permanent gondolas and scaffolding requirements.

Provide system to ensure all panels shall be demarcated in a manner to facilitate backtracking of panel information (e.g., batch number of sealants, date of sealant application, assembly date, glass reference/ batch number, quality control check date, back pan water test).

Provide list of testing facilities for all materials and façade systems (e.g., coatings, aluminium, gaskets, sealants, etc.)

Provision of staff responsible for keeping the Façade Contractor works area on site clean at all times, for keeping safety railing in place and access equipment in a safe condition at all times, for cleaning the curtain wall and the works described in this Specification and for carrying out service and maintenance work during the 24 months of Defects Liability Period.

Provision of staff both onsite and in factory, as necessary to lift/handle/manoeuvre panels for inspection of the Client's representative.

Information of Subcontractor's assembly/fabrication lines, allocated resources on the project.

Programs for all activities which are consistent with the Main Contractors working schedule, and which comply with the overall program for this project.

Coordination of all activities with the Main Contractor and all other Sub-contractors.

1.1.7 Drawings and Specification

The Specification and the Tender drawings are for the purpose of defining the scope of the works, the design intent and performance requirements. The tender drawings do not claim to solve all movement or structural requirements, pressure equalization, waterproofing, air sealing, acoustic requirements, glass movement, seismic performance, or thermal shock requirements. It is the Facade Contractor's responsibility to develop and modify the detailed design to comply with all requirements in the Specification and other relevant standards and codes.

The drawings are provided to show design intent and are not intended to show all conditions, components, materials, etc. The final detailing and appearance of components shall be subject to the Architect and Façade Consultant's approval.

Alternatives proposed by Tenderers to the design nominated on the tender documents will be considered, provided they satisfy all the performance requirements of this Specification and are equal to that material or design specified.

Any discrepancies or contradictions in the drawings or specifications shall be brought to the attention of the Architect and Façade Consultant for clarification during the tender bid period by the Tenderer.

1.2 References

1.2.1 Generally

The following sections outline the Relevant Indian and International Building Codes, Standards and Regulations to which all work outlined in the Tender Documents must conform. The Façade Contractor is responsible to ensure that all works are in complete compliance with these and other Codes, Standards and Regulation referred to within this Specification.

- No substitution for the following codes will be accepted without endorsement from the Architect and Façade Consultant.
- The Façade Contractor shall be responsible for ensuring all work is carried out in accordance with local authority requirements.
- Wherever there is a conflict between different codes, the requirements of the more stringent code shall apply.
- The most recent or current version of these documents shall apply.

1.2.2 Local and International Building Codes / Standards

Comply with current edition of required Standards and Codes of Practice, including:

- National Building Code of India 2016 – Volume 1 and 2 as per below but not limited to;
  - Part 4 – Fire and Life Safety
  - Part 6 – Structural Design (Section 6 and 8)
- Bureau of Indian Standards (BIS) or Indian Standards mentioned herein.
- British Standards (BS and CP) mentioned herein.
- AAMA Architectural Aluminium Manufacturers' Association Standards mentioned herein.
- ANSI American National Standards Institute Standards mentioned herein.
- AS/NZ Australian/New Zealand Standards mentioned herein.
- ASTM Standards mentioned herein.

AAMA CW-DG-1	Aluminium Curtain Wall Design Manual
AAMA	Metal Curtain Wall, Window, Store Front and Entrance – Guide Specifications Manual
AAMA 101-97	Voluntary specifications for aluminium prime windows and sliding glass doors.
AAMA 1503-98	Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Section.
AAMA 2603 – 02	Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminium Extrusions and Panels
AAMA 2604 - 05	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminium Extrusions and Panels
AAMA 2605 - 05	Voluntary Specification, Performance Requirements and Test Procedures for Superior Performance Organic Coatings on Aluminium Extrusions and Panels
AAMA 501 – 05	Methods of Test for Exterior Walls
AAMA 501.1	Standard Test Method for Exterior Windows, Curtain Walls and Doors for Water Penetration Using Dynamic Pressure

AAMA 501.2-83	Field Check of Metal Storefronts, Curtainwalls, Windows and Sloped Glazing Systems
AAMA 606.1-76	Voluntary Guide Specifications and Inspection Methods for Integral Colour Anodic Finishes for Architectural aluminium.
AAMA 607.1	Voluntary guide specification and inspection methods for clear anodic finishes for architectural aluminium.
AAMA 608.1	Voluntary guide specification and inspection methods for electrolytically deposited colour anodic finishes for architectural aluminium.
AAMA 609.1-93	Voluntary guide specification cleaning and maintenance of architectural anodized aluminium.
AAMA 701/702-01	Voluntary Specifications for Pile Weatherstripping and Replaceable Fenestration Weatherseals.
AAMA AAMA –SET	AAMA technical Reference Volumes I-IV
AAMA CW10 - 04	Care and Handling of Architectural aluminium From Shop to Site
AAMA CW13 - 85	Structural sealant glazing systems (A Design Guide)
AAMA FC-1	Field Check of Metal Curtain Walls for Water Leakage
AAMA CW-11-85	Curtain Wall Manual #11 - Design Windloads for Buildings and Boundary Layer Wind Tunnel Testing
AAMA TIR-A9	Metal Curtain Wall Fasteners
ANSI Z97.1-04	For safety Glazing materials used in buildings - Safety performance specifications and methods of test.
ANSI/TCA A118.1	Dry-Set Portland Cement Mortar
ANSI/TCA A118.4	Latex Portland Cement Mortar
ASTM A1008-01	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength :Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A1011-01	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A36/A36M-	Standard Specification for Carbon Structural Steel

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ASTM C97	Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
ASTM C99	Test Method for Modulus of Rupture of Dimension Stone
ASTM C119	Terminology Relating to Dimension Stone
ASTM C170	Test Method for Compressive Strength of Dimension Stone
ASTM C503	Specification for Marble Dimension Stone (Exterior)
ASTM C568	Specification for Limestone Dimension Stone
ASTM C615	Specification for Granite Dimension Stone
ASTM C616	Specification for Quartz-Based Dimension Stone
ASTM C629	Specification for Slate Dimension Stone
ASTM C880	Test Method for Flexural Strength of Dimensional Stone
ASTM C1201	Test Method for Structural Performance of Exterior Dimension Stone Cladding Systems by Uniform Static Air Pressure Difference
ASTM C1354	Test Method for Strength of Individual Stone Anchorages in Dimension Stone
ASTM C1527	Specification for Travertine Dimension Stone
ASTM A123/A123 M-02	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A446/A446M-01	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A618-01	Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural tubing
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A666-03	Standard Specification for Annealed or Cold-Worked Austenitic

	Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A792/A792M-06	Standard Specification for Steel Sheet, 55 % Aluminium-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A793-96(2001)	Standard Specification for Rolled Floor Plate, Stainless Steel
ASTM B26/B26M-05	Specification for aluminium alloy sand castings.
ASTM B209-06	Standard Specification for Aluminium and Aluminium-Alloy Sheet and Plate.
ASTM B221-05a	Standard Specification for Aluminium and Aluminium-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B247-02a	Standard Specification for Aluminium and Aluminium-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings
ASTM B429-02	Standard Specification for Aluminium-Alloy Extruded Structural Pipe and Tube ASTM International.
ASTM B449-93(2004)	Standard Specification for Chromates on Aluminium.
ASTM B483/B483M-03	Standard Specification for Aluminium and Aluminium-Alloy Drawn Tubes for General Purpose Applications.
ASTM C1036-01	Standard Specification for Flat Glass
ASTM C1048-04	Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C1087-00(2006)	Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
ASTM C1172-03	Standard Specification for Laminated Architectural Flat Glass
ASTM C1186-02	Standard Specification for Flat Non-Asbestos Fibre - Cement Sheets
ASTM C1253-93(2005)	Standard Test Method for Determining the Outgassing Potential of Sealant Backing
ASTM C1376-03	Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass
ASTM C170-	Standard Test Method for Compressive Strength of Dimension

90(1999)	Stone
ASTM C295-03	Standard Guide for Petrographic Examination of Aggregates for Concrete
ASTM C509-06.	Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing
ASTM C510-05a	Standard Test Method for Staining and Colour Change of Single- or Multicomponent Joint Sealants.
ASTM C666/C666M-03	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C794-01	Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
ASTM C864-05	Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C1193-05a	Standard Guide for Use of Joint Sealants
ASTM C962	Standard guide for use of elastomeric joint sealants.
ASTM D1149-99	Standard Test Method for Rubber Deterioration-Surface Ozone Cracking in a Chamber
ASTM D7091-05	Standard Practice for Non-destructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals
ASTM D1730-03	Standard Practices for Preparation of Aluminium and Aluminium-Alloy Surfaces for Painting
ASTM D2203-01	Standard Test Method for Staining from Sealants.
ASTM D2240-05	Standard Test Method for Rubber Property - Durometer Hardness.
ASTM D244-04	Standard Test Methods and Practices for Emulsified Asphalts
ASTM D297-93(2002)e1 & e2	Standard Test Methods for Rubber Products-Chemical Analysis.
ASTM D395-03	Standard Test Methods for Rubber Property - Compression Set
ASTM D412-98a(2002)e1	Standard test method for vulcanised rubber and thermoplastic elastomers - Tension.

ASTM D624-00e1	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
ASTM D746-04	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D865-99(2005)	Standard Test Method for Rubber-Deterioration by Heating in Air (Test Tube Enclosure)
ASTM D897-01	Standard Test Method for Tensile Properties of Adhesive Bonds.
ASTM E1036-02	Standard Test Methods for Electrical Performance of Non concentrator Terrestrial Photovoltaic Modules and Arrays Using Reference Cells
ASTM E1105-00	Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Door and Curtain Walls by Uniform of Cyclic Static Air Pressure Difference
ASTM E1300-04e1	Standard Practice for Determining Load Resistance of Glass in Buildings
ASTM E283-04	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E330-02	Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E331-00	Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E488-96(2003)	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM E546-88(1999)e1	Standard Test Method for Frost Point of Sealed Insulating Glass Units.
ASTM E773-01	Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units
ASTM E2188-02	Standard Test Method for Insulating Glass Unit Performance
ASTM E2190-02	Standard Specification for Insulating Glass Unit Performance and Evaluation
ASTM C1087-	Standard Test Method for Determining Compatibility of Liquid-

00(2006)	Applied Sealants with Accessories Used in Structural Glazing Systems
BS CP3	Chapter V. Wind Loading
BS EN 1991-1-1	Actions on Structures
BS 1161	Specification for aluminium alloy sections for structural purposes.
BS 1449	Steel plate, sheet and strip. Carbon and carbon-manganese plate, sheet and strip. General specification
BS 7079	Preparation of steel substrates before application of paints and related products.
BS EN 10210-1:2006	Hot finished structural hollow sections of non-alloy and fine grain steels. Technical delivery requirements
BS EN 485-1:1994	Aluminium and aluminium alloys. Sheet, strip and plate. Technical conditions for inspection and delivery.
ASTM B209M-06	Standard Specification for Aluminium and Aluminium-Alloy Sheet and Plate
BS 1473:1972	Specification for wrought aluminium and aluminium alloys for general engineering purposes - rivet, bolt and screw stock.
BS 1474	Specification for wrought aluminium and aluminium alloys for general engineering purposes: bars, extruded round tubes and sections.
BS 1580	Unified Screw Threads
ASTM B580-79(2004)	Standard Specification for Anodic Oxide Coatings on Aluminium
BS EN 12373-1:2001	Aluminium and aluminium alloys. Anodizing. Method for specifying decorative and protective anodic oxidation coatings on aluminium
BS EN 12373-15:2001	Aluminium and aluminium alloys. Anodizing. Assessment of resistance of anodic oxidation coatings to cracking by deformation
BS EN 12373-9:1999	Aluminium and aluminium alloys. Anodizing. Measurement of wear resistance and wear index of anodic oxidation coatings using an abrasive wheel wear test apparatus
BS EN 12373-	Aluminium and aluminium alloys. Anodizing. Estimation of loss

4:1999	of absorptive power of anodic oxidation coatings after sealing by dye spot test with prior acid treatment
BS 6161-18:1991	Methods of test for anodic oxidation coatings on aluminium and its alloys. Determination of surface abrasion resistance
BS 6161-7:1984	Methods of test for anodic oxidation coatings on aluminium and its alloys. Accelerated determination of light fastness of coloured anodic oxidation coatings using artificial light
BS 2571:1990	Specification for general-purpose flexible PVC compounds for moulding and extrusion.
BS EN 1435:1997	Non-destructive examination of welds. Radiographic examination of welded joints
BS EN 10246-10:2000	Non-destructive testing of steel tubes. Radiographic testing of the weld seam of automatic fusion arc welded steel tubes for the detection of imperfections
BS EN 10293:2005	Steel castings for general engineering uses
BS EN 10246	Non-destructive testing of steel tubes
BS 3923-2:1972	Methods for ultrasonic examination of welds. Automatic examination of fusion welded butt joints in ferritic steels
BS EN 970:1997	Non-destructive examination of fusion welds. Visual examination
BS EN 14295:2003	Welding consumables. Wire and tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels. Classification
BS EN ISO 9692-2:1998	Welding and allied processes. Joint preparation. Submerged arc welding of steels
BS 4190: 2001	ISO Metric Black Hexagon Bolts, Screws and Nut. Specifications
BS EN ISO 8503-5:2004	Preparation of steel substrates before application of paints and related products
BS EN ISO 8504-2:2001	Preparation of steel substrates before application of paints and related products.
BS 4255-1:1986	Rubber used in preformed gaskets for weather exclusion from buildings. Specification for non-cellular gaskets

BS 4255.1	Specification for non-cellular gaskets.
BS 4315.2	Methods of test for resistance to air and water penetration. Permeable walling constructions (water penetration).
BS 4320:1968	Specification for metal washers for general engineering purposes. Metric series
BS EN 10210: 2006	Hot finished structural hollow sections of non-alloy and fine grain steels.
BS 4515-1:2004	Specification for welding of steel pipelines on land and offshore. Carbon and carbon manganese steel pipelines
BS 4848-2:1991	Hot-Rolled Structural Steel Sections - Part 2: Specification for Hot-finished Hollow Sections
BS 4871-3:1985	Specification for approval testing of welders working to approved welding procedures. Arc welding of tube to tube-plate joints in metallic materials
BS 4873:2004	Aluminium alloy windows.
AS 4882-2003	Shielding gases for welding
BS EN 1011-1:1998	Welding. Recommendations for welding of metallic materials. General guidance for arc welding
BS EN ISO 12944:1998	Paints and varnishes. Corrosion protection of steel structures by protective paint systems
BS EN ISO 9934-1:2001	Non-destructive testing. Magnetic particle testing. General principles
BS 6262: 2005	Code of practice for glazing for buildings.
BS EN 10296: 2003	Welded circular steel tubes for mechanical and general engineering purposes.
BS 638	Arc Welding Plant, Equipment and Accessories
BS 6497	Specification for powder organic coatings for application and stoving to hot-dip galvanized hot rolled steel sections and preformed steel sections and preformed steel sheet for windows and associated external architectural purposes, and for the finish on galvanized steel sections and preformed sheet coated with powder organic coatings.
BS EN	Paints and varnishes. Powder organic coatings for galvanized or

13438:2005	sherardised steel products for construction purposes
BS 6561	Specification for zinc alloy sheet and strip for building.
BS EN 1714:1998	Non-destructive testing of welded joints. Ultrasonic testing of welded joints
BS EN 876:1995	Destructive tests on welds in metallic materials. Longitudinal tensile test on weld metal in fusion welded joints
BS EN 1320:1997	Destructive tests on welds in metallic materials. Fracture tests
BS EN 1321:1997	Destructive test on welds in metallic materials. Macroscopic and microscopic examination of welds
BS EN 1043:1996	Destructive tests on welds in metallic materials.
BS EN 875:1995	Destructive tests on welds in metallic materials.
BS EN 895:1995	Destructive tests on welds in metallic materials. Transverse tensile test
BS EN 910:1996	Destructive tests on welds in metallic materials. Bend tests
BS EN ISO 9018:2003	Destructive tests on welds in metallic materials. Tensile test on cruciform and lapped joints
BS EN ISO 1461:1999	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
BS 4190:2001	ISO metric black hexagon bolts, screws and nuts. Specification
BS 8118:1991	Structural use of aluminium. Code of practice for design.
BS2789 (Revision 85)	Spheroidal Graphite or Nodular Graphite Cast Iron
BS3100 (Revision 91)	Steel Castings for General Engineering Purposes
BS5135 (Revision 84)	ARC Welding of Carbon & Carbon Manganese Steels
BS1295 (Revision 87)	Code of Practice for Training in ARC Welding Skills
BS4871 P3 (Revision 85)	Approval Testing of welders working to approved welding procedures – Part 3: ARC Welding of Tube to Tube – Plate Joints in Metallic Materials

BS4871 P1 (Revision 82)	Fusion Welding of Steel
S4871 P2 (Revision 82)	TIG or MIG Welding of Aluminium and its Alloys
BS4872 P1 (Revision 82)	Approval testing of welders when welding procedure approval is not required. Part I Fusion welding of steel
BS4872 P2 (Revision 76)	Approval testing of welders when welding procedure approval is not required. Part 2 : TIG or MIG welding of aluminium and its alloys
BS4870 P4 (Revision 88)	Specification for automatic fusion welding of metallic materials, including welding operator approval
BS4870 P1 (Revision 81)	Fusion welding of steel
BS4870 P2 (Revision 82)	TIG or MIG Welding of aluminium and its alloys
BS4870 P3 (Revision 85)	ARC welding of tube to tube – plate joints, metal
BS1639 (Revision 64)	Methods for Bend Testing of metals
IS-875- Part 3	Indian Standard for Wind load on buildings and structures
IS-875 Part 2	Indian Standards for design Loads for building and structures
IS-3548	Code of practice for glazing and buildings
IS 513	Cold Rolled low carbon steel sheets and strips
IS 800	Code of practice for general construction in steel
IS 816	Code of practice for use of metal arc welding for general construction in mild steel
IS 1079	Hot rolled carbon steel sheets and strips
IS 3954	Hot rolled steel channel sections for general engineering purposes – Dimensions
IS 4759	Hot dipped zinc coatings on structural steel and other allied products

IS 4923	Hollow steel sections for structural use
IS 1029	Hot rolled steel strip
IS 8147	Code of Practice for Use of Aluminium Alloys in Structures
AS 1288-2006	Glass in buildings - Selection and installation
AS 1449	Wrought alloy. Steels - Stainless and heat-resisting steel plate. sheet and strip
AS/NZS 1664.	Aluminium Structures
AS/NZS 1734:1997,	Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate
AS/NZS 2208:1996	Safety glazing materials in buildings
FGMA/GANA	Glazing manual.
FGMA/GANA	Sealants manual.
GANA Hours Manual	FGMA Fabrication, Erection, and Glazing Hours Manual
IGCC	Insulation glass Certification Council
SIGMA	Sealed Insulating Glass Manufacturer's Association of America.
FED TT-S-1543B	Sealing Compound: Silicone Rubber Base (For Caulking, Sealing, and Glazing in Buildings and Other Structures
TT-S 00227E	Sealing compound, elastomeric type, multi-component (for caulking, sealing and glazing in buildings and other structures).
TT-S 00230C	Sealing compound, elastomeric type, single component (for caulking, sealing and glazing in buildings and other structures).
TT-S 01657	Sealing compound, single component butyl rubber based, solvent release type (for buildings and other types of construction).
ACI 318-05/318R-05	Building Code Requirements for Structural Concrete and Commentary
ADCA	Aluminium Standards and Data - Wrought Products
AISC 325-05	Steel Construction Manual, Thirteenth Edition

The Aluminium Association	Aluminium Design Manual, 2005

American Welding Standard

ANSI/AWS D1.1/D1.1M:2006	Structural Welding Code - Steel
Steel structures Painting Council	Society for Protective Coatings Painting Manual/Standards, Specifications (Current)
NAAMM	Metal Finishes Manual
S15 055900	Surface Preparation for Painting Steel Surfaces
P.C.I.	Prestressed Concrete Institute Design Handbook, Current Edition

1.3 Quality Assurance

1.3.1 Generally

Prepare, submit, and implement a detailed project specific Quality Plan in accordance with ISO 9001.

