

9.3 Application of Paint

The surface shall be treated with waterproof cement paint in minimum three coats maintaining the coverage rate (kg/ square metre) as mentioned in approved Manufacturer's standard literature. No less than 24 hours shall be allowed between two coats and subsequent coats shall be applied only after the preceding coat has become hard to resist marking by subsequent brushing.

9.4 Curing

Curing shall be started after the paint has hardened. Curing shall be done as recommended by the approved Manufacturer and by sprinkling with water two or three times a day. This shall be done between coats and for at least two days following the final coat.

10.0 ACRYLIC/ PLASTIC EMULSION PAINTING (For interior surfaces)

10.1 Acrylic/ plastic emulsion paint (for interior surfaces) shall be of interior grade, premium quality conforming to IS: 15489 and having VOC less than 50 gm/ litre.

10.2 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. It shall then be sand papered and cleaned to give a smooth and even surface.

First coat of primer shall be applied over the surface and the surface shall be allowed to be dry for 6-8 hours.

All cracks, holes, undulations, unevenness shall be filled up and made even with putty. The surface then shall be allowed to be dry.

Once the surface is dried, second coat of primer shall be applied after sand papering and cleaning the surface.

After 6-8 hours, when the surface is dry, it shall again be sand papered and cleaned for a clean and smooth service.

In case of already painted surface, old paint and loose particles shall be removed before stating the above mentioned preparation process.

The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

10.3 Preparation of Paint

Preparation of paint shall be as per manufacturer's instructions.

10.4 Application of Paint

The paint mix shall be continuously stirred while applying for maintaining uniform consistency. Number of coats shall be minimum two. The painting shall be laid evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard at first, then brushing alternately in opposite direction 2 to 3 times and then finally brushing lightly in a direction at right angles to

the same. In this process, no brush marks, no hair marks no clogging of paint puddles shall be permitted. The full process of crossing and laying off will constitute one coat. The paint shall be applied by means of brush or roller.

The surface on finishing shall present a flat, velvety smooth finish, even and uniform shade without patches, marks, paint drops etc.

11.0 ACRYLIC BASED EXTERIOR EMULSION PAINT (For exterior surfaces)

11.1 Acrylic/ plastic emulsion paint (for exterior surfaces) shall be of exterior grade, premium quality conforming to IS: 15489 and having VOC less than 50 gm/ litre.

It shall be an acrylic based wall coating for exterior surfaces to form a crack free, flexible, tough, alkali & fungal resistant and UV resistant waterproof coating with silicone additives.

11.2 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. It shall then be sand papered and cleaned to give a smooth and even surface.

Any old paint shall be removed with removing agent as per manufacturer's instructions. The surface affected by moss, fungus, algae, efflorescence shall be treated in accordance with IS: 2395.

All cracks, holes, undulations, unevenness shall be filled up and made even with putty. The surface then shall be allowed to be dry.

1-2 coats of primer shall be applied over the surface and the surface shall be allowed to be dry for 6-8 hours.

After 6-8 hours, when the surface is dry, it shall again be sand papered and cleaned for a clean and smooth service.

The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

11.3 Preparation of Paint

Preparation of paint shall be as per manufacturer's instructions.

11.4 Application of Paint

The paint mix shall be continuously stirred while applying for maintaining uniform consistency. Number of coats shall be minimum two. The painting shall be laid evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard at first, then brushing alternately in opposite direction 2 to 3 times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks, no hair marks no clogging of paint puddles shall be permitted. The full process of crossing and laying off will constitute one coat. The paint shall be applied by means of brush or roller.

The surface on finishing shall present a flat, velvety smooth finish, even and uniform shade without patches, marks, paint drops etc.

12.0 ACRYLIC COPOLYMER AGGREGATE FINISH

12.1 It shall be an acrylic based textured wall coating system consisting of quartz and silica aggregate, inorganic pigments and other additives to form a crack free, flexible, tough, waterproof coating.