All products used on this project shall be reputable proprietary products and be manufactured in accordance with ISO 9001. Provide any necessary verification documents.

1.3.2 Certification

Submit Certification as follows;

a. Acceptance of design intentions of the Contract Documents (before commencing shop drawings).

b. Compliance of proposed performance design with Contract Documents, and suitability of proposed materials and products (before commencing fabrication).

c. Compliance with manufacturer's recommended installation procedures (on commencing fabrication).

d. Compliance of performance design, including materials and components, with Contract Documents (on completion).

e. As a condition of supply, the manufacturer and/or supplier of components and materials shall be required to:

i. Inspect the Contract Documents and certify the suitability of all proposed materials and products for the relevant substrates and conditions during Tender period.

ii. Witness the first site installation of each type and condition and certify that the preparation and installation procedures are in accordance with the manufacturer's written recommendations and have not in any way breached the manufacturer's warranties.

iii. Periodically inspect the ongoing and/or subsequent installation(s) to ensure that certified procedures are being maintained.

f. Following certification, the installer shall not vary the methods of preparation and installation from that recommended by the manufacturer.

g. The contents and wordings of the above required certifications shall be to the satisfaction and approval of the Architects.

1.3.3 Inspection

Give sufficient notice (not less than 4 working days) so that inspection may be made of the following:

a. Required visual mock-ups and prototypes constructed and ready for inspection or testing with 2 weeks' notice.

b. Commencement of any required testing, on or off site.

c. Factory inspections

d. Fabricated assemblies at the factory ready for delivery.

e. Building substrates, including sub-framing, prepared and ready for the installation of the fabricated assemblies, with anchor brackets and other attachments (including BMU components and lightning conduction) fixed in place.

f. First occurrence of installation of each system (first 20 m^2).

g. Preparation for, and commencement of, any site glazing or reglazing.

h. Field tests including gutter testing and water testing.

i. Any other inspection as may be required at the Façade Consultant's discretion.

For panel inspections in the factory, the minimum number of panels to be available for inspection shall be agreed with the Main Contractor, to approval of the Architect, but generally shall be in logical groupings of finished work. These are to be arranged to allow all faces, returns and edges to be viewed and compared with approved samples under adequate lighting for both close and comparative inspection.

The Façade contractor shall pay for client (2 representatives), architect (1 representative) and consultant (1 representative) to attend factory inspections. Façade contractor is responsible to arrange transport, flight and accommodation for the factory inspections.

1.4 Qualifications

The work shall be performed by one façade contractor, who is regularly engaged in the engineering, manufacture, fabrication, finishing, installation, glazing and sealing of glass, sealing and similar work. Subcontractor shall have all compulsory permission license issued by authority. Subcontractor shall demonstrate to the satisfaction of the client that they have successfully performed on comparable facade projects over the previous ten years.

All fabricating and finishing shall be done in the contractor's own plant or approved suppliers, except as provided for hereinafter. The subcontracting of any work included here under is specifically prohibited, except that which may be accepted by the Architect in writing prior to award of this contract.

1.5 Regulatory Requirements

All work shall be performed in accordance with the applicable building code, and the requirements of this specification whichever is more stringent. The subcontractor shall obtain all necessary permits and approvals as may be required by the Municipal and/or development authority in India and other regulatory authorities in conjunction with the work performed by the subcontractor and shall perform all tests, submit all required documents, make all modifications, etc., as required to obtain such approvals.

The subcontractor shall submit to the local authority, all necessary documents to obtain the required approvals and permits.

The subcontractor must allow for review and approval from the local authority without delay to the overall schedule.

1.6 Submissions

1.6.1 Generally

Provide all required submissions for a comprehensive performance proposal, to demonstrate compliance with the required design intentions and performance requirements, record construction methods and procedures, record materials and components proposed, and to establish quality standards.

1.6.2 Tender (Bid) Submissions

All submissions shall be submitted in the following format:

a. Drawings (A3)

b. Calculations and all other information (A4)

c. Softcopy of all drawing and documents in PDF

Any submission not following the format will not be accepted.

The Tenderer shall submit the following documents at no cost or obligation to the Employer:

a. Preliminary design drawings and calculations of the façade system, mullions, transoms and rain screen cladding system details at full size. (This is to include preliminary calculation of joint requirements based on the building movements given in this Specification.)

b. Provide written system description for each wall type.

c. Complete wall elevations and building sections at scale (1:100 or bigger), showing all relevant geometric information and a fully colour coded elevations to confirm the various wall types and materials.

d. Preliminary design drawings & calculation for all windows, facades & roofs including fixings, frames, claddings and steel structure details in 1:20 & 1:1 scale. (This is to include preliminary calculation of joint requirements based on the building movements given in this Specification.)

e. Anchorage details and calculations. The client reserves the right to use the anchorage design and calculations prior to tender award, for Government submissions or facilitating civil and structural works without binding the Employer to accept the Tenderer.

f. Provide clear methodology adopted to ensure all panels shall be demarcated in a manner to facilitate backtracking of panel information (e.g. batch number of sealant, date of sealant application, assembly date, glass reference/ batch number, quality control check date, backpan water test).

g. Program for design, approvals, material ordering, fabrication and installation of the curtain wall and the works included in this specification.

h. Provide company capability statement and background information.

i. Outline of a quality plan suitable for this project and conforming to ISO 9001.

j. Submit project references.

k. Details of all proposed materials, operable sash and door hardware, backer rods, stone, glass, aluminium, sealants, gaskets, etc. Brand, resources and specification of each product should be provided. (See Appendix F, must be fully completed).

l. Provide protection plan & maintenance statement.

m. Confirmation that all warranties will be provided as required.

n. Submit detailed plans & methods to comply with any requirements of LEED / Green Building certification of project.

o. Submit safety plan & methods.

p. Preliminary method statement for the supply and installation of the curtain wall, glass walls and the cladding systems, outlining all assembly factory, storage space and equipment or gondolas to be used in the assembly factory and on site.

q. Provide direct subcontractor lists (shall be subject to approval from Owner, Architect and façade consultant).

r. Provide specific organization chart for this project

s. Staffing structure that is proposed, together with the names, positions, levels of attendance and resumes of key staff. Key staff shall be subject to approval from Owner and Architect.

t. Provide fabrication plant information, assembly information and installation.

u. Submit details of test proposal including type, place, price and list of tests and laboratories where these tests are to be carried out. This includes all tests required; stone/stone fixings, performance mock-up, sealants, hardware etc.

v. A list of current jobs that are in hand, together with an outline of capacity to handle this project.

w. List of exceptions or deviations from the bid documents.

1.6.3 Program, Calculations and Shop Drawing Schedule

Submit (in accordance with the Main Contractor's programme and within 2 week of the award of contract) the following items:

a. Program of submissions for shop drawings & samples allowing a minimum of 15 working days for approvals. Shop drawing and calculation packages should be broken down in a logical manner that is easily manageable.

b. Program of works.

c. Schedule of materials to be used in the façade system together with a list of suppliers.

d. Programmes are to be consistent with the Master programme for this project, and shall be endorsed by the Main Contractor, before they are submitted to the Architect.

1.6.4 Prototypes

Submit prototype installations as follows:

a. Visual assessment prototype for each wall type:

Submit drawings of a prototype area for visual assessment of glass and cladding types, including any modifications requested, in a location to be advised. Visual prototype scope shall be as specified (refer to Appendix D) and may include various samples for architectural comparison of materials. The proposed prototype arrangement is to be submitted to the Architect for acceptance. The prototype is to be erected on site and facing south and removed when no longer required at the façade contractor's own costs.

b. First constructed example prototype:

The first completed area of not less than 25 m^2 (or 5 m of linear work) of each type of work or system, and any non-standard parts, for inspection and approval before proceeding with the remainder of work.

1.6.5 Product Data

Submit (in accordance with the Main Contractor's programme and within 4 weeks of award) all manufacturer's product specification and test data, manufacturer's quality assurance documentation, preparation and installation recommendations.

Include product data for:

a. Metals and metal alloys, including welding materials.

b. Glass and glazing accessories.

c. Applied finishes, including preparation and pre-treatment, application, curing, and maintenance procedures.

d. Sealants, gaskets and glazing accessories, membranes, vapour barriers.

e. Insulation (thermal and fireproofing).

f. All proprietary accessory products, hardware and fixings.

g. Manufacturer's procedures for handling, transportation and installation.

h. Fire test reports for fire safing, smoke stops and fire rated doors.

1.6.6 Samples

Submit (in accordance with the Main Contractor's programme and within 8 weeks of award) representative samples of products and materials, including finishes and representative factory-fabrications and site-installed assemblies.

2 sets of all samples are to be submitted, one set is to be submitted to the Architect and the Facade Consultant and the other is to be sent to the Main Contractor on site.

Include samples as follows:

a. Metal types and finishes, including proposed finished shapes, sections and extrusions. Provide metallurgical analysis certificates for alloy and temper of metal components.

b. Glass types and finishes indicating colour, surface pattern or texture, finish, surface coatings, and the range of variation, if any.

c. Colour samples of prefinished production material showing the limits of the range of variation in the selected colour.

   i. Check samples to confirm or match Architect's sample.

   ii. Preliminary finishes control samples.

   iii. Final finishes control samples.

   iv. Colour samples for all sealants, gaskets, and accessories.

d. Joint system components, visible fixings, including sealants, rain screens, baffles, flashings, elastomeric sealants, backing rods, etc., with details of compatibility with silicone and polyurethane based sealants, and all extruded gaskets, seals and tapes.

e. Typical fabrications and assemblies, showing welds and grinding, screwed and bolted junctions, fastenings and workmanship.

f. Architects shall be allowed to ask for and receive any additional samples as they deem necessary.

g. All samples shall be accompanied by additional descriptive information, including: brand, fabrication place, finish, data sheet, application and certifications.

1.6.7 Shop Drawings

Submit comprehensively detailed and dimensioned shop drawings to indicate all set-out and construction details not indicated in the Contract Documents, adjacent work by others, and for all proprietary products where required details are not indicated in the manufacturer's product data.

Time required for examination of shop drawings will be 10 working days for approval of 1st submission and major resubmission, and allow 7 working days for approval of revision resubmission.

Manufacture should not commence until approval to use the relevant shop drawings has been obtained.

All revisions will be noted on the drawings. The revised areas shall be clouded and the revision numbers indicated.

This signatory shall be responsible for the calculations and the design/drafting supervisor prior to each first issue submission.

Do not commence manufacture until approval to use the relevant shop drawings has been obtained.

Include and indicate:

a. A cover sheet containing an index of drawings

b. Notation index of all materials including alloy, thickness, finish, coating, size, hardness, brand, product name, tempering etc.

c. Setout of all work, including reference points, edge conditions and joint pattern, indicated on plans, elevations and sections as applicable.

d. Full size sections of all members, including descriptions of structural properties and specifications of materials. This includes a full schedule of section profiles.

e. All drawings to be cross-referenced both forward and backward in logical markings.

f. Overall building elevations, geometry set out drawings, and key plans.

g. Complete wall elevations and building sections at scale (1:100 or bigger), showing all relevant geometric information and a fully colour coded elevations to confirm the various paint colours.

h. Typical unit or area elevations at scale (1:20 or bigger) both exterior and interior.

i. Full size elevations of all intersections and joints.

j. Provide any additional drawings, details, rendering drawings, 3-D representations, etc. as may be requested by the Architect and Façade consultant.

k. Shop drawing must show interface and coordination with all surrounding construction and systems.

l. Framing, anchorages and fixings supported from base-structure, and embedments in the base-structure with setting out and dimensions, if required (cast-in anchors locations and setting out drawings shall be submitted in 2 weeks and obtained Architect’s approval within 4 weeks of award).

m. Movement joints and seismic joints

n. Provisions for acoustic requirements as stipulated by Acoustic Report (if available).

o. Methods of assembly at all junctions, including sealing and fixing, indicated by three-dimensional and exploded views if requested.

p. Method of installation, including

i. Erection tolerances

ii. Machined slots, keyholes and other methods for handling and connecting components

iii. Junctions and trim to base-structure and adjoining surfaces

q. Glazing Details, Including

i. Glazing materials including sealants, gaskets, tapes, setting and spacer blocks

ii. Rebate depth, and edge restraint

iii. Clearances and tolerances

iv. Methods of in-service panels/glass/cladding/replacement.

r. Calculations shall be submitted in the format below：

i. Glazing materials including sealants, gaskets, tapes, setting and spacer blocks

ii. Rebate depth, and edge restraint

iii. Clearances and tolerances

iv. Methods of in-service panels/glass/cladding/replacement.

s. Calculations shall be submitted in the format below：

i. Design Building Codes/Design Synopsis

ii. Material strength and design Parameters (Limit state checks shall be adopted unless otherwise accepted by Architect/Consultants)

iii. Load Path diagram

iv. Calculations shall be supported using relevant diagrams (with drawing references)

v. Page references shall be made

vi. Calculations justifying capacity of components shall be checked in a logical sequence. (In accordance to load path).

vii. Computer graphical output showing all service and limit state loadings/load cases/forces/reactions/deflections.

viii. All moment and prying forces as a result of eccentric loads shall be considered.

ix. Buckling and deformation checks shall be provided for all relevant components.

x. Information for proprietary products.

t. Method of draining the assembly, including details showing

i. Pressure equalised drained joints

ii. Location, number and size of weepholes

iii. Mechanical baffles to drainage outlets which are not pressure equalised.

u. Methods of meeting performance criteria for thermal insulation, fire resistance, sound transmission and the like.

v. Shop drawings shall be in strict compliance with "prototype as tested" drawings approved as part of the prototype testing procedure.

1.6.8 Installation, demounting and re-installation Procedure Manual

Submit a comprehensive manual containing all installation procedures, equipment and personnel required for acceptance prior to the commencement of work.

1.6.9 Maintenance (and operating) manuals

Submit a manual (in English and Hindi / Marathi if requested) containing procedures for cleaning and maintenance, materials for maintenance and cleaning, all information required to ensure the full service capability of the work, including source of replacement components, and methods of replacement of damaged components. This is to be completed prior to the completion of work. Complete list of contact for system/material suppliers and manufacturers.

The recommended schedule of inspection and checklist and method of cleaning and timetable are to be specified together with cleaning agents which can and cannot be used.

The façade contractor shall provide the Employer with 3 hard copy sets of the Maintenance Manuals after obtaining approval from the Architect. The hard

copy submission shall also be accompanied by soft copy versions on a flash drive.

1.6.10 As-built documentation

Prepare as-built drawings, photographs and other records progressively as the work proceeds. Submit progress reports at 15 days intervals and complete as-built documentation in compliance with local government and regulatory requirements. 2 additional copies and 1 computer file in a Flash Drive shall be submitted for the Employer’s retention within 15 days of the completion of work. Both editable (.dwg) and portable document formats (.pdf) shall be included in the submission.

1.7 Delivery, Handling and Storage

1.7.1 Generally

All materials shall be packaged in accordance with relevant codes and regulations and palletted for safe and convenient handling by fork-lift vehicles and Main-Contractor's cranage and hoisting equipment being available on the Site.

All components of the façade shall be clearly marked after fabrication indicating their source and the location on the building as shown on the drawings.

Provide a complete numbering system and schedule for all cladding and glazing panel units. Each panel shall be individually numbered in such a way that the manufactured history can be traced. Provide an approved permanent concealed marking system. Submit details.

The Curtain Wall Subcontractor shall be responsible for disposing of all packing materials. This is to be done in accordance with the Main Contractors requirements.

1.7.2 Glass

Glass and allied materials must be protected from any possibility of water/condensation damage during shipping/storage.

1.8 Project Conditions

1.8.1 Survey and Set-out

Take into consideration the effect of ongoing base building movements on curtain wall system and cladding system set out.

Façade contractor shall survey and sign off on the existing conditions fully coordinated with the principal / civil contractor prior to façade installation.

1.8.2 Spare materials and Parts

Submit certification that all spares will be available off-the-shelf, or with a lead time not exceeding 4 weeks from date of order, for the warranty period. Provide name and address and contact numbers of all suppliers and manufacturer's. The Client reserves the right to store spare panels at Façade Contractor's storage facilities with immediate access to such spares after handover and completion of works.

All spares shall be new and in approved wrapping material.

Deliver the spares at the completion of the work. Formally handover, and submit complete schedule of types and quantities, including full replacement instructions, and any special tools required.

Required spares shall be in accordance with client's requirements, or as follows:

a. 1.5% of each size and type of glass on the project not less than 10 pieces of each type used whichever is more.

b. 1.5% of each size and type of cladding on the project not less than 10 pieces of each type used whichever is more.

c. 2% of each component hardware (locks, hinges etc...)

d. All special dies or moulds used specially to extrude or cast the curtain wall sections on this project shall be retained by the extruder for the warranty period and shall not be used for any other project / application.

1.9 Warranties

a. Provide a warranty for materials, finishes and workmanship of the works executed in this sub-contract from Date of Practical Completion for a period of 10 years (the "warranty period"). Provide all manufacturer's product warranties. Also provide a warranty to cover all the costs of materials, labour and equipment to remove any defective components of the curtain wall and replace them. This warranty shall also cover the costs associated with removing and replacing internal finishes trims and services so that remedial works can be carried out. The content of each warranty is to be approved by the Architect.

b. The guarantee shall further state that glass shall be guaranteed against breakage due to defects in glass materials, fabrication of insulating units, and installation for a period of ten (10) years after acceptance of the work by the Architect. The Curtainwall Subcontractor shall include with his bid a copy of the proposed warranty.

c. Laminated glass units shall carry a ten (10) year warranty from their manufacturer against delamination (Beyond 10mm from the edge), obstruction of vision by fogging up and collection of dust or dirt in the enclosed space or cracking, peeling of flaking of coating and/or frit as applicable and in a form acceptable to the Architect. Curtain wall

Subcontractor shall include with his bid proposed copy of warranty from proposed glass manufacturer for each type of unit.

d. In addition, silicone sealants shall carry a ten (10) year warranty from the sealant manufacturer against adhesive or cohesive failure or staining in a form acceptable to the Architect. The Curtainwall Subcontractor shall include with his bid a copy of the proposed warranty.

e. Defective materials and workmanship for these guarantee provisions is hereby defined to include, but not be limited to, evidence of:

i. Penetration of water into the building

ii. Air infiltration exceeding specified limits.

iii. Structural failure of components resulting from forces within specified limits.

iv. Delamination of panels or insulating glass units.

v. Discoloration, excessive fading, excessive non-uniformity, pitting, cracking, crazing, peeling, or corrosion.

vi. Glass breakage and glass corrosion unless caused by loading / impact / stress beyond specified limits

vii. Secondary glass damage and/or damage due to falling curtain wall components.

viii. Adhesive or cohesive failure of sealant. Staining caused by sealant.

ix. Crazing on surface of non-structural sealant.

x. Non-structural sealant hardening beyond Shore A durometer 50 or softening below 20.

xi. Failure to fulfil other specified performance requirements. Failure of operating parts to function normally/ properly.

xii. Rusting of stainless steel cladding.

xiii. Rusting of painted or galvanized steel support.

1.10 Performance Requirements

1.10.1 Generally

The façade wall, cladding systems, windows, doors, balustrades and canopies and other works executed in thus sub-contract shall be waterproof, weatherproof and shall not show evidence of deterioration for the warranty period.

Materials and components shall be engineered to accommodate all loading conditions, and shall be of adequate strength and stiffness for the purpose intended.

1.10.2 Corrosion and chemical attack of dissimilar materials

Provide protective coatings to prevent corrosion, staining, acid rain or other possible chemical attack of all materials, within the entire façade system and at all interfaces to the building, including finishes.

Submit details of coatings, spacers and other means of isolation between dissimilar or incompatible materials together with certificates from relevant manufacturers confirming acceptance of the use of the selected products in the manner and on the substrates proposed.

1.10.3 Concrete Building Frame tolerances

The curtain wall shall be designed to accommodate the concrete tolerances allowed to the Main Contractor. Unless otherwise noted in Appendix 'B', the maximum construction tolerances are:

a. Plan Position of the building edge = +/- 25mm

b. Level slab surface and soffit = +/- 10mm

c. Deviation in plan over 10 floors < 30mm

1.10.4 Fabrication tolerances

The fabrication tolerances of curtain wall and cladding systems should meet with the following requirements:

Tolerances at joints and junction details shall take precedence over tolerances of panels and major components. Tolerances generally shall be:

a. Joint width: +/- 1 mm.

b. Length and width of major components: +/- 0.5 mm.

c. Diagonals of major components: +/- 1 mm.

d. Cutting and fabrication of aluminium extrusions generally

e. Misalignment of mating surfaces: +/- 0.5 mm.

Submit a schedule of fabrication tolerances for all major curtain wall system components. Indicate extremes of allowable base building tolerances on shop drawings.

1.10.5 Installation tolerances

In addition to required fabrication tolerances, all parts of the curtain wall and cladding systems, when completed, shall be within the following tolerances:

a. Position on plan, or vertical surface: +/- 5 mm.

b. Deviation in alignment: Not more than 1 in 300.

c. Deviation in level (horizontal) Not more than 1 in 800

d. Deviation in plumb (vertical) Not more than 1 in 800

e. Offset in alignment of adjoining surfaces +/- 0.5 mm.

f. Offset in alignment of separated surfaces +/- 1.5 mm.

g. Embed tolerances (horizontal and vertical) +/- 25 mm.

Site check the cumulative effect of all building tolerances and adjust installation procedures as required.

1.10.6 Service Life

The service life of the facade system shall be not less than 25 years.

1.10.7 Loads

a. Generally

Design all components of the facade system for the loads specified in this section.

b. Dead Loads

Design façade wall system to carry 2x its own total self-weight without causing overstress or excessive deflection of any component for safety requirement.

The total self-weight (un-factored) shall be used in combination with wind load and live load in the design of all components.

c. Wind loads

The Façade Contractor shall design the façade for wind loads confirming to local code. The wind load is calculated based on IS 875 Part 3 (2015) using the basic wind speed as per the locations.

d. Seismic loads

Design seismic forces shall be in accordance with the latest edition of ASCE7 and IS:1893(Part 1)2002

e. Live loads

Design façade systems to carry the following loads in combination with full dead and 25% of the design wind loading:

i. A point loading of 1.15 kN on all horizontal surfaces including projecting features, sills and canopies.

ii. A line loading of 0.75 kN/m acting either downward or outward on all window sills.

iii. A uniformly distributed loading of 0.75 kPa on all roofs and canopies.

iv. A line loading on inner lites of glass of 0.75kN/m acting outwards at a height of 1100mm above the finished floor level. A line load of 1.5kN/m shall be applicable for public areas like roof terraces, lobbies and foyers.

v. Live loading for canopies shall be taken as 0.75 kPa + allowable for BMU access loadings.

These live loading requirements do not need to be superimposed with each other.

f. Design load reduction for cladding to features canopies and blanked off walls

Single sealed panel systems to drained cavities with solid backup walls shall not be designed to incorporate wind load reduction principles based on (partial) pressure equalisation.

g. Temporary and construction loads

Design the curtain wall and cladding systems to allow for all handling and installation loads without causing overstress, permanent deflection or warping.

The façade element should be checked to stand any restraining and impacting load from BMU system, which should be provided by BMU contractor.

h. Deflections and displacement

i. The vertical dead load deflection of transoms of façade systems shall not exceed span/1000 or 2 mm maximum based on setting blocks being located at quarter points. Should the setting blocks be moved closer to the supports to satisfy this deflection criteria, then glass calculations supporting alternative setting block locations are to be provided to the acceptance of the Consultant Team

ii. The vertical dead load deflection of horizontal frame members for roof systems shall not exceed span/500.

iii. The deflection limits perpendicular to the roof, curtain wall and cladding systems under serviceability wind loading conditions shall be as follows:

- Aluminium mullions and transoms of facade systems: The lesser of Span/240 or 20 mm. For cantilevers, the span shall be taken as 2 times the distance between anchor centreline and end of cantilever.
- Aluminium frame of windows and doors: The lesser of Span/150 or 20 mm.
- Steel members: Span/250 or 20mm

- Framing members for stone support: Span/500
- Glass: For IGU, maximum 1/90 of the glass edge length or 20mm, whichever is lesser: For monolithic/laminated glass, maximum 1/60 of the glass edge length or 20mm, whichever is lesser.
- Aluminium sheet: Short Side/90 but not more than 20mm.
- Fixing brackets: Not more than 1 mm.

1.10.8 Connection Requirements

a. Fixing requirements generally

All fixing brackets and anchorages shall be scheduled and described in detail on shop drawings. They shall be designed for the maximum three-dimensional tolerance of the system, and due consideration shall be given to additional forces from prying action, eccentric loading, and bolt group effects.

b. Base building substrates

Provide contingency design and installation procedures for all typical substrate conditions and deficiencies including:

i. Reinforcement clash

ii. Excessive out-of-tolerance concrete

iii. Honeycombing or other concrete defects

iv. Clash with concrete joints, and other structural details

v. Mis located, missed and incorrect embedment

Check all base structure reinforcement locations. Refer to structural drawings to establish bracket fixing locations. Verify relationship between brackets and concrete reinforcement on shop drawings.

1.10.9 Movement Requirements

a. Generally

Design curtain wall system, cladding systems and attached components for the combined building and thermal movements outlined in this section. Movement joints shall accommodate the full range of movements in addition to all tolerances.

Joints shall be designed to prevent loads of any kind being transferred from the building into the curtain wall system, excessive movements of any joints or failure of weather seals.

Prepare and submit a movement analysis of the whole building together with shop drawings of proposed movement joints indicating movement limits, setting out positions, and required clearances.

b. Base building sway due to wind and earthquake, not inclusive of Roof steel work. Since the project is in the zone 3 under the seismic activity classification, the grade of performance in plane deformation for both windows and facade systems should be taken as 3 times of the values as follows:

Anticipated building sway due to wind loading (50 year wind).

i. Maximum Story Drift = h / 500, where h = story height

Anticipated building sway due to Earthquake.

ii. Maximum Story Drift = h / 500, where h = story height

c. Base Building Beam and Slab Edge Deflections

The maximum deflection at the mid span of beams supported at both ends (where Lo = Effective Length of beam)

i. For Lo<7m; Total deflection limit = Lo / 250

ii. For 7m≤Lo≤9m; Total deflection limit = Lo / 300

iii. For Lo>9m; Total deflection limit = Lo / 350

The maximum deflection at the end of a cantilever (where Lo = Effective Length of beam)

i. For Lo<3.5m; Total deflection limit = Lo / 125

ii. For 3.5m≤Lo≤4.5m; Total deflection limit = Lo / 150

iii. For Lo>4.5m; Total deflection limit = Lo / 175

For all cantilever beams and beams greater than 5m, precambering for these beams during construction may be carried out (TBC). Beams treated with precambering shall be able to achieve the deflection limit of 1/350 (Cantilever beam: 1 / 175).

Long term deflection limit due to live load will be 20mm max.

For additional deflection profiles for specific locations refer to Appendix B

d. Column Shortening

Anticipated differential axial deformation between adjacent columns

i. Under Gravity Loads (Dead + Live Loads) = +/- 9mm

ii. Under Transient loads (e.g. wind & seismic) = +/- 2mm

e. Movements within curtain wall system due to thermal loads

A metal temperature range of from 15°C to 70°C shall be used to calculate movement requirements due to thermal loading. The movement calculations shall be based with the mean temperature assumed at which the curtain wall is fabricated.

1.10.10 Environmental Requirements

a. Generally

Design and warrant the wall and roof system to be watertight weatherproof and have the required acoustic performance as required by the Acoustic Consultant's Report (if available).

Provide for all weather and rainfall conditions. Submit full details on shop drawings including all assumptions.

b. Weatherproofing

Provide complete water drainage and system, including pressure equalised drained joints, gutters and troughs to allow water and condensation to discharge to the exterior face of the curtain wall.

Provide mechanical baffles to drainage outlets such as weep holes and slots.

Sealants and gaskets which are inaccessible in the installed system shall remain effective for the service life of the system.

Provide two means of defence against uncontrolled water penetration into the building for all conditions.

Provisions shall be made to drain to the exterior face of the work any water entering the system joints, at glazing, panels, and from condensation. Drainage to the exterior shall be provided at every floor.

c. Air infiltration requirements

In addition to the requirements for a drained joint system, the design and installation of the air sealing shall be carried out to high standards to minimise air infiltration. Coordinate with installers for adjacent work to achieve the specified maximum air infiltration at junction with curtain wall system.

d. Thermal properties

The cladding system shall have an appropriate level of insulation to prevent excessive heat or cold transfer to the building interior or exterior. The complete building envelope shall comply with local thermal requirements. Vapour barriers shall be located to prevent condensation in interstitial and

visible surfaces. If condensation is permitted to occur within cavities then provision shall be made for adequate drainage.

e. Weathering

The system and its components shall not fail to comply with performance requirements due to the effects of weathering.

f. Acoustic Performance

The curtain wall system is to meet the performance requirements of STC = 32 throughout, unless otherwise stated in an Acoustic Report, forming part of the technical requirements of this contract.

The system shall not generate noise due to the following: wind whistling, movement, creaking, drumming or rattling.

g. Fire Proofing

The design shall meet all relevant fire code requirements and the local authority requirement.

The facade shall be constructed from non-combustible (Class 1) components. The facade is not required to perform as a fire separator between floors. It is however, required to provide smoke separation between floors and incorporate fire-stopping materials as required by local statutory requirements. In addition, smoke separation and fire separators are to be provided for fire-rated wall partitions and party walls.

Fire access panels

Provision of fire access panels shall be made based on the local fire safety code requirements as established by the Chief Fire Officer (CFO) from time to time.

1.10.11 Visual Requirements

a. Profiles

Design curtain wall and cladding system components so that sizes, profiles, dimensions and architectural style are as close as possible to those indicated on the Drawings. Indicate any variations on the shop drawings. Do not commence production of extruded aluminium sections until all profiles have been approved and tested in the prototype.

b. Applied finishes

The design of the components, selection and application of finishes, and installation procedures shall ensure a high standard of applied finish protection during construction. Develop and implement procedures to eliminate

scratches, marks and blemishes to finished surfaces. Indicate procedures on shop drawings and provide a method statement with a control sample before commencing the works.

c. Flatness and alignment

The design of the components, fabrication and installation procedures shall ensure a high standard of flatness, joint and edge straightness, and alignment of mating surfaces of joinery. Close attention shall be given to cutting and cut edge treatment procedures, stiffening and the tightening of fixings and fastenings which may cause distortion or warping.

Panels and formed sheet material shapes are to be free of oil canning, warping, bowing, deformations, pinches, stress marks, etc. Read-throughs for welded connections, including studs, are not allowed.

d. Exposed sealants

Indicate all sealants and gaskets on shop drawings. Indicate the anticipated service life and method of replacement for all sealant and gasket components.

1.11 Testing

1.11.1 Field Water Testing

a. Site Water Test

General Field Water Testing per AAMA 501.2: Field water testing shall be carried out periodically during the facade installation. This is to ensure that leaks are identified and repaired prior to installation of internal linings and finishes. These tests shall be carried out by a certified third party testing agency.

- Initially, 30 m^2 shall be tested following the installation of the first 3 floors of curtain wall.
- Further testing of 30 m^2 shall be carried out every 5 floors. (Minimum of 5 locations each.)
- Each test shall cover an area of not less than 30 m^2 and not less than 5 linear meter of work.
- The tests shall be included in the program by the Contractor, with specific locations as selected by the Façade Consultant.
- Should problems arise during any of the above testing, the Project Architect may instruct that further testing be carried out at no additional costs. Locations and times shall be nominated by the Project Architect / Façade Consultant.

b. Gutter Test (Unitized curtain wall system)

Conduct 100% Gutter Testing for all relevant unitised curtain wall assemblies. Submit recorded documentation. Verify during construction that water leakage and condensation are effectively collected and drained to the exterior. Test internal gutters for every floor by temporarily plugging weep holes and filling with a mix of water and fluorescent dye. After a minimum of one (1) hour inspect for water leakage in presence of UV light to ascertain the path of leakage. Correct deficiencies and retest until successful tests are achieved. Remove weephole plugs after testing. All gutters are to be clean and free of debris prior to installing additional material that would prevent access later.

1.11.2 Testing, Structural Glazing

a. Generally

Submit manufacturer's test reports prepared by the approved laboratory for all structural adhesives (silicone) used in structural glazing before commencing installation. Include details of sampling and test procedures.

Test procedures and minimum acceptance criteria shall comply with AAMA CW 13.

b. Initial adhesion and compatibility testing

Carry out and submit results for initial adhesion and compatibility testing to ASTM C794 and ASTM C510. Verify that no material in contact with the structural adhesives will cause deterioration of structural adhesives, and the structural adhesives will not cause intrusion into laminated glass interlayers or IGU seals.

c. Direct tension tests

Direct tension tests between silicone and glass shall be carried out using an Instron Tensile Tester, or approved alternative.

Test ten samples of each joint type without weather seals and using actual materials and joint configuration identical to that proposed and complete testing prior to manufacture, as follows:

- Five samples shall be air cured 21 days then water immersed 7 days before testing.
- Repeat procedure on completion of manufacture of 30% of the materials.
- Apply a 5x safety factor to the mean of the ultimate strength results to determine joint dimension.
- Complete initial tests prior to commencement of manufacture.

1.11.3 Testing, Components

a. Generally

Arrange and pay for testing at an approved laboratory and submit test results for components as follows:

i. Fixing brackets

Test a minimum of 5 brackets and embedment fixed to the base structure for each fixing condition. The brackets shall be fixed to prefabricated concrete blocks which exactly represent the base structure in relation to edge distances, reinforcement, and concrete strength. Prepare and submit shop drawings prior to fabrication of the concrete blocks. Be responsible for making and transporting the concrete blocks to the testing laboratory.