12.2 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. It shall then be sand papered and cleaned to give a smooth and even surface.

Any old paint shall be removed with removing agent as per manufacturer's instructions. The surface affected by moss, fungus, algae, efflorescence shall be treated in accordance with IS: 2395.

All cracks, holes, undulations, unevenness shall be filled up and made even with putty. The surface then shall be allowed to be dry.

The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

12.3 Preparation of coating

Preparation of coating using various components shall be in accordance with procedures recommended by the approved Manufacturer to achieve the desired finish.

12.4 Application

Application of the system shall be in accordance with procedures recommended by the approved Manufacturer to achieve the desired finish. Sealing coat, primer etc. as recommended by the approved Manufacturer shall also be provided.

13.0 SYNTHETIC ENAMEL PAINTING

13.1 Synthetic Enamel paint shall conform to IS 2933

13.2 Preparation of surface

A. Preparation of wood surface

The woodwork to be painted shall be dry and free from moisture and any foreign matter. 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. The surface treated for knotting shall be dry before paint is applied.

Plywood, Block board, Particle board etc. shall be treated in the same manner as for wood work.

B. Preparation of Iron and 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 if any, shall be removed.

13.3 Priming

The primer shall be ready mixed primer and compatible to the paint.

Primer for wood work shall conform to IS 3536. Primer for Iron and steel shall be Red Oxide Zinc Chromate primer conforming to IS 2074, for cement, concrete and plastered surfaces primer shall conform to IS 109.

Dirt or any other extraneous material on the surface shall be removed and the priming shall be applied in minimum two coats.

13.4 Preparation of Paint

Preparation of paint shall be as per manufacturer's instructions.

13.5 Application of Paint

The paint mix shall be continuously stirred while applying for maintaining uniform consistency. Number of coats shall be minimum two. The painting shall be laid evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard at first, then brushing alternately in opposite direction 2 to 3 times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks, no hair marks no clogging of paint puddles shall be permitted. The full process of crossing and laying off will constitute one coat. The paint shall be applied by means of brush or roller.

The surface on finishing shall present a flat, smooth finish, even and uniform shade without patches, marks, paint drops etc.

14.0 APPLICATION OF CLEAR FINISHES (Polishing, Varnishing)

14.1 For the application of clear finishes, the following procedures shall generally be adopted in accordance with IS: 2338 (Part-I)

- A. Filling
- B. Staining
- C. Sealing
- D. Finishing

14.2 Filling

Fillers shall be applied to prevent the excessive penetration of the finish to the surface for obtaining a smooth finish. Fillers shall be conforming to IS: 345.

Fillers shall be heavily applied to the wood surface by hand, using hessian or jute rag across the grain. It shall be rubbed when still wet to get better penetration. After 5-10 minutes it shall be wiped off by hand across the grain followed by a light wipe with the grain. The filled surface shall be dried preferably over night and smoothed with abrasive paper.

14.3 Staining

A. Spirit Stains

Spirit stains are solutions of spirit soluble dyes in Industrial methylated spirit.

B. Oil Stains

Oil stains are solutions of oil soluble dyes in linseed oil, but, usually consist of insoluble, semi-transparent pigments ground in linseed oil and thinned with turpentine or other solvent.

14.4 Surface Preparation

Surface intended for staining shall be kept scrupulously clean and free from greasy finger marks. It shall be prepared by careful smoothing with fine abrasive paper used in the direction of the grain. Small cracks/nail holes shall be stopped with plastic wood/fine plaster of Paris. The stopping shall be rubbed down with fine abrasive paper when hard and touched with a thinned knotting before staining. In case of oil staining stopping shall be done after staining using tinted putty or wood filler.

14.5 Application of Stains

Stains shall be applied by brushing and wiping or by spraying. The stain shall be so thinned that it can be applied fairly, liberally without over staining and over lapping.

14.6 Sealing

A suitable sealer shall be applied on the filled and sanded surface to prevent absorption by the wood of the succeeding coats of finish and to seal stain and filler and thus preclude their bleeding into the finish coat.