Install test fixings in accordance with approved shop drawings but locate with most adverse tolerances and application of loads.

Testing procedure

Test to 200% of design working loads (On site Test)

- Apply the initial load equal to 5% of the test loads to bring all members in full bearing contact.

- Remove the preload. Apply the load via 10 equal load increments to the maximum test load. Each incremental load is to be maintained for 2 minutes. Remove the loads. Record the specimen displacements at each incremental load, maximum test load and after the removal of loads.

- Inspect the tested specimen and record, if any, any signs of deleterious effect.

Test to 300% of design working loads (Off site Test):

- Apply the initial load equal to 5% of the test loads in order to bring all members in full bearing contact.

- Remove the preload. Apply the load via 10 equal load increments to the maximum test load. Each incremental load is to be maintained for 2 minutes. Remove the loads. Record the specimen displacements at each incremental load, maximum test load and after the removal of loads.

- Inspect the tested specimen and record, if any, any signs of deleterious effect.

Acceptance of the fixing system is dependent on each test failure load being at least 3x the design working load for concrete failure, 2x for metal failure and the absence of permanent deformation at 1.5x the design load.

The test report shall be submitted and approved prior to casting in and embedment's or fixings into the structure.

Façade Contractor shall get approved from the structural engineer of this project prior to doing the pull-out test for on-site built-in embedment. The test method is similar as above mentioned procedure. Test 1% or minimum 3 of each type of embedment, whichever is more. The maximum on-site test load is 200% of design working load of anchor/embedment.

ii. Aluminium and steel stud fixings

Prior to the start of fabrication, demonstrate the strength of welded stud fixings by testing in tension to destruction six fixings attached to test panels cut from sheets identical to the permanent panels. Repeat process at 30% and 60% stages of the fabrication programme. Submit a test report prepared by the approved laboratory prior to the start of fabrication.

Acceptance of the fixing system is dependent on the average of each set of six test failure loads being at least twice the design load and the absence of permanent deformation at 1.5 times the design load.

iii. Screws secured in extrusion flutes

Demonstrate the strength of each connection by testing 18 screws in accordance with AS/NZS 1664. Or an equivalent Standard, Stagger tests in groups of 6.

The test report shall be submitted and approved prior to fabrication.

1.12 Assembly Factory Requirements

a. Must provide full overhead cover for all storage and assembly works. No panels shall be stored outdoors

b. Must have air-conditioned climate controlled and dust-controlled environment for structural glazing. Temperature and Relative humidity shall be maintained within the range specified by the silicone manufacturer's guidelines.

c. The fabrication unit should be certified by the sealant supplier for application of structural silicone.

d. Must be well lit and ventilated. If insufficient lighting or ventilation factory will be rejected.

e. Must always be kept clean. Materials and panels must be properly stored on approved storage racks.

f. Must have a well laid out assembly line that can accommodate vertical glazing of insulated glass units.

g. Each assembly is always required to be supervised by senior technical manager. Factory workers are required to have minimum 1-year experience for curtain wall assembly. Task role for each work shall be repetitive.

2. Products

2.1 Glass and Glazing

a. Generally

Provide approved glazing systems, glass and glazing accessories that comply with all performance requirements. Where differences occur between relevant Standards, comply with more stringent requirements. Submit details.

Refer to Appendix A: Materials Schedule for types, locations, and colours.

Products shall be reputable proprietary products, factory manufactured under ISO 9002. Submit quality assurance documentation for all products, including bought-in products, including ISO 9002 certification, and evidence of satisfactory long-term performance in similar commercial conditions.

The glass is to be protected during assembly, transportation, installation and on the finished building. Care should be taken to ensure that protection of glass panels will not result in staining or corrosion.

b. Thickness

Determine the glass thicknesses in accordance with relevant Standards, functional requirements including design wind loads, deflections and safety, and manufacturer's recommendations. Submit computations.

Visual distortion of the glass will not be acceptable. The Facade Contractor shall increase the glass thickness as necessary to prevent visible distortion from occurring.

All glass in the same visual plane shall be the same thickness unless otherwise approved in writing.

Glass types and thicknesses shall be not less than indicated in the attached Appendix A: Glass Schedule.

c. Thermal Stress

For annealed glass, submit computations demonstrating the elimination of thermal stress breakage risk, methods of overcoming thermal stress problems, and all assumptions.

Probability of breakage of glass due to anticipated thermal stress in glass shall not exceed 8/1000 based on ASTM E1300.

d. Replacement of Glass

All glass unit and connection details should be designed to make possible replacement of each glass unit. Submit details of replacement procedures, including glass size limitations, and equipment required. Include estimated maximum lead time required by the glass manufacturer to supply replacement units for each type of glass unit.

e. Glazing

Supply glazed units factory pre-glazed in accordance with AS1288. No site glazing or re-glazing shall take place unless approved in writing.

Installation of each glass component shall be watertight and airtight and withstand all required temperature changes and wind loading without failure, including loss or breakage of glass, failure of sealants or gaskets, deterioration of glazing materials and other defects.

Install glass with correct edge distances at all rebates. Protect glass from edge work damage during handling and installation.

Surfaces to receive glazing materials shall be free of dirt, dust, grease, oil and other foreign materials.

Perform required cutting, holing, obscuring and other required processes on glass in the factory, site cutting shall not be permitted. Finish exposed glass edges to a finish not inferior to ground arised.

f. Production Quality Control for Quenching Heat-Treated Glass

i. Uneven Quench Pattern

All heat-treated glass is to be produced in a manner that prevents uneven quench patterns in the glass. Uneven quench patterns are quench patterns that result in the glass having a blotchy appearance or colour change when viewed with the naked eye from any angle and distance under a typical range of daylight conditions.

ii. Cause of Quench Patterns

The exact cause of quench patterns is not well understood, but it appears that quench patterns occur because of uneven heating and/or cooling of the glass during the heat treatment process. This is often because of incorrect oven settings, operating speeds or a blockage to heating and/or cooling jets that results in uneven and/or overheating of the glass.

iii. Checking for Quench Patterns

Checking for quench patterns involves visually inspecting manufactured glass. This is done by taking the glass outside and lifting it on a forklift or in a test rig, so that the glass can be viewed looking up at it under a range of daylighting conditions and orientations. A black sheet needs to be fixed to the back of the glass. Initially a polarising light filter needs to be used to identify quench pattern bands (only), and these then needs to be checked by naked eye, for a range of light conditions and angles to replicate exposure conditions on the building.

This should be done under both blue-sky conditions as well as overcast/fading light conditions. Check photos should be taken both through a Polaroid filter and without a filter as a record to verify whether the quench pattern is visible. Photographic records need to be maintained for all quench pattern checks.

iv. Frequency of Checking

Quench patterns need to be checked at the commencement of production for every glass configuration, and then at intervals as outlined below:

- Order size less than 100 panels - 2-hour intervals
- Order size 101 to 500 panels - 4-hour intervals
- Order size over 500 panels - daily

v. Pass / Fail Criteria

Glass will be rejected based on there being uneven quench patterns when blotches are visible by naked eye from any viewing angle. If some degree of unevenness is unavoidable, the Client / Architect are to be provided with a sample as a benchmark for their consideration. If this is accepted it shall be used as a control sample for production.

vi. Actions in the event of excessive Quench Patterns

If uneven quench patterns are observed, production through the oven used to heat treat the glass needs to be stopped, and the heat treatment oven needs to be checked/serviced by the furnace manufacturer. Where thermal imaging cameras are fitted, glass thermal images are to be compared with quench patterns to determine whether there are areas of over-heating to the glass.

Following servicing of the oven, test panels are to be manufactured and tested prior to proceeding with production.

2.1.1 Primary Glass

a. Generally

All primary glass shall be approved float glass in accordance with ASTM C1036.

All glass shall be free from cracks, scratches, bubbles, blisters, all inclusions of deleterious matter including nickel sulphide and other defects which detract from appearance or interfere with performance.

All glass shall have clean, wheel cut edges with minimum feather, free from vents, notches, or shells.

Float Glass shall be supplied one of the following manufacturers: Other suppliers not listed below must be approved by the Architect and the façade consultant.

- Guardian – USA/Europe/India
- Asahi Glass – Japan / India
- Saint Gobain – France / India
- Pilkington/FlachGlas - UK/Germany
- Viracon - USA
- China Southern Glass – PRC
- Shanghai Yaohua Pilkington – PRC
- AGC
- Emirates Glass - UAE

b. Tolerances

Dimensional tolerances of glass generally shall comply with ASTM C1036 for glass. Safety glass shall comply with AS/NZ 2208, Section 3.

c. Quality records

Submit production and test records to ASTM 1036, Table 4, proportionally adjusted to proposed project glass thickness. Indicate test procedures, acceptance criteria and pass and/or fail rate.

d. Edge quality

Edge quality criteria for annealed glass are as follows:

- Shark teeth shall not penetrate more than half of glass thickness
- Serration hackle may occur only within 150 mm of corners
- Flare shall not exceed 1 mm measured perpendicular to glass surface across the edge. Flare shall not occur at setting blocks.
- Bevel shall not exceed 1.5 mm.
- Flake chips may occur only within 200 mm of corners. Depth shall not exceed 1 mm and length, or diameter shall not exceed 6 mm.

e. Rough chips which exceed any of the dimensional limits for flake chips are not permitted.

2.1.2 Heat Strengthened Glass

a. Generally

Base material shall be an approved selected quality float glass from Section 2.1.1.

Heat treatment and heat soaking testing shall be provided by one of the following or an architect and consultant approved equivalent:

- Flach Glass
- Sekurit St. Gobain
- Asahi
- NSG (Nippon Sheet Glass)
- Guardian
- Viracon
- China Southern Glass
- Shanghai Yaohua Pilkington
- AGC
- Emirates Glass

b. Edge quality

All heat strengthened glass shall have belt arised edges or better.

Do not cut, work, or permanently mark after toughening. Use installation methods which prevent the glass making direct contact with metals or other non-resilient materials.

c. Quality records

Submit production and test records to AS/NZ 2208 and ASTM 1048. Indicate test procedures, acceptance criteria and pass and/or fail rate.

d. Warranty

All heat strengthen glass in single pane applications shall be warranted for the warranty period.

e. Roller wave distortion

Roller wave distortion shall not exceed 0.040mm when measured using an approved roller wave gauge.

BS 6262 - Code of practice for glazing for buildings.

AAMA 101 - Voluntary specifications for aluminium prime windows and sliding glass doors.

f. Residual surface compressive stress

100% residual surface compressive stress measured to ASTM C1279 for heat strengthen glass shall be carried out and its stress shall be within 24-52 MPa. ICE to be provided to witness the 100% residual surface compressive stress measurement.

2.1.3 Fully Tempered Glass

a. Generally

Provide approved Fully Tempered (toughened) glass, manufactured using the "roller hearth", or an equivalent approved process in accordance with AS/NZ 2208, ASTM 1048 and/or ANSI Z97.1.

Base material shall be an approved selected quality float glass from Section 2.1.1.

Heat treatment and heat soaking testing shall be provided by one of the following or an architect and consultant approved equivalent:

- Flach Glass
- Sekurit St. Gobain
- Asahi

- NSG (Nippon Sheet Glass)
- Guardian
- Viracon
- China Southern Glass
- Shanghai Yaohua Pilkington
- AGC
- Emirates Glass

b. Edge quality

All fully tempered glass shall have belt arised edges or better.

Do not cut, work, or permanently mark after toughening. Use installation methods which prevent the glass making direct contact with metals or other non-resilient materials.

c. Quality records

Submit production and test records to AS/NZ 2208 and ASTM 1048. Indicate test procedures, acceptance criteria and pass and/or fail rate.

d. Warranty

All fully tempered glass in single pane applications shall be warranted for the warranty period.

e. Roller wave distortion

Roller wave distortion shall not exceed 0.040mm when measured using an approved roller wave gauge.

BS 6262 - Code of practice for glazing for buildings.

AAMA 101-Voluntary specifications for aluminium prime windows and sliding glass doors.

f. Heat Soak Testing

100% heat soak testing in accordance to EN14179-1-2001(E).

2.1.4 Laminated Glass

a. Generally

Provide all required laminated glass in accordance with AS/NZS 2208 and FGMA Glazing Manual. Submit details.

Lamination process to be provided by one of the following processors or an approved equivalent:

- Sekurit Saint Gobain
- Pilkington
- Asahi
- NSG (Nippon Sheet Glass)
- Viracon
- China Southern Glass
- Shanghai Yaohua Pilkington
- AGC
- Emirates Glass

b. Interlayer

Provide an approved polyvinylbutyral (PVB) or SGP interlayer. Submit details.

Products which may be approved include Kuraray "Butacite" or SGP, Saflex or approved equivalent.

For all overhead and structural uses like Glass fins, Balustrade, Canopy, Skylight etc Kuraray SGP, Trosifoil ES or an approved equivalent shall be used

c. Quality records

Submit production and test records to AS/NZ 2208, ANSI Z97.1 and/or ASTM 1048 (whichever is more stringent). Indicate test procedures, acceptance criteria and pass and/or fail rate. Include records for interlayer.

d. Warranty

All laminated glass in single pane applications shall be warranted for the warranty period.

e. Edge quality

All laminated glass shall have belt arised or better edges as required to eliminate thermal stress breakage risk.

Edge protection of laminated glass is required for all exposed edges. The sealing detail shall comprise of a mitre to the glass, with oversize PVB interlayer hot rolled into the mitre left by the rebate. The edge to be created

with a UV resistant edge protector that prevents water penetration to the laminate. Then a pressed stainless-steel cover is to be fixed to the edges.

f. Installation

Use glazing materials which do not cause deterioration or discolouration of the interlayer.

Submit test results in accordance with an approved test programme to confirm the compatibility of laminated glass with adjacent glazing materials.

2.1.5 Insulated Glass Units

a. Generally

Provide insulating glass units (IGUs) of approved types in accordance with ASTM E774 and the recommendations of SIGMA. Submit complete details, including all construction details, primary and secondary seals, gas filling, corner treatment, nature of spacers, evacuation and assembly process.

IGU assembly to be provided by one of the following or an approved fabricator:

- Viracon
- Guardian
- PPG
- China Southern Glass
- Asahi Glass
- Guardian Glass
- Saint-Gobain
- Shanghai Yaohua Pilkington
- Emirates Glass

b. Seal performance

IGUs shall incorporate approved polyisobutylene primary (vapour) seals continuously bonded to glass, and two-part silicone secondary (structural) seals. Primary seal shall be not less than 3 mm deep. Secondary seal shall completely cover spacer with no gaps or voids, continuously bonded to glass.

Spacer bar shall be an approved proprietary aluminium type, or other metal material, including stainless steel, desiccant filled, anodized in an approved silver colour compatible with seals. Conceal spacer bar within the depth of the

glazing gasket line to ensure smooth sight line. Façade contractor is required to custom paint spaces as directed by architect. Submit details and colour samples.

c. Structural edge distances

Submit computations for distance between the outer edge of the glass and the innermost edge of the aluminium spacer indicating minimum bite of secondary (structural) seal and spacer bar depth.

d. Edge quality

IGUs shall have belt arised edges or better. Stone or hand finishing is not allowed.

e. Quality records

Submit production and test records for IGUs. Indicate test procedures, acceptance criteria and pass/fail rate to AS/NZ 2208.

f. Testing

Submit report from a testing laboratory the unit type has attained Class A as defined in ASTM E774 when tested in accordance ASTM E773.

g. Warranty

All IGUs complete shall be warranted for the warranty period. For a period not less than the warranty period, all IGUs shall be free from evidence of manufacturing defects and shall be free from:

- Intrusion of moisture or dirt.
- Internal condensation at temperatures above 10 $^{\circ}$C.
- Other visual evidence of seal failure or performance failure.

h. Acoustic testing of double-glazed units (IGUs)

Test results for similar systems may be interpolated provided that:

i. Each tested system differs from the proposed system by not more than one variable of one of the following elements:

- First panel: Glass type, glass thickness.
- Cavity: width dimension.
- Second panel: Glass type, glass thickness.
- Mounting: type, seal type.

- Cavity reveal: Acoustic absorption treatment.

j. A dimensional (thickness or width) difference does not exceed a ratio of 1:1.5.

2.1.6 Visual Effects and Coatings

a. Generally

Provide approved coatings, and visual effects of paint or film to glass to match approved samples. Submit details.

Colour, reflectivity, and appearance shall be uniform for each glazing type. Defects, including scratches and pinholes shall not be visible when viewed at 3 m. Provide safety backing restraint for fallout resistance.

Low-e and reflective coatings can only be supplied by processors with more than 10-year experience in related coating.

Visual effects and soft coatings to be provided by one of the following:

- Viracon
- Guardian
- Asahi
- Saint Gobain
- PPG
- China Southern Glass
- Shanghai Yaohua Pilkington
- Emirates Glass

b. Warranty

Submit manufacturer's certification that applied films (if applicable) and coatings will not be detrimental to the glass or limit in any way the glass product warranty period.

2.1.7 Glazing Accessories, Gaskets, Weather Seal

a. Generally

Provide approved non-cellular elastomeric extruded profiles, including gaskets, seals and glazing accessories, required for a complete installation, in accordance with ASTM C864 and HB/T3099. Submit details, including compatibility with adjacent components and sealants. Indicate sizes and locations on shop drawings.

Glazing accessories, including spacers, setting blocks, wedges, and the like, shall comply with AS 1288 and the recommendations of the glass manufacturer or glazing system.

Extruded profiles shall be smooth, of uniform dimensions, correctly selected for the conditions of use, and free from components likely to bleed, stain or detrimentally affect performance of the glazing. All products shall be of ultra-violet and ozone resistant grade.

Products may be manufactured from EPDM (ethylene-propylene-diene monomer).

Provide factory vulcanization for EPDM products at joints and corners.

Relevant Standards

AAMA 701-702	Voluntary Specification for pile weather strip and replaceable fenestration weather seals.
ASTM C864	Standard Specification for dense elastomeric compression seal gaskets, setting blocks and spacers.
BS 2571	Specification for general-purpose flexible PVC compounds for moulding and extrusion.
BS 4255	Rubber used in preformed gaskets for weather exclusion from buildings
ASTM D1149	Standard test method for rubber deterioration - Surface ozone cracking in a chamber (Flat Specimens).
ASTM D2240	Standard test method for rubber property - Durometer hardness.
ASTM D297	Standard test method for rubber products - Chemical analysis.
ASTM D395	Standard test method for rubber property - Compression set.
ASTM D412	Standard test method for vulcanized rubber and thermoplastic elastomers - Tension.
ASTM D624	Standard test method for tear strength of conventional vulcanized elastomers - Tension.
ASTM D746	Standard test method for brittleness temperature of plastics and elastomers by impact.

ASTM D865	Standard test method for rubber - Deterioration by heating in air (test tube enclosure).
BS 4315.2	Methods of test for resistance to air and water penetration.

b. Quality

Submit production and test records for all products in accordance with relevant Standards. Indicate test procedures, acceptance criteria and pass and/or fail rate.

c. Hard Profiles

Where indicated on the Drawings or required, provide dense profiles including flashings, wiper seals and the like, complying with ASTM C864, as follows:

- Shore A durometer hardness: 75 +/- 5 for solid profiles and 60 +/- 5 for hollow profiles when tested in accordance with ASTM D2240.
- Compression set 100% (168 hrs): Not greater than 40% when tested in accordance with ASTM D395.

d. Soft Profiles

Where indicated on the Drawings or required, provide soft profiles including bulb seals, sponge seals and the like, complying with ASTM C509, as follows:

- Shore A durometer hardness: 40 +/- 5 when tested in accordance with ASTM D2240.
- Compression set (168 hrs): 30% +/- 5% when tested in accordance with ASTM D395.

e. Side Blocks

Where indicated on the Drawings or as required, provide approved side blocks of dense material as follows:

- Shore A durometer hardness: 55 +/- 5 when tested in accordance with ASTM D2240.

Install side block with 3 mm clearance between block and bearing surface. Block shall be of sufficient length to prevent point loading on the glass.

Side blocks are not required where glass is supported along the vertical edges with structural silicone.

Side blocks of extruded silicone may be approved acceptable for IGUs with silicone edge seals. Neoprene or EPDM side blocks may be approved only if recommended by the IGU manufacturer.

f. Setting Blocks

Where indicated on the Drawings or required, provide approved setting blocks of dense material as follows:

- Shore A durometer hardness: 85 +/- 5 when tested in accordance with ASTM D2240.
- Compression set (168 hrs): Not greater than 25% when tested in accordance with ASTM D395.

Locate setting blocks at quarter points unless otherwise approved but not less than 150 mm or 0.125 x glass width between edge of glass and edge of setting block. Shims used with setting blocks shall be the same material as the setting block. Setting blocks shall be secured against dislodgement.

Setting Block lengths shall be calculated in accordance with BS6262 and shall be not less than 80mm.

g. Double sided tape

Use 3M, Norton V-2100 or approved equivalent double-sided tape as glass space for structural silicone applications. Submit compatibility test results supplied by manufacturer.

h. Contact with structural silicone sealants

Extruded profiles in contact with structural silicone sealants shall be approved black heat cured silicone rubber. Submit details.

i. Structural Gaskets

Where indicated on the drawings or required, provide approved structural gaskets shall be made from approved rubber-based material having proven compatibility with silicone as follows:

- Shore A durometer hardness: 71 +/- 1 when tested in accordance with ASTM D2240.
- Compression set (22 hrs): Not greater than 25% when tested in accordance with ASTM D395.

Products which may be approved include those manufactured by Tremco, or equivalent.

Dry gaskets shall be extruded with integral locking strips or zipper type insertions producing a compression grip on the frame and glass. Dry gaskets

shall be continuous around glazing. Dimensional tolerance and the resulting edge bite shall comply with manufacturer's instructions.

Colour of the gaskets shall be approved before manufacture.

2.1.8 Structural Glazing

a. Generally

Design and provide structural sealant glazing systems where indicated on the Drawings, or otherwise if approved in writing.

Structural Silicone shall be two part type manufactured by the following companies:

- Momentive
- Dow

All glazing and sealants shall comply with manufacturer's recommendations, relevant Standards, and approved shop drawings.

Relevant Standards

AAMA CW13 - 85	Structural sealant glazing systems (A Design Guide)
ASTM C1087-00(2006)	Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
ASTM C1253-93(2005)	Standard Test Method for Determining the Outgassing Potential of Sealant Backing
ASTM C510-05a	Standard Test Method for Staining and Colour Change of Single- or Multicomponent Joint Sealants.
ASTM C794-01	Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
ASTM C1193-05a	Standard Guide for Use of Joint Sealants
ASTM C962	Standard guide for use of elastomeric joint sealants.
ASTM D2203-01	Standard Test Method for Staining from Sealants.
FGMA/GANA	Sealants manual.
Dow Corning	Structural Glazing: Industry Code of Practice.

a. Structural glazing requirements

Structural glazing adhesive contact surfaces shall be anodized or other coated which is tested compatible with the structure sealant. Raw milled aluminium surface is not allowed for structural sealant glazing. All surfaces contacting with structural silicone sealant must be tested the compatibility to ensure reliable adhesion.

b. Structural Sealant Design

i. The structural glazing adhesive has been satisfactorily tested to ASTM C1087 for compatibility with the adjacent materials and components, is not detrimental to its long term structural performance, weathering and visual quality, is compatible with the edge seal of IGUs, and will not cause delamination or other impairment to laminated glass.

ii. Calculations, are required for the following:

- Limits the working stress of sealants to 138kPa, and the working stress of pressure sensitive tapes to 230kPa.
- Limits the working stress of sealants to 5x the working load.
- Provides for thermal movement between abutting glass edges by an adequate "working joint" design with the necessary clearances and dimensions.
- The dead load of the glass shall be fully supported by the setting blocks in the installed position, and fully engaged with the setting blocks prior to the application of structural adhesive.

c. Experience of glaziers and logbooks

Glazing shall be carried out by experienced personnel who have pre-qualified for the type of work undertaken.

All work shall be supervised by an approved glazing supervisor.

Maintain a glazing logbook daily for all glazing and submit progressively. The glazing logbook shall be available for inspection at any time without notice.

As a minimum the logbook shall contain:

- Date
- Name of glazier
- Individual panel numbers glazed / intended location of installed work
- Sealant manufacturer and type, colour and batch number

- Daily air temperature inside and outside the factory
- Tape and accessory manufacturers and types
- Test results, including “butterfly test”, “snap test”, "skin over", "de-glaze, and "hand pull" results, as applicable
- Glazing supervisor's verification

2.2 Aluminium

a. Generally

Provide approved aluminium extrusions and/or sheet of alloy and grades suitable for the structural requirements, applied finishes and project conditions not less than the strength and durability properties of the alloy and temper designated in the relevant Standards.

Manufacturers shall be approved established manufacturers with a reputation for producing high quality materials. Submit full details of manufacturers for approval.

Relevant Standards: (British)

BS 1161	Specification for aluminium alloy sections for structural purposes.
BS EN 485-1:1994	Aluminium and aluminium alloys. Sheet, strip and plate. Technical conditions for inspection and delivery.
BS 1473:1972	Specification for wrought aluminium and aluminium alloys for general engineering purposes - rivet, bolt and screw stock.
BS 1474	Specification for wrought aluminium and aluminium alloys for general engineering purposes: bars, extruded round tubes and sections.
BS 4873:2004	Aluminium alloy windows
BS 8118:1991	Structural use of aluminium. Code of practice for design
AS/NZS 1664.	Aluminium Structures
AS/NZS 1734:1997,	Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate
ADCA	Aluminium Standards and Data - Wrought Products
The Aluminium	Aluminium Design Manual, 2005

Association	

Relevant Standards: (US)

AAMA CW-DG-1	Aluminium Curtain Wall Design Manual
AAMA 101-97	Voluntary specifications for aluminium prime windows and sliding glass doors.
AAMA 101-97	Voluntary specifications for aluminium prime windows and sliding glass doors.
AAMA CW10 - 04	Care and Handling of Architectural aluminium From Shop to Site
ASTM B26/B26M-05	Specification for aluminium alloy sand castings.
ASTM B221	Specification for aluminium alloy extruded bars, rods, wire, shapes and tubes.
ASTM B429	Specification for aluminium alloy extruded pipe and tube.
ASTM B483/B483M-03	Specification for aluminium alloy drawn tubes for general purpose applications.
ASTM B209	Specification for aluminium alloy sheet and plate.
ASTM B26/B26M-05	Specification for aluminium alloy sand castings.

b. Quality and certification

Submit manufacturer's certificate of compliance or test report for each batch of aluminium supplied. Each batch shall be suitably identified and cross-referenced with the certificate.

Quality control measures shall ensure that materials are inspected before shipment. Material that has not been tested, has not been processed in accordance with the Specification, or does not satisfy visual requirements shall not be shipped.

c. Extrusions

Unless otherwise indicated or required, extruded aluminium alloy shall be Grade 6061 or 6063, Temper T5 or T6. The selected material is to be suitable for painting. Aluminium brackets shall be 6061 T6.

Extrusion shapes and thickness shall withstand all required loads, and shall be rigid with straight and sharply defined profiles, free of draw marks. Structural sections minimum wall thickness is 3.0mm, and the minimum wall thickness of non-structural trims is 1.4mm. Extrusion walls and screw flutes shall be of sufficient thickness for all fixings including flush countersinking where required.

d. Sheet

Unless otherwise indicated or approved, sheet alloy that is to be anodized shall be Grade 1100-H14. The aluminium alloy panel for painting finish should be 3000 series, H14 or H36 tempered.

The bend radii shall be such that no surface cracking is visible. All corners in visible conditions to be back cut for small radius bends.

e. Sheet thickness for external cladding

Unless otherwise indicated on the Drawings, thickness of sheet aluminium for external cladding shall be not less than 3 mm.

Composite sheet products shall not be substituted for aluminium sheet unless approved in writing by Architect and the façade consultant. Sheet thicknesses at coping panels and all conditions subject to lighting strikes/protection to be thickened.

2.2.1 Aluminium Fabrication

All extruded material is to be produced in India, China, Western Europe, USA, Australia or Japan by an Architect and consultant Approved Extruder.

a. Generally

Fabricate aluminium in accordance with approved shop drawings and prototypes.

Cut edges, drilled holes, riveted joints and flat sheets shall be clean, neat, and free from burrs and indentations. Remove sharp edges without creating excessive radius.

Relevant Standards:

BS 4873	Specification for aluminium alloy windows.
BS 8118	The structural use of aluminium.
IS 8147	Aluminium Alloy in Structures

b. Joints and junctions

All visible joints shall be fixed by concealed means, unless otherwise indicated on the drawings or approved in writing.

Fit exposed joints accurately to provide close continuous contact to a fine hairline. Ensure continuity of finish, colour and texture without surface variations at joints.

Where required, joints shall be watertight and weather tight.

Other than for concealed stud welding, aluminium extrusions shall not be welded except where approved and writing, and, if approved, only on concealed surfaces. Read-through on welding is not allowed.

c. Fixings in aluminium work

Fastener requirements listed are applicable to screws, bolts, washers, nuts, and pins. (All fasteners should be non-magnetic stainless-steel type 316.)

All self-drilling/self-tapping fasteners ('Teks') shall be 'Dril-flex' with Stalgard finish, manufactured by ELCO Industries, Rockford, Illinois or approved equal. Cadmium-plated steel or aluminium fixings shall not be used.

d. Welded studs

Where required for fixing face sheeting to support frames, provide not less than M6 fully threaded welded studs of approved type, and welded by approved procedures. Submit complete details including samples and pull out test results. Include preliminary and on-going production test results. Welding shall not cause ghosting on the visible face of the cladding.

A testing program shall include an initial proof testing procedure of not less than 100 examples of each type of fixing, and subsequent testing of not less than 10 examples progressive through the fabrication program at monthly intervals.

Approval of fixings shall require that the average of each set of 6 test failure loads be not less than 2x the design load, and absence of permanent deformation at 1.5x the design load.

e. Holes

Provide holes and connections for site assembly and to accommodate work of others as required. Holes shall be drilled, or punched and reamed, perpendicular to the surface.

f. Built-up members and reinforcement

Steel reinforcement of aluminium members shall be completely enclosed and separated from aluminium by approved methods. Submit details.

g. Moving parts

Moving parts shall operate freely and smoothly, without binding or sticking, at correct tensions or operating forces, lubricated where appropriate.

h. Protection

Protect finished aluminium surfaces to prevent damage during transportation, storage, installation, and until the Main Contractor approves its removal.

Provide factory applied protective film, tape or coatings which will not bond to the aluminium surfaces when exposed to sunlight or weather.

i. Anti-drumming Treatment

Horizontal or near horizontal (more than 10° inclination to the vertical) shall have the provision of anti-drumming membrane underneath the cladding panel.

2.2.2 Aluminium Welding

a. Generally

Welding of aluminium will not normally be permitted. Where it is required, it will be carried out subject to the following:

i. Approved Welding Procedures
ii. By Approved welders with relevant Certificates for this work.
iii. At locations nominated and approved on shop drawings
iv. Not near finished surfaces or glass
v. Strength test of 5% of samples
vi. Approval from the Architect

Carry out all welding, including detailing of all joints, welding procedures, appearance and quality of welds, and correction of defective work in accordance with approved samples and AS 1665 or for aluminium welding.

Welded parts shall be accurately fabricated to ensure proper fit. All welding equipment shall be of suitable type and in good condition.

b. Weld testing

Welding Testing shall be carried out by and approved independent testing laboratory. Submit test results. In the event of test failure, rectify the defect and repeat the test.

Non-destructive testing

i. Magnetic Particle test on 20% of all Fillet and Partial Penetration Welds.
ii. 100% Visual Testing on all fillet weld
iii. 100% Radiographic tests on all Splice Butt Welds (Full Penetration)
iv. Ultrasonic tests on 100% of Full-Penetration Butt Welds other than b above.

2.2.3 Aluminium Clad Panels

All Aluminium panels are to be properly designed with extruded aluminium stiffeners both horizontal and vertical on back of panels. Edge stiffening may also be required. Stiffeners shall be attached by both stud method and structural silicone.

Where aluminium clad panel form part of the sealed curtain wall system, they shall be insulated in the same manner as the spandrel glass.

All aluminium panels within 3 meters of the ground, or any walking surface, shall have concealed sound dampening applied.

2.2.4 Aluminium Louvres

a. Operable Louvres

Operable louvres are to be waterproof and weatherproof and self-draining. They are to be PVDF Coated for all external applications, unless otherwise indicated.

b. Architectural Louvres

Architectural louvres are not required to be weatherproof, but the cavity between them and any operable louvre is to be fully flashed with a stainless-steel flashing to drains.

Exterior louvers are to be storm proof. All louvers to be extruded aluminium frames and blade painted per architect's requirements. Frame corners and blade ends shall be fastened with 316 grade stainless steel screws.

Provide concealed stiffeners for blades, such that vector sum of blade deflection parallel to principal axes does not exceed L/175 times span at design pressure assume that pressure acts perpendicular to the plane formed by the corners of the perimeter frame, and that the tributary area for one blade equals its projected area on the same plane.

Continuous louver blades to be locked and fastened to vertical support members, heads and sills shall have an integral sealant reveal. Provide base catch fan and flashings to shed all water.

c. Airflow

Design louvre assemblies with a free area of at least 50% to allow for free air flow requirements indicated on the Drawings or as required by the Mechanical engineer. Submit verification of compliance with free-air movement requirements. Minimum free area to be confirmed with mechanical engineer prior to approval.

Submit manufacturer's test reports, including previous tests of identical louvre design, or tests of the actual louvre to be used or a representative prototype.

d. Insect wire-mesh

Make provisions as per the drawings for installing insect wire mesh to the interior of all external louvre assemblies, except false louvres backed by walls or baffles. Mesh to be installed by the occupant post hand over.

e. Installation and removal

Louvres to plant rooms shall be designed to be removed and re-installed if required, for the removal / replacement of major plant items.

2.3 Finishes

2.3.1 Steel Preparation and Priming and Finishing

Refer to the Steel Specification, section 3.0.

2.3.2 Aluminium Anodising

a. Generally

Anodised aluminium panels and extrusions are to be produced in China, Western Europe, USA, Japan or Australia by an Architect and consultant approved anodiser when a local coated is to be proposed with a minimum of 600mm long extrusions and 600X600 mm cladding samples submitted.

Where required, finish aluminium by an approved anodized coating process in accordance with relevant Standards to match approved samples. Submit details, including details of preparation and pre-treatment.

Relevant Standards: (British)

BS 6161-18:1991	Methods of test for anodic oxidation coatings on aluminium and its alloys. Determination of surface abrasion resistance
BS 6161-7:1984	Methods of test for anodic oxidation coatings on aluminium and its alloys. Accelerated determination of light fastness of coloured anodic oxidation coatings

	using artificial light
BS EN 12373-1:2001	Aluminium and aluminium alloys. Anodizing. Method for specifying decorative and protective anodic oxidation coatings on aluminium
BS EN 12373-15:2001	Aluminium and aluminium alloys. Anodizing. Assessment of resistance of anodic oxidation coatings to cracking by deformation
BS EN 12373-9:1999	Aluminium and aluminium alloys. Anodizing. Measurement of wear resistance and wear index of anodic oxidation coatings using an abrasive wheel wear test apparatus
BS EN 12373-4:1999	Aluminium and aluminium alloys. Anodizing. Estimation of loss of absorptive power of anodic oxidation coatings after sealing by dye spot test with prior acid treatment
BS 6161-7:1984	Methods of test for anodic oxidation coatings on aluminium and its alloys. Accelerated determination of light fastness of coloured anodic oxidation coatings using artificial light

Relevant Standards: (US)

AAMA 101-97	Voluntary specifications for aluminium prime windows and sliding glass doors.
AAMA 2603 – 02	Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminium Extrusions and Panels
AAMA 2604 - 05	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminium Extrusions and Panels
AAMA 2605 - 05	Voluntary Specification, Performance Requirements and Test Procedures for Superior Performance Organic Coatings on Aluminium Extrusions and Panels
AAMA 606.1-76	Voluntary Guide Specifications and Inspection Methods for Integral Colour Anodic Finishes for Architectural aluminium.
AAMA 607.1	Voluntary guide specification and inspection methods for clear anodic finishes for architectural aluminium.
AAMA 608.1	Voluntary guide specification and inspection methods for electrolytically deposited colour anodic finishes for architectural aluminium.
AAMA 609.1-93	Voluntary guide specification cleaning and maintenance of architectural anodized aluminium.