Sealer may be sprayed on taking care not to flood the surface and it shall be allowed to dry hard. When fully dry the surface shall be sanded taking care not to cut through at corners and edges. Dust shall be blown off and surface wiped with a clean rag.

14.7 Finishing

The stained surface shall be varnished, wax-polished or French polished as required after it is dried.

A. Varnishing

Varnishing of wood and wood based material shall be in accordance with IS: 2338 (Part-I).

Surfaces to be varnished shall be prepared to produce a smooth, dry and matt surface and all dust and dirt shall be removed from the surface.

The Varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with short light strokes to avoid frothing. It shall be allowed to flow out while the next section is being laid in. Excess Varnish shall be scraped out of the brush and then the first section be crossed, re- crossed and laid off lightly. The Varnish, once it has begun to set, shall not be retouched. In case of any mistake, the Varnish shall be removed and the work shall be started afresh.

Where two coats of varnish are applied, the first coat shall be a hard drying under coating or flattening varnish which shall be allowed to dry hard and then be flattened down before applying the finishing coat. Sufficient time shall be allowed in between two coats.

When flat varnishing is used for finishing, a preparatory coat of hard drying undercoating of flattening varnish shall first be applied and shall be allowed to harden thoroughly. It shall then be lightly rubbed down before the flat varnish is applied. On larger areas, the flat varnish shall be applied rapidly, and the edges of each patch applied shall not be allowed to set, but shall be followed up whilst in free working conditions.

B. French Polish

French polish shall conform to IS :348. Suitable pigments shall be added to get the required colour.

The surface to be French polished shall be rubbed down to smoothness with sand paper and shall be well dusted. Pores in the surface shall be filled up with fillers.

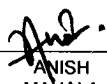



A pad of woollen cloth covered by a fine cloth shall be used to apply the finish. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil may be used on the face of the pad for the purpose. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly dampened with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

15.0 MEASUREMENT

Painting/ polishing shall be measured by the area of actual painted/ polished surface.

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STANDARD SPECIFICATION FOR ROOFING

7	04.03.22	REVISED & ISSUED AS STANDARD SPECIFICATION	 ANISH MAHALA	 ANISH KUNDU	 SAMIR DAS	 SANJAY MAZUMDAR
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4	21.03.07	REVISED & ISSUED AS STANDARD SPECIFICATION	SD	JKB	ARVIND KUMAR	V. CHATURVEDI
3	09.03.99	REAFFIRMED AS STANDARD SPECIFICATION	SD	MLB	SCJ	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	

Abbreviations:

AS	: Australian Standards
ASTM	: American Society for Testing and Materials
BS	: British Standards
BS-EN	: British Standards European Norm
CGI	: Corrugated Galvanized Iron
EN	: European Standards
EPDM	: Ethylene Propylene Diene Monomer
GI	: Galvanized Iron
IS	: Indian Standards
ISO	: International Organization for Standardization
MS	: Mild Steel
NBC	: National building Code
SWG	: Standard Wire Gauge

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1.0 GENERAL

- 1.1 This Specification covers requirements of sheet roofing/ cladding and associated accessories for buildings and sheds. The specifications of metal sheets (with regards to material) are also applicable for barricades required during construction.
- 1.2 The roofing and cladding system shall ensure leak-proof enclosure by means lapping of sheets, closure of joints, junctions and gaps etc., efficient roof water drainage system etc. using necessary flashings, accessories and fittings.
- 1.3 The roofing and cladding system shall also have provisions for natural lighting and ventilation.