ASTM B449	Standard Specification for Chromates on aluminium.
ASTM D1730	Standard Practices for preparation of aluminium and aluminium-alloy surfaces for painting.
NAAMM	Metal Finishes Manual

b. Colour and finish

Refer to Architectural Drawings and approved control samples for required colours, gloss, texture, patina and the like.

There shall be three sets of three range samples 600 mm x 600mm in each set representing both the degree of specula gloss and the lightest, median, and darkest shades of that colour to be accepted for use on the project. (One set is to be used by the Anodiser, the other by the Architect for checking and one for the client).

Materials acceptable shall be clear (or natural) anodised to AAMA 607.1 or colour anodised to AAMA 601. The etched surface is to be permanently sealed. The etched surface is to have 25 microns minimum of material removed from all exposed surfaces.

Surfaces to be finished shall be free from imperfections, scratches, scrapes, die lines and dents. After the finish is applied, all coatings, when cured, shall be visibly free of spots, stains, and streaks.

The Architect reserves the right to reject any panels or extrusions which do not conform to the specification or which he considers visually unacceptable.

c. Grade and thickness

Unless otherwise required, anodizing grade and average thickness shall be:

i. External: 25 microns with local thickness not less than 20 microns.
ii. Internal: 25 microns with local thickness not less than 20 microns.

The minimum coating weight shall be 5.5 milligrams/cm^2

d. Quality records and testing

i. Submit manufacturer's production and test records prior to shipping materials to site.

Each batch shall be tested for film thickness and the batch number referenced to the delivery documentation for trackability. An approved testing laboratory shall perform testing.

Colour testing shall be carried out an all batches using a Gardnier XL-S Colour meter.

e. Warranty

All preparation and coating work shall be warranted for the warranty period.

2.3.3 Aluminium SDF Powder Coating

a. Generally

Where required, finish metals with an approved powder coating system by an approved manufacturer and applicator in accordance the relevant Standards to match the approved samples. Submit details, including details of preparation and pre-treatment. Powder coating shall only be used for interior applications as described in Architectural Drawings. If used for exterior application, it must have minimum service life of 25 years and meet AAMA 2605 standards requirements. For internal applications, the minimum service life shall be 15 years with compliance to AAMA 2603 standard requirement.

The powder coating system shall be a thermosetting polyester resin, applied electrostatically and oven cured in accordance with the manufacturer's recommendation.

Products which may be approved include Jotun Durasol, Jotun SDF, Tiger DRYLAC 58series, Tiger DRYLAC 75series, IGP "HWF", IGP "PFC", Orica Camel "Duratec", Orica Camel "Fluoroset", PPG Duranar, Valspar Fluropan, or an approved equal.

b. Colour and finish

Refer to Appendix 'A' and approved control samples for required colours, gloss, texture, patina and the like.

There shall be three sets of three range samples 600 mm x 600mm in each set representing both the degree of specula gloss and the lightest, median, and darkest shades of that colour to be accepted for use on the project. (One set is to be used by the Finisher, the other by the Architect for checking and one set for the client).

Surfaces to be finished shall be free from imperfections, scratches, scrapes, and dents. After the finish is applied, all coatings, when cured, shall be visibly free of spots, stains, and streaks.
The Architect reserves the right to reject any panels or extrusions which do not conform to the specification or which he considers visually unacceptable.

c. Grade and thickness

Unless otherwise required, grade and average thickness shall be:

i. Internal: The minimum dry film thickness (DFT) shall be 50 microns.
ii. External: The minimum dry film thickness (DFT) shall be 60 microns.

The paint finish shall comply with AAMA 2604.

d. Quality records and testing

Submit manufacturer's production and test records prior to shipping materials to site.

Each batch shall be tested for film thickness and the batch number referenced to the delivery documentation for tracability. An approved testing laboratory shall perform testing.

Colour testing shall be carried out an all batches using a Gardnier XL-S Colour meter.

Site touch-up of damaged surfaces shall not be permitted without approval from the Architect. Where touching up is not authorized, damaged material shall be replaced.

e. Warranty

All preparation and coating work shall be warranted for the warranty period.

2.4 Joints and Junctions

2.4.1 Sealant Materials

a. Generally

Sealant type and installation method shall be in accordance with manufacturer's recommendations suitable to the location, function, substrates and performance requirements including movement, air infiltration, fire and acoustic requirements. Submit complete details, specifications, installation and curing instructions, including manufacturer's certification that the proposed product selections are suitable for the joint types and are compatible with and non-staining, and non-bleeding to adjacent materials.

All weather silicone sealant shall be manufactured by the following companies:

i. Momentive
ii. Dow

Relevant Standards:

AAMA CW13 - 85	Structural sealant glazing systems (A Design Guide)

ASTM C1087-00(2006)	Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
ASTM C1253-93(2005)	Standard Test Method for Determining the Outgassing Potential of Sealant Backing
ASTM C510-05a	Standard Test Method for Staining and Colour Change of Single- or Multicomponent Joint Sealants.
ASTM C794-01	Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
ASTM C1193-05a	Standard Guide for Use of Joint Sealants
ASTM D2203-01	Standard Test Method for Staining from Sealants.
FGMA/GANA	Sealants manual.
ASTM D412	Standard test method for vulcanised rubber and thermoplastic elastomers - Tension.
ASTM D897	Standard Test Method for tensile properties of adhesive bonds
TT-S 001543A	Sealing compound, silicone rubber base (for caulking, sealing, and glazing in buildings and other structures).
TT-S 00227E	Sealing compound, elastomeric type, multi-component (for caulking, sealing, and glazing in buildings and other structures).
TT-S 00230C	Sealing compound, elastomeric type, single component (for caulking, sealing, and glazing in buildings and other structures).
TT-S 01657	Sealing compound, single component butyl rubber based, solvent release type (for buildings and other types of construction).

b. Movement requirements

Where sealants are used to seal movement joints, movement capability of sealant shall be appropriate to expected maximum deflection or movement.

Unless otherwise approved, sealant depth for movement joints shall not exceed half the joint width.

c. Fire rated requirements

Provide approved fire-rated sealant and joint fillers where indicated or required. Submit test results indicating fire rating and compliance with statutory requirements.

Where dry foam fire rated fillers are proposed for wall types which also have acoustic or air infiltration requirements, provide an elastomeric cover bead.

d. Compatibility

All proposed sealants and accessories shall be compatible with substrates, adjacent materials, accessories, and other sealants, and shall be non-staining and non-bleeding. A compatible primer shall be provided on absorbent surfaces like concrete and rendered finishes.

e. Coloured sealants

Provide coloured or paintable sealants where required in accordance with approved samples. Sealants shall be resistant to staining due to dirt or pollution and shall be capable of cleaning. Sealants to be custom and standard coloured as selected by architect, multiple types-provide list.

f. Sealant accessories

Provide all required accessories recommended by sealant manufacturer, including backing rods, bond breaker tape and the like. Submit details.
Submit manufacturer’s certification that they have reviewed all project details and that they approve the use of their product.

g. Manufacturer's standard test data

Submit manufacturer's standard test reports and certificates previously performed on proposed sealants, including details of the following characteristics:

i. Chemical composition
ii. Adhesion, bond strength, cohesion or tensile strength, and elongation
iii. Compatibility
iv. Hardness and viscosity
v. Colour stability
vi. Compression set
vii. Low-temperature flexibility
viii. Modulus of elasticity
ix. Water absorption
x. Effects of exposure to ozone and ultraviolet light
xi. Stain resistance

Include adhesion characteristics for all relevant surfaces including applied coatings to aluminium, glass and adjacent sealants and gaskets. Include

statement of differences between the proposed sealants and previously tested products, if any.

Include long-term aged performance or accelerated exposure performance for the above characteristics.

h. Quality records

Submit production and test records for sealants. Indicate test standards and procedures, acceptance criteria and pass/fail rate.

i. Warranty

All sealants shall be warranted for the warranty period.

2.4.2 Sealant Installation

a. Generally

All sealants shall be installed in accordance with manufacturer's recommendations.

b. Cleaning

Clean the joint surfaces immediately before installation of backing rod and again before applying the sealant, as recommended by sealant manufacturer.

i. Glass and aluminium
Cleaning compounds shall be applied with clean lint-free cloths. A two-wipe method of application shall be employed. First wipe with an acceptable cleaning-grade solvent onto the cloth to remove contaminate and then immediately wipe the cleaned area with a separate clean, dry cloth.

ii. Porous substrates, concrete, masonry:

Clean where necessary by grinding, mechanical abrasion, detergent washing or a combination of methods to ensure a clean sound interface in accordance with the manufacturer's recommendations.

c. Priming, etching and sealing

Prime or seal joint surfaces where recommended by sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

d. Installation of sealant accessories

i. Install backer rod for sealants, at a proper depth to provide sealant bead profiles indicated on approved shop drawings.

ii. Install bond breaker tape where indicated and where required by the manufacturer's recommendations to ensure the proper performance of sealants.

e. Proof of supply shelf life

Ensure that remaining shelf life of products is well within the likely installation period. Confirm expiration dates with manufacturer.

f. Curing

Provide for the appropriate cure conditions, in accordance with the sealant manufacturer's written recommendations at factory and on-site. Protect external sealants from inclement weather until fully cured. Glazed panels are not to be moved until the joint has developed sufficient bond strength and cohesive integrity.

2.4.3 Flashing

a. Generally

Provide all required flashings, baffles, trims, capping and the like to prevent the entry of water and weather, and make neat and clean junctions with the base-structure and adjoining work. Where visible, provide matching materials and finishes. Include all fixings and sealing.

Where flashings are fitted to pre-formed rebates, coordinate cast-in grooves or reglets as required.

Construct weep holes and weep tubes as required to enable the passage of moisture to the outside of the building. Lap and seal all flashings by approved methods. Submit details.

Provide flashings at all conditions as required to provide a second means of defence against uncontrolled water penetration.

Relevant Standards

BS 6561	Specification for zinc alloy sheet and strip for building.
ASTM D1149	Test method for rubber deterioration - Surface ozone cracking in a chamber (Flat Specimens)

b. Locations

Unless otherwise indicated on the Drawings, types and locations shall be as follows

i. Concrete wall flashings at every second storey: Stainless steel sheet or Zinc alum steel.
ii. Louvre flashings: Stainless steel sheet.
iii. Continuous horizontal and vertical smoke flashings: Zinc alum steel.
iv. All Horizontal offsets, ledges, copings, etc. in exterior enclosure assembly.
v. All gutters of roof should be provided with secondary waterproof membranes, like self-adhering weather sheet.
vi. Perimeter of cladding termination, horizontal and vertical.

c. Materials

Unless otherwise indicated on the Drawings, types and locations shall be as follows

i. Zinc alum sheet to be steel base grade G2, coating class AZ 275.
ii. Stainless steel sheet, 0.8 mm thick, Grade 316.
iii. Aluminium sheet, not less than 1.2mm thick
iv. Neoprene strip shall be 3.5 mm and shall comply with ASTM D1149 with regards to ozone and flame resistance.
v. Self-adhering weather sheet shall be at least 1.5mm thick.

2.4.4 Vapour retarder layer

All rock wool or fibre glass insulation should be isolated from indoors warm and humid air using PVC or PE vapour retarder film to avoid condensation. The permeance rate of film must be less than 0.05.

2.5 Fixings and Anchors

a. Generally

Submit details, including computations and shop drawings where required, indicating type, size and spacing of all items.

Co-ordinate with others if required to ensure anchorages are provided and accurately built-into base-structure without delay or disruption. Provide setout drawings, templates and installation instructions as required.

Ensure that all bolts and similar fixings are tight at the completion of installation.

b. Minimum Level of Protection

i. All bolts, nuts, washers in any given assembly shall be of the same material and grade.
ii. Bolts between galvanized steel components shall be galvanized.
iii. Bolts between aluminium and steel shall be stainless steel and fully insulated.
iv. Bolts between aluminium and stainless steel shall be stainless steel.
v. Bolts between steel and stainless steel shall be stainless steel and fully insulated.

vi. Bolts between aluminium components shall be stainless steel.

c. Locking of nuts and threads

Apply an approved nut locking compound or device to all nuts.

2.5.1 Anchorages

a. Expansion or Chemical Anchors

Provide approved proprietary anchorages, with corrosion-resistant finish, suitable for the substrates and conditions, with holding power at least 5 x design load.

Products, which may be approved, include those manufactured by Hilti or Fischer Fasteners, or equivalent approved by architect and consultant.

Do not use explosive shot fired devices unless approved in writing before commencing installation.

Chemical anchors are not to be used were a fire-resistant fixing is required.

b. Channel anchorages

Provide approved channel anchorages in hot-dip galvanized steel or Grade 304 stainless steel where required, complete with polystyrene insets and plastic end caps.

Channel length, tail size and tail locations shall satisfy the most extreme loading conditions allowed for in the structural calculations.

Products, which may be approved, include those manufactured by HALFEN original imported from Germany, or equivalent approved by Architect and consultant.

2.5.2 Fixings

a. Fasteners

Fastener requirements listed are applicable to screws, bolts, washers, nuts, rivets, and pins. (All fasteners should be non-magnetic stainless-steel type 316.)

All self-drilling/self-tapping fasteners shall be 'Dril-flex' with Stalgard finish, manufactured by ELCO Industries, Rockford, Illinois or approved equal.

b. Bolts

Galvanized

i. High Strength Grade 8.8 to BS 3692

Stainless steel:

i. Bolts exterior-Grade A4
ii. Bolts interior-Grade A2

2.6 Window Hardware and Door Ironmongery

All components and hardware that make up an operable vent, inclusive of, but not limited to, glazing, sashes, glazing accessories, structural sealant (if applicable), capping (if applicable), locking systems, hinges, mullions and transoms shall be designed to withstand a barrier load of 0.75kN/m at 1100mm above FFL in both the open and closed position to comply with the local regulations.

a. Operable Vents

All window hardware is to be of a proprietary type stainless steel, grade 304 or 316, which has been fully designed and tested. Load capacity tables provided by the Supplier are to be submitted, together with test results, if required. The profile of the handle shall be designed in association with the Architect to ensure its operability in terms of depth and access for recoverability of the vent when it is in open position. Options for profiles shall be provided for the architect's selection. All visible hardware to be finished to match window frame and sash.

All operable sash/vents to be weatherproof with 2 rows of gaskets. Gaskets shall be heat vulcanization at corners.

The force to open and close the vent cannot be greater than 50N. And all vents shall have a service life not less than 10,000 cycles of operation. Submit detailed testing report to testify the performance of vents.

b. Locking System

Locking System for operable vents shall be Ferco Multi-Point Locking System or Architect Approved Equivalent. Handle shall be located at mid-point of operable vent on the vertical face. The handle in the open position should not obstruct the action of the outward opening vent.

Locking Points shall be calculated based on acceptable vent defection and stress limits.

The locking system shall be fully concealed within the body of the vent frame and shall lock into a concealed location.

c. Hinges & Limiting Devices

The vents shall be manually opened to a point of full extension allowing the full cross-sectional area of the vent opening to be vented. At full extension or at a maximum opening position as requested by code there shall be a 'keeper', which shall be adequate to restrain the open vent in full wind loading conditions. The restraint shall be designed so that the vent may be manually closed without compromising the future functioning of the 'keeper'.

Hinges for the vent shall be extruded and punched and shall run the full length of the operable vent. The hinges shall be free moving but shall be designed to a 'snug' fit so as to prevent any vibration of the vent in either closed or open positions. Hinges shall be concealed.

d. Openable Doors & Hinges

Door hinges shall be Dorma or GU concealed spring hinges or Architect approved equivalent.

Door locks and handles shall be Dorma, GU or Architect approved equivalent. Locking mechanisms shall be Chubb or Architect approved equivalent and shall be based on a Master-Keying System.

All hardware shall be Grade 304 or 316 Stainless Steel and Architect specified finish.
All doors shall have a Grade 316 Stainless Steel kick plate of at least 150mm height unless otherwise specified.

2.7 Other Components

2.7.1 Internal Trims to Curtain Wall

Internal trims are to be provided to sills, jambs and ceiling transoms at all floors. These trims are to provide a uniform surface, with hairline joints. Sill trims to be reinforced to prevent damage from being stood on. The space for pelmet shall be involved in consideration.

2.7.2 Fire Stops

a. Fire Safety system, fire and smoke stop, and Spandrel Backpan shall work as a system to meet all requirements of local Building Authorities' regulations, with regards to the fire rating of the exterior façade system. Construction details and fire resisting materials shall be a tested and proven system and approved by the appropriate local Building Authorities.

b. Fire containment system shall be of a least 2-Hours Fire Rating.

c. Vertical Fire Containment System between compartmentations/ room-to-room shall be provided as per the requirement of the Consultant Team's fire compartmentation plans.

d. Fire containment tests are performed by a qualified, testing agency, in compliance with ASTM E2307 or an approved equivalent. Fire containment

systems shall be listed under Product Listing Scheme [PLS] by the accredited testing agency.

e. Provide fire containment system products that are compatible with one another, with the substrates forming openings, under conditions of service and application, as demonstrated by fire containment system product manufacturer based on testing and field experience.

f. Provide components for each fire containment system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the accredited testing agency for the designated fire containment systems.

g. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, ponding water or other forms of moisture characteristic during and after construction, in accordance with standard ASTM D6904.

h. Provide sealants sufficiently flexible to accommodate movement such as thermal expansion, inter-storey differential building sway and other normal building movement without damage to the seal.

i. Provide perimeter fire containment systems subjected to an air leakage test conducted in accordance with Standard, ANSI/UL2079 and ASTM E2307, with published L-Ratings for ambient and elevated temperatures as evidence of the ability of the fire-resistive joint system to restrict the movement of smoke.

j. Provide moisture-curing products where inclement weather or greater than transient water exposure is expected.

k. Use of CSR insulation or approved equivalent with minimum nominal density of 80kg/m3 for which minimum thickness to be 200mm from top to bottom. A tested and proven fire safety system can be proposed subject to local fire authority approval and comply with the following requirement:

- Asbestos Free
- Non- Combustible comply to BS 476-Part 4

The continuous gap between the curtain wall insulation and the concrete slab edge is to be filled with Fire Bureau and/or other relevant Authority approved mineral fibre insulation material with a 2-hour fire resistant period. Use CSR insulation with minimum nominal density of 60kg/m^3 for which minimum thickness to be 135mm from top to bottom or 100mm for 80kg/m^3. Fire stops to mechanically fixed in position.

2.7.3 Smoke Seals

Provide 1.5mm or thicker sealed zinc aluminium or galvanized steel sheet as a continuous smoke seal between the slab edge and the curtain wall at each slab level. Use fire rated sealant to seal all joints. The 1.5mm thick GI sheet should be designed and Engineered to take dead loads and live load.

2.7.4 Back pans

All back pans are to be Galvanised Iron sheet fully sealed to form a drained spandrel cavity. Front sheet to be 1.5mm thick, see drawings for detail. When fire rated, rear sheet should be galvanized steel sheet or Zinc alum plate with minimum thickness 1.5mm and reliably isolated from aluminium frame.

2.7.5 Thermal Insulation

All thermal insulation shall be rock wool or fibre glass board, with maximum thermal conductivity λ less than 0.04W/m.K. (CSR Span-seal 64 kg/m^3 or Approved equivalent).

All fire rated insulation to have mechanical fasteners.

2.7.6 Electrical Wiring and Earthing Tabs

Lightning protection tabs to facilitate electrical continuity between façade panels shall be provided and installed by Façade Contractor. Earthing tabs shall be provided by Façade Contractor, while provisions of locations to the base structure shall be coordinated with the Electrical Sub-Contractor and Main Contractor. Connections shall be the responsibility of the Electrical Sub-Contractor and Main Contractor.

2.7.7 Lighting

Provision for light boxes, wiring conduits and fixing points for lighting is to be provided in accordance with the Electrical Sub-Contractor's requirements. The Electrical Sub-Contractor shall be responsible for supplying and installing all wiring and lighting. Façade Contractor responsible for sealing all penetrations.

2.7.8 Sign Boxes

Façade contractor to coordinate with signage manufacturer for all signage anchoring and penetration requirements. Curtain wall contractor responsible for fully sealing all penetrations. The sign boxes shall be fitted with a hinged tempered glass cover that allow the inside and outside of the glass to be cleaned and the lights to be replaced.

3. Steelwork for Façade

3.1 Scope of Work

The work shall consist of the design, supply, fabrication, surface treatment, storage, delivery and erection of all the steelwork shown on the contract drawings. This also includes the supply and installation of all cast-in items used to support the steelwork, the grouting of base plates, the provision of cleats and drilling of holes for the attachment of the cladding system, and repairs to damage surfaces during construction.

The Facade Contractor will be responsible for the façade support steel design and preparation of shop drawings The work shall be fully co-ordinated and comply with the Registered Structural Engineer's drawings, this specification, all other drawings and specifications included in this contract, and any Architect/RSE authorised written instruction that may be issued during the course of this project.

Where any conflicts are found in the contract documents by the Façade Contractor they shall be immediately brought to the attention of the Architect. Façade Contractor shall await a written instruction from the Architect before proceeding with the affected area of work. During tendering, the Tenderer shall assume the greater criteria in terms of cost in the absence of other instructions.

3.2 Standards

The Façade Contractor shall comply with the local Building (Construction) Regulations, and all British Standard that are relevant to this Contract, including but not limited to the British Standards, and other Overseas Standards specified below.

British Standards

BS 1449	Steel plate, sheet and strip. Carbon and carbon-manganese plate, sheet and strip. General specification
BS EN 10246-10:2000	Non-destructive testing of steel tubes. Radiographic testing of the weld seam of automatic fusion arc welded steel tubes for the detection of imperfections
BS EN 10293:2005	Steel castings for general engineering uses
BS 3923-2:1972	Methods for ultrasonic examination of welds. Automatic examination of fusion welded butt joints in ferritic steels
BS EN 14295:2003	Welding consumables. Wire and tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels. Classification
BS EN ISO 9692-2:1998	Welding and allied processes. Joint preparation. Submerged arc welding of steels
BS 4190: 2001	ISO Metric Black Hexagon Bolts, Screws and Nut. Specifications
BS EN ISO 8503-5:2004	Preparation of steel substrates before application of paints and related products

BS EN ISO 8504-2:2001	Preparation of steel substrates before application of paints and related products
BS EN 10210: 2006	Hot finished structural hollow sections of non-alloy and fine grain steels.
BS 4515-1:2004	Specification for welding of steel pipelines on land and offshore. Carbon and carbon manganese steel pipelines
BS 4848-2:1991	Hot-Rolled Structural Steel Sections - Part 2: Specification for Hot-finished Hollow Sections
BS EN ISO 12944:1998	Paints and varnishes. Corrosion protection of steel structures by protective paint systems
BS EN 10296: 2003	Welded circular steel tubes for mechanical and general engineering purposes.
BS 6497	Specification for powder organic coatings for application and stoving to hot-dip galvanized hot rolled steel sections and preformed steel sections and preformed steel sheet for windows and associated external architectural purposes, and for the finish on galvanized steel sections and preformed sheet coated with powder organic coatings.
BS EN 13438:2005	Paints and varnishes. Powder organic coatings for galvanized or sherardised steel products for construction purposes
BS EN ISO 1461:1999	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
AS 1449	Wrought alloy. Steels - Stainless and heat-resisting steel plate. sheet and strip
BS EN 60974-5:2002	Arc welding equipment. Wire feeders
BS EN 60974-12:2005	Arc welding equipment. Coupling devices for welding cables
BS EN ISO 9018:2003	Destructive tests on welds in metallic materials. Tensile test on cruciform and lapped joints
BS EN 910	Destructive tests on welds in metallic materials. Bend tests
BS EN 1320:1997	Destructive tests on welds in metallic materials. Fracture tests
BS EN 1321:1997	Destructive test on welds in metallic materials. Macroscopic and microscopic examination of welds
BS EN 1043-1:1996	Destructive tests on welds in metallic materials. Micro hardness testing on welded joints

BS EN 875:1995	Destructive tests on welds in metallic materials. Impact tests. Test specimen location, notch orientation and examination
BS EN 876:1995	Destructive tests on welds in metallic materials. Longitudinal tensile test on weld metal in fusion welded joints
BS EN ISO3834-4:2005	Quality requirements for fusion welding of metallic materials. Elementary quality requirements
BS 1580	Unified Screw Threads
BS EN 1435	Non-destructive examination of welds. Radiographic examinations of welded joints.
BS 4190:2001	ISO Metric Black Hexagon Bolts, Screws and Nut. Specification
BS 4320:1968	ISO Metric Black Hexagon Bolts, Screws and Nut. Specification
BS 4320:1968	Specification for Metal Washers For General Engineering Purposes. Metric series
BS 4871	Specification for approval testing of welders working to approved welding procedures. Arc welding of tube to tube-plate joints in metallic materials.
BS 4882	Specification for bolting for flanges and pressure containing purposes
BS EN ISO 9934-1:2001	Non-destructive testing. Magnetic particle testing. General principle.

American Standards

ASTM A1008-01	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength :Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A1011-01	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A36/A36M-05	Standard Specification for Carbon Structural Steel
ASTM A123/A123M-02	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A618-01	Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural tubing
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A792/A792M-06a	Standard Specification for Steel Sheet, 55 % Aluminium-Zinc Alloy-Coated by the Hot-Dip Process

Indian Standards

IS 513	Cold rolled ow carbon steel sheets and strips (fifth revision)
IS 800	Code of practice for general construction ins steel
IS 816	Code of practice for use of metal arc welding for general construction in mild steel
IS 1079	Hot rolled carbon steel sheets and strips
IS 875	Code of practice for design loads for buildings and structures
IS 3954	Hot rolled steel channel sections for general engineering purposes – Dimensions
IS 4759	Hot dipped zinc coatings on structural steel and other allied products
IS 4923	Hollow steel sections for structural use
IS1029	Hot rolled steel strip (Bailing)

Other Standards

AISC 325-05	Steel Construction Manual, Thirteenth Edition
ANSI/AWS D1.1/D1.1M:2006	Structural Welding Code - Steel
Steel structures Painting Council	Society for Protective Coatings Painting Manual/Standards, Specifications (Current)
S15 055900	Surface Preparation for Painting Steel Surfaces
AISC 325-05	Steel Construction Manual, Thirteenth Edition
ANSI/AWS D1.1/D1.1M:2006	Structural Welding Code - Steel

Steel structures Painting Council	Society for Protective Coatings Painting Manual/Standards, Specifications (Current)
S15 055900	Surface Preparation for Painting Steel Surfaces

American Welding Standard

3.3 Materials

a. Structural Steelwork

Structural steelwork shall comprise weldable structural steel to BS EN 10210 Grade S275 mild Steel or Grade S355 high yield steel, unless otherwise indicated on the drawings.

b. Hot Rolled Sections

Dimensions, mass, tolerances and rolling margins are to comply with the following standards:

Universal beams, columns, tee sections and channels to BS 4: Pt 1.

Hollow sections to BS 4848: Pt 2.

Angles to BS 4848: Pt 4.
Flats, plates, round bars and square bars to BS 4360

c. Cold Rolled Sections

Dimensions, mass, tolerance of cold rolled sections to be in accordance with BS 2994. Cold rolled sections are not permitted unless specifically nominated on the Engineer’s drawings.

d. Stainless Steel

Wrought Stainless Steel shall comply with BS EN 10083 grade S16.

Flat rolled Stainless steel shall comply with BS1449 and shall be grade 316 S16 softened.

e. Stainless steel tubes shall comply with BS EN 10296 designation LW 23 GZF(S).

f. Cast Iron and Cast Steel

Grey cast iron shall comply with BS EN 1561, grade 10

Malleable cast iron shall comply with BS EN 1562

Spheroidal cast iron shall comply with BS EN 1563.

Carbon manganese steel castings shall comply with BS EN 10293

g. Forged Steel

Steel forgings and forged steel pins shall comply with BS 29.

3.4 Welding

a. Welding Consumables

All welding of structural steel shall comply with BS EN 1011-1. Welding consumables used in fusion welding shall comply with BS EN 1011-8. Welding consumables used in metal arc welding of austenitic stainless steel shall comply with BS 4677.

Welding consumables and the procedures used shall ensure that the mechanical properties of the deposited weld metal shall not be less than the parent metals.

b. Preparation for welding

Prepare fusion surfaces to BS EN 1011-1. Surfaces must be dry. Warm the surfaces if required to remove condensation.

Remove welding slag by chipping before depositing subsequent runs.

c. Tack welds

Tack welding may only be used with express approval. Tack welds to be minimum 50mm long.

d. Butt welds

Butt welds shall be full penetration welds between prepared fusion faces, unless otherwise specified. Carry out back chipping, grinding or gouging of the deposited weld as required to obviate imperfections in the root run. Grind butt welds flush without loss of parent metal.

e. Fillet welds

Deposit fillet welds to the required length, throat thickness and with partial or full penetration as specified.

f. Temporary attachment

Do not weld temporary attachments to principle joints. Obtain approval of the position of welds for temporary attachments.

3.5 Grout for Base Plates

Grout for column base plates shall be proprietary type cementitious non-shrink grout with a minimum compressive strength of 40MPa. Data sheets, installation procedures and other supporting information for flowing and dry pack grout are to be submitted to the Architect for written acceptance before use.

3.6 Supply and Substitution

The Façade Contractor shall be responsible for the ordering of all materials and the Tender shall be based on an assured source of supply.

The substitution of materials shall not be made without the Architect's written approval. Any approved substitution shall not cause an increase to the contract sum or a delay to the project.

Members shall be supplied in a single stock length. Splicing of members is not permitted unless it has been approved in writing from the Architect.

3.7 Quality Control Programme

The Façade Contractor shall establish, document and maintain an inspection and testing system capable of producing objective evidence that the works conform to the Specification, whether carried out by the Contractor, his sub-contractors or procured from suppliers. The summary of this system is to be included in the Quality Manual.

3.8 Shop Drawings

The Facade Contractor shall submit the shop drawings progressively to the Architect for approval prior to commencement of fabrication. These drawings shall be checked and (2 sets) returned to the Facade Contractor within 10 working days. Drawings that are not approved must be corrected and resubmitted. Approval must be given before fabrication is allowed to commence.

The approval of shop drawings is for member sizes, surface treatment and the soundness of structural connections. Approval will not be given for any dimension or fabrication related issues. Furthermore, the approval in no way alleviates the Facade Contractor from responsibility for errors or omissions.

No alterations are permitted to the approved shop drawings without written confirmation of the change from the Architect.

a. Drawing Issues

The drawings in each submission shall consist of Marking Plans and elevations (A1 size) and corresponding Details (A1 or A3 size). A drawing list shall accompany each drawing issue and is to provide and up to date record of all drawing issues, revisions and status (rejected, approved, etc.)

As and when requested by the Architect and/or Main Contractor, the Facade Contractor shall, in addition to hard copies, submit shop drawings in soft copy format at no extra cost to the Client.

b. Drafting Requirements

The drawing shall show clear and complete details of each connection, and its component parts, together with all information relevant to fabrication, surface treatment and erection. The Engineer's drawings are not considered to contain sufficient information and are not to be used as shop drawings.

The drawings are to be clear an all text must be written in English.

c. Alignment of Members
Unless otherwise indicated on the Engineer's drawings, all member intersections are to be setout so that the centroids of the intersecting members are coincident. The only exception shall be tube to tube welded connections which shall be setout in accordance with Cidect limitations.

Checklist of Information to be included on shop drawings (this list is not exhaustive).

i. Section sizes with accompanying steel grades
ii. Grade of bolts
iii. Types and positions of welds
iv. Weld preparation requirements
v. Cambers to steel sections
vi. Locations and sizes of bleed holes in tubes
vii. Cover plates
viii. Temporary cleats and lifting points, with load capacities

3.9 Test Certificates

The Façade Contractor shall submit Test Certificates for all steel plates, sections, connections and welding consumables to the Architect for approval before fabrication begins. Fabrication shall not commence until the Test Certificates are verified by the Architect in writing.

3.10 As-Built Documents

As-built drawing (3 sets) is to be compiled for the structure at the completion of the project. This is to comprise of a full set of marking plans and shop drawings that have been updated to show all construction related modifications to the steelwork. The one set of drawings is to be indexed, bound and issued to the Architect and the other two to the client.

3.11 Material Testing

Test certificates shall be provided for all steelwork. In the event that a test is left out or the source of a section cannot be traced, then it shall be tested at the Sub-contractor's expense in accordance with BS18.

3.11.1 Weld Testing

Provide an experienced and competent operator to supervise welding. Submit certificates proving that all welders have passed the training tests in BS1295 and are fully certified. If specified, carry out approval tests to BS 4871:Pt.1 or BS 4872: Pt. 1.

Keep a record on Site when specified to identify welders responsible for major welds.

Obtain approval of the proposed welding procedures prior to commencing welding including:

i. Preparation of fusion faces
ii. Preheating temperature where required.
iii. Type of electrodes.
iv. Number and sequence of runs to build-up the weld bead.
v. Post-heating treatment if required.

Do not depart from the agreed welding procedure without the prior agreement of the Engineer.

Carry out approval testing of welding procedures to BS EN 288 P3 when specified, strictly in accordance with the proposed welding procedure using representative samples of the materials. Prepare specimen welds and subject to one or more of the following tests as required:

Butt welds

i. Transverse tensile tests to BS 18.
ii. Transverse bend tests to BS EN ISO 7438 with the root of the weld in tension and compression respectively.
iii. Side bend tests.
iv. Macro-examinations.

Fillet welds

i. Fracture test.
ii. Macro-examinations.

Strictly follow the procedures of welding established in the successful approval test for the works. Carry out further approval tests if either the material or procedure changes.
Extent of Testing:

Weld testing is to be carried out by an independent Approved Testing Company
The following testing is required.

Fillet Weld	**Visual**	**Ultrasonic or X-Ray**
All plates less than 12mm		
Secondary Connections	25%	-
Primary Connections	50%	10%
Plates between 12 and 24mm		
Secondary Connections	50%	10%
Primary Connections	100%	25%
Plates over 24mm		
Secondary Connections	100%	25%
Primary Connections	100%	100%
Butt Welds	100%	100%
Combination Butt Fillets		
Tubes <10mm	100%	25%
>10mm	100%	100%

Primary connections are at the ends of a member

Secondary connections are to minor cleats, stiffener plates etc.

3.11.2 Testing of Fixings

a. Bolt Assembly Testing

Bolted assembles will not generally require testing except in the event where loads are transferred through HSFG bolts onto bearing surfaces.

The coefficient of friction of coated surfaces shall be determined before site assembly is commenced. Should HSFG Bolts are used, torque of bolts shall be checked with methods as approved by supplier.

Cast-in plates and channels shall be tested by carrying out direct tensile load testing to 2 x design capacity for 10% of first 100, 5% of next 400 and 2% of fixings thereafter.

b. Masonry anchor and stud testing

Masonry anchors and studs shall be tested by carrying out direct tensile load testing to 2 x design capacity for 10% of first 100, 5% of next 400 and 2% of fixings thereafter.

3.12 Protective Coatings

All steelwork is to be provided with a protective coating system with a 20 year minimum design life. The coatings are to be provided over the full surface area of steelwork. Exposed edges and site weld areas are to be coated with an approved coating system for site applications. Details are to be submitted for the Architect's approval.