2.0 REFERENCES

- 2.1 The codes and standards listed below contain provisions which through reference in this specification constitute provisions of this standard specification if not specifically mentioned otherwise.
- 2.2 In case of similar codes of different organizations such as IS, ISO, BS, EN, BS-EN, ASTM, NBC etc. conformity with any of the similar codes is acceptable.
- 2.3 Reference codes and standards:

Standards	Document title
IS: 277	Galvanized steel strips and sheets (Plain and corrugated)
IS: 513	Cold reduced carbon steel sheet and strip
IS: 737	Wrought aluminium and aluminium alloy sheet and strip for general engineering purposes
IS: 1254	Corrugated aluminium sheet
IS: 2676	Dimensions for wrought aluminium and aluminium alloys, sheet and strip
IS: 13592	Unplasticized Polyvinyl Chloride (PVC-U) Pipes for Soil and Waste Discharge System Inside and Outside Buildings Including Ventilation and Rainwater System
IS: 14871	Products in fibre reinforced cement - Long corrugated or asymmetrical section sheets and fittings for roofing and cladding - Specification
IS: 15961	Hot dip aluminium - Zinc alloy metallic coated steel strip and sheet (Plain)

3.0 CORRUGATED GALVANISED STEEL SHEET (C.G.S) ROOFING

3.1 Material

3.1.1 C.G.S. Sheets

C.G.S sheet shall conform to IS: 277.

Unless otherwise specified in drawings, item descriptions, job specifications etc. the sheets shall be 1.00 mm thick and with zinc coating (total on both sides) not less than 275 gm/ sqm.

The sheets shall be free from cracks, split edges, twists, surface flaws etc. They shall be clean, bright and smooth. The galvanising shall be non-injured and in perfect condition. The sheets shall not show signs of rust or white powdery deposits on the surface. The corrugations shall be uniform in depth and pitch and parallel with the side.

3.1.2 Ridges, hips, valley, flashing and gutter of plain galvanised steel sheets

Leakproof roofing system with efficient rain water drainage of the roofing system shall be ensured by providing ridges, hips, valley, flashing and gutter etc. (all bent and fabricated to required shape) made of plain galvanized steel sheets.

Unless otherwise specified in drawings, item descriptions, job specifications etc. thickness and width etc. of these shall be as below:

Item	Thickness (mm)	Minimum overall width (mm)
Ridge	0.8	600
Hip	0.8	600
Valley	1.60	900
Flashing	1.00	400
Gutter	1.00 (minimum)	Profile, dimensions shall be as required for roof drainage

3.1.3 Rain water pipes

Unless otherwise mentioned specifically, rain water pipes shall be unplasticised rigid PVC rain water pipes conforming to IS : 13592 Type A with fittings/ accessories.

3.2 Laying and Fixing

3.2.1 The sheets shall be laid and fixed in accordance with Manufacturer's recommendations/ guidelines and in the manner described below, unless otherwise shown in the working drawings or directed by the Engineer-in-Charge.

3.2.2 The sheets shall be laid on the purlins to a true plane, with the lines of corrugations parallel or normal to the sides of the area to be covered unless otherwise required as in special shaped roofs.

3.2.3 The sheets shall be laid with a minimum lap of 150 mm at the ends and 2 ridges of corrugations at each side. The above minimum end lap of 150 mm shall apply to slopes of 1 vertical to 2 horizontal and steeper slopes. For flatter slopes the minimum permissible end lap shall be 200 mm. The minimum lap of sheets with ridge, hip and valley shall be 200 mm measured at right angles to the line of the ridge, hip and valley respectively. These sheets shall be cut to suit the dimensions or shapes of the roof, either along their length or their width or in a slant across their lines of corrugations at hips and valleys. They shall be cut carefully with a straight edge chisel to give a smooth and straight finish.

- 3.2.4 Lapping in C.G.S. sheets shall be painted with a coat of approved steel primer and two coats of painting with approved paint suitable for G.S. sheet, before the sheets are fixed in place.
- 3.2.5 Sheets shall be fixed to the purlins or other roof members such as hip or valley rafters etc. with anticorrosive polymer coated J or L hook bolts and nuts, 8 mm diameter, with polymer cap, seal and thrust washer. J hooks shall be used for fixing sheets on angle iron purlins, and L hooks shall be used for fixing the sheet to R.S. joists, timber