Protective coatings are to be as outlined below for normal internal and external applications. For more aggressive environments, higher performance paint systems are to be used.

As required by the Architect, fire protection to steelwork shall be provided.

3.12.1 Internal Concealed Steelwork

Internal concealed steelwork is to be Hot Dip Galvanised with a minimum dry film thickness of 70 microns.

3.12.2 Internal Exposed Steelwork

The coating system is to be by Dulux, Taubmans, Coultards, or an alternative approved by the Architect and façade consultant suitable for internal surfaces and wear from impact and traffic as necessary.

The coating system shall comply with the following minimum requirements:

i. 3 Part or 4 Part Inorganic Zinc Silicate system.
ii. Surface preparation - Blast Cleaned to Sa 2.5 in accordance with BS EN ISO 8501-1.
iii. Primer Ethyl Zinc Silicate, 80 micron minimum dry film thickness, conventionally sprayed.

iv. Barrier Coat - Two pack epoxy Micaceous Iron Oxide (MIO), 100 micron minimum dry film thickness, conventionally sprayed.
v. Finish Coat - to be specified by the Architect.

Paint samples, technical catalogues and Manufacturer's Application Procedures are to be submitted for the Architect's approval before commencement of paint application.

3.12.3 External Concealed Steelwork

External concealed steelwork is to be Hot Dip Galvanised with a minimum dry film thickness of 100 microns.

3.12.4 External Exposed Steelwork

The coating system is to be by Dulux, Taubmans, Coultards, or an Architects Approved equivalent suitable for external surfaces and wear from UV, pollution (including acid rain), impact and traffic as necessary.

The coating system shall comply with the following minimum requirements:

i. 3 Part or 4 Part Inorganic Zinc Silicate system.
ii. Surface preparation - Blast Cleaned to Sa 2.5 in accordance with BS EN ISO 8501-1.
iii. Primer Ethyl Zinc Silicate, 80 micron minimum dry film thickness, conventionally sprayed.
iv. Barrier Coat - Two pack epoxy Micaceous Iron Oxide (MIO), 100 micron minimum dry film thickness, conventionally sprayed.
v. Finish Coat - to be specified by the Architect.

Paint samples, technical catalogues and Manufacturer's Application Procedures are to be submitted for the Architect's approval before commencement of paint application.

3.12.5 Hot Dip Galvanised Steelwork

a. Surface Preparation

The steelwork is to be chemically descaled and cleaned, so that rust, mill scale, oil, grease and other foreign matter are removed immediately prior to galvanising. Tubular sections are to have bleed holes as necessary. The size and location of bleed holes is to be shown on shop drawings.

b. Distortion due to Galvanising

The contractor is to ensure the steelwork does not distort as a result of galvanising. The size of components, preheating requirements, and dipping method are to be reviewed to achieve minimal distortion and maintain steelwork Tolerances.

c. Galvanising Process

Hot dip galvanising shall be carried out in accordance with BS EN 10210-01.

Following galvanising the steelwork is to be left to cure for 48 hours before transportation to site.

d. Repair and touching up

All abrasions site welds etc. are to be repaired by grinding (wire brushing) the surface back to a sound substrate and batch coating with an inorganic zinc silicate primer equivalent in quality of 110 micrometres dry film thickness of Dimetcote 6

3.12.6 Fire Proofing Material

All structural steelwork where required by code shall be protected by approved fire proofing material and must be approved by local authorities.

The sprayed fireproofing material shall be an intumescent paint type (Nullifire) fireproofing unless noted otherwise. All manufactured material shall be delivered in original, unopened packages bearing the name of the manufacturer, the brand, and a recognised testing body's label verifying compliance with said body's quality control inspection programme and the appropriate fire resistance ratings. Colour of the paint to be approved by the Architect.

3.13 Storage and Handling

All structural steel shall be stored and handled so that members and their coatings are not subjected to excessive stresses or damage. Stacking shall be such as not to interfere with the smooth progress of the works.

Open ends of tubular members at all times shall be securely protected from the ingress of water or deleterious materials.

3.14 Erection

a. Site Safety Considerations

Safety requirements, erection cranes, equipment, scaffolding and staging, shall meet the requirements of relevant local building regulations.

The Façade Contractor shall take full responsibility for the Safety and Stability of the steelwork during erection and until such time as it is finally completed and handed over, must take all precautions including temporary bracings necessary to ensure stability of the partially assembled structure against wind

forces, and those stresses exerted due to erection equipment and its operation tending to distort or deform the framework.

The Facade Contractor shall submit a safety plan for the contracted works to the satisfaction of the PM, RSE, Main Contractor for obtaining consent.

The Facade Contractor shall comply with all safety regulations and requirements of the Municipal Corporation and Development Authority.

b. Temporary Supports

The Façade Contractor shall adopt an erection procedure such that all members can be placed and fixed in position without distortion

The Façade Contractor shall allow for the cost of temporary erection bracing required and any professional advice required in connection with such bracing.

As each section of steel is erected, all members shall be aligned, levelled and plumbed before final bolting up or welding commences. The ties, jacks braces, etc., used in lining, levelling and plumbing the steelwork shall be left in position until all bolts have been finally tightened.

All temporary support designs shall be submitted to the structural engineer for review and approval.

3.15 Construction Tolerances

Fabrication tolerances for steelwork shall comply with BS5400: Part 6, Clause 4.2 or BS5950: Part 2, sub-section 7.2 as appropriate

a. Erection of Steelwork

i. The position in plan of vertical components at the base shall be within 10mm of the specified position along either principal setting out axis.
ii. The level of the top of base plates and the level of the lower end of vertical or raking components in a pocket base shall be within 10mm of the specified level.
iii. The thickness of packing plates shall not vary from the specified nominal thickness or 10mm, whichever is less.
iv. The line of vertical or raking components other than in portal frames shall be within 1 in 600 and within 10mm of the specified line in every direction.
v. The line of vertical or raking components in portal frames shall be within 1 in 600 and within 10mm of the specified line in every direction.
vi. The position and level of components connected with other components shall be within 5mm of the specified position and level relative to the other components at the point of connection.
vii. The position of components supported on a bearing shall be within 5mm of the specified position relative to the bearing along both principal axes of the bearing.

4. Installation

4.1 Installation Requirement and Tolerances

a. Generally

Installation shall only commence after checking of the existing structure and accepting the site conditions, including acceptance of reference lines and marks, and embedments in base-structure. Submit certification of acceptance of substrates and conditions.

Do not commence installation unless all substrate conditions are strictly in compliance. Where substrate conditions are not in compliance, notify Main Contractor immediately and obtain instructions.

b. Manufacturer's recommendations

Install work in accordance with manufacturer's recommendations.

c. Installation Tolerances

Comply with manufacturer's recommendation and install work not more than the tolerances given in Section 1.10.

4.2 Anchorages and Bracket Installation

a. Anchors to installed concrete substrates

Install mechanical and/or chemical anchors as required to support the work by approved methods into base-structure. Submit details of proposed methods and obtain statutory approval in writing prior to commencing installation. Comply with approved hole diameters, spacing, depth and minimum edge clearances indicated on shop drawings.

Façade contractor is responsible for providing setting out details for all cast-in items to be installed by the Main Contractor. Check Main Contractor setting out prior to concreting to confirm that cast-in items are correctly positioned.

Refer to Drawings for concrete reinforcement locations, and position anchors to minimise risk of conflict with reinforcement.

Approved methods may include drilling, pre-formed pockets, or explosive driving. Select and install anchors strictly in accordance with manufacturer's instructions.

Relevant Standards:

ASTM E488	Standard Test Methods for Strength of Anchors in

	Concrete and Masonry
BS 5080	Methods of test for structural fixings in concrete and masonry
BS 5080.1	Tensile loading.
BS 5080.2	Method for determination of resistance to loading in shear

b. Anchor placement tolerances

Install anchors to not exceed

i. Maximum deviation from correct position: +/- 12 mm.
ii. Minimum distance from the concrete edge to the nearest part of the anchor: 100 mm.

c. Testing of built-in anchors

Carry out testing of installed anchorages in accordance with ASTM E488 and a testing programme approved before commencing.

Anchors shall be tested to demonstrate:

i. No permanent deformation of the anchor at 1.5 x the design load.
ii. No failure of the anchor at 2 x the design load.
iii. No failure of the structural concrete at 3 x the design load.

Testing shall be carried out by the anchor manufacturer or an approved laboratory.

Submit full report on proposed testing procedures, including any additional test criteria proposed, substrate inspections, and the like. Submit test results and reports on unsuitable substrates, progressively, if found.

d. Testing of anchors to installed concrete soffits

Test anchors supporting loads suspended from concrete soffits as follows:

i. Test the first 10 anchors installed.
ii. If any of the first 10 fail, re-install and re-test failed anchors and test a further 10 anchors.
iii. Repeat until no anchors fail.
iv. Test 1 in 40 of subsequent anchors.
v. If any subsequent anchors fail, re-install and retest, together with 5 additional tests on the previous 40 anchors.
vi. Repeat until no anchors fail.

e. Supply only of items to be installed by others

Where required, supply anchors and embedments for building-in to the base-structure by others.

Provide all required templates and installation instructions, and coordinate with relevant subcontractors. Do not delay the Works.

Monitor placement tolerances and installation procedures, and certify the correct placement of all work by others before commencing the installation of work under this Section.
Inspect installed anchorages after fixing but before placing of concrete to confirm correct locations and tolerances.
Provide sufficient tolerance to fixings and attachments to compensate for anchorages which become dislodged of damaged during placement of concrete.

4.3 Curtain Wall Installation

a. Generally

Install the cladding system in accordance with shop drawings and prototypes to comply with all performance requirements, Codes and Standards and the requirements of the relevant Statutory Authorities.

Install the cladding system plumb, level and true to line within required tolerances, and suitably anchored to the base-structure.

b. Site modifications

Unauthorised site modifications, or work not in accordance with the approved shop drawings, may be required to be removed and replaced.

Unauthorised work may be approved subject to additional computations and testing at the Architect's sole discretion. If requested, carry out and pay for all such testing, and submit all computations, test results and any other information required.

c. Staged completion

Cladding shall be installed in an orderly sequence. Where practical, cladding shall be completed and closed off on a floor-by-floor basis.

Provide temporary flashings at completion of each stage to waterproof and weatherproof the enclosed work. Remove temporary flashing before proceeding with subsequent work.

4.4 Protection

a. Progressive cleaning

Clean the work area progressively remove debris, waste, excess materials and the like from the work area on a daily basis and maintain the works areas allocate for this contract clean at all times.

b. Final cleaning

At completion of installation, clean the work area thoroughly and clean the finished work to remove all marks, soiling and the like.

Finished work shall be free from defects and mechanical imperfections such as scratches, scrapes, dents, and abrasion.

c. Adjacent work by others

At the completion of all adjacent work by others, including services work, attend the Site, inspect the work areas generally, and repair all damage, complete or make good finishing, trimming and sealing, and replace any damaged or dislodged work.

d. Commissioning

At completion of installation, commission, test and adjust as required, all manual and mechanical operating components in all functional modes.

e. Architectural finishes

At completion of installation, wrap or cover architectural finishes to avoid soiling, damage, or wear and tear during subsequent building activities. Otherwise, clean and maintain finished work as frequently as necessary through-out remainder of construction period. Protection shall be designed for removal without damage to finished surfaces.

f. Glass

Remove and replace glass which is broken, cracked, abraded, chipped or damaged in other ways before or during installation.

g. Responsibility

Be responsible for all breakage until installation is completed and handed over. The Main Contractor may assign responsibility for damage to another party causing breakage where applicable, unless damage occurred as the result of incorrect or unsuitable materials or installation procedures.

Appendix A – Material Finishes Schedule

Glass Notation:

Code	Type	Material	Material Description
(A)–GL1a Annneal	Typical Fixed Vision Glass	Low E Coated Insulated Glazing Unit	Minimum thickness: 6mm clear (HS) + 12mm (AS) + 6mm (HS) with double silver low-e coating on surface 2 of outer lite. **(Saint-Gobain SKN II 476 Envision Plus)** (Performance confirmed by MEP)
(HS) GL1b – Heat	Typical Fixed Vision Glass	Low E Coated Insulated Glazing Unit	Minimum thickness: 8mm clear (HS) + 12mm (AS) + 6mm (HS) with double silver low-e coating on surface 2 of outer lite. **(Saint-Gobain SKN II 476 Envision Plus)** (Performance confirmed by MEP)
GL2 Str	Skylight Glass	Laminated clear glass	Minimum thickness: 6 mm clear (H.S) + 1.52mm SGP + 6 mm clear (H.S).
GL3a	Interior Glass partition	Clear Glass	Minimum thickness: 10mm thick Clear Fully Tempered Glass
GL3b	Interior Door Glass	Clear Glass	Minimum thickness: 8mm clear (F.T)

engthened

(FT) – Fully Tempered & Heat Soaked

(AS) – Air Space

(PVB/SGP) – Interlayer

Glass Property Certification

Glass sizing shall be checked by Contractor prior to award of subcontract. Contractor should provide supporting documents to demonstrate the glass property of the envelope system. Specification of the glass should be certified by an internationally recognized laboratory or international recognized body or equivalent with minimum 3 specimens of

each glazing types and at least 5 pieces of glass panels on each glass batch. Tested parameters should not be limited to shading coefficient, light transmittance, internal light reflectance, and external light reflectance as requested for the green building certification. Calculation of the U-value should be prepared through hand calculation or computer simulation by a competent person.

Code	Type	Material	Material Description
C1a	Exterior Cladding at Curtain wall	Solid aluminium cladding	Minimum thickness: 2.5mm Finish: SDF Powder coating Colour: To be confirmed by the Architect
MT1	Extruded frame, Aluminium Capping	Aluminium extruded profile	Minimum thickness as per structural requirement Finish: Materials acceptable shall be clear (or natural) anodised to AAMA 607.1 or colour anodised to AAMA 601. The etched surface is to be permanently sealed. The etched surface is to have 25 microns minimum of material removed from all exposed surfaces. Colour: To be confirmed by Architect
C2	Prelaminated Plywood	Plywood	Minimum thickness: 10mm BWR plywood with 1mm laminate on both sides Finish: SF laminate
ST1	Double height CW	Steel Frame	Minimum frame thickness as per structural requirement Finish: Hot Dip Galvanised steel.

Appendix B – Base Building Movements

Refer to structural specifications and performance requirements.

Appendix C – System Description Schedule

EWS Ref	Location	Façade Type	System Description
CW1	Ground and First Floor	Stick Frame System	System: Site assembled stick system framework installed on site fixed brackets. Work Includes aluminium extruded framework, assembly hardware, interface details such as fire seal flashing sealants, brackets and any sub-frame as required including aluminium extruded capping. Fixed Vision Glass: Low-e Vision Glass (GL1a) Operable Vision Glass: Low-e Vision Glass (GL1a) Frame Finish (Internal): MT1 Frame Finish (External): MT1
CW2	Second Floor	Double height Curtain wall	System: Site assembled stick system with steel framework installed on site fixed brackets. Work Includes aluminium extruded framework, assembly hardware, interface details such as fire seal flashing sealants, brackets and any sub-frame as required including aluminium extruded capping. Fixed Vision Glass: Low-e Vision Glass (GL1b) Frame Finish (Internal): MT1 Frame Finish (External): MT1 Steel frame: ST1
SK1	Roof	Skylight- SCW	System: Site assembled stick system framework installed on site fixed brackets. Work Includes aluminium extruded framework, assembly hardware, interface details such as fire seal flashing sealants, brackets and any sub-frame as required including aluminium extruded capping. Fixed Vision Glass: Laminated clear

			glass (GL2) Frame Finish (Internal): MT1 Frame Finish (External): MT1
IP1	Interior	Solid Partition	System: 25mmX100mm Aluminium Extruded Frame anodised to AAMA 607.1. in approved finish with etched surface having 25 microns minimum of material removed. Works to include anchors, interface seals, brackets etc. Solid Infill - 10mm prelaminated ply + 80mm system gap + 10mm pre-laminated plywood - Providing and fixing 10mm Pre-Laminated plywood with 1mm finish laminate as per architect's choice on exterior/ exposed side and 1mm solid finish laminate on the internal/ hidden surface for infill within the framing system, with any adapters/ gaskets required for compensating the system track width. System gap to have an infill of Glass wool of density @ 48 Kg / cum with black glass tissue (BGT) Frame Finish (External): MT1 Solid panel: Plywood (C2)
IP2	Interior	Glass Partition	System: 25mmX100mm Aluminium Extruded Frame anodised to AAMA 607.1. in approved finish with etched surface having 25 microns minimum of material removed. Works to include anchors, interface seals, brackets etc. Providing and fixing 10mm fully tempered clear glass + system airgap + 10mm fully tempered clear glass for infill within the framing system. Frame Finish (External): MT1 Fixed Glass: Laminated Clear Glass (GL3a) Door Glass: Clear Glass (GL3b)

Appendix D– Materials Offered List

Must be completed by curtain wall sub-contractor at time of tender submission

Material or Component	Source and Country	Material, Composition, Grade	Further Description	Fabrication, Location and Finish
Glass – GL1a				
Glass – GL1b				
Glass – GL2				
Glass – GL3a				
Glass – GL3b				
Cladding - C1a				
Prelaminated Plywood- C2				

GMS Bracket to RC Wall				
Extrusions-MT1				
Steel Frame-ST1				
Extrusion Finishes – Interior				
Extrusion Finishes – Exterior				
Profiled Aluminium Panels				
Panel Finishes				
Door and Windows Ironmongery				
Ground Door Spring				
Hardware – Operable Vent				
FireStop				
Smoke Seal				
Weather Sealant				
Structural Sealant – 2 Part				
Gaskets				
Double Sided Tape				
Embed Channels				
Embed Plates				

Remedial Concrete Anchors				
Curtain Wall Brackets				
Flashing				
Louvers				
Secondary Steel Frame				
Fire Retardant Mineral Fibre				
Thermal Insulation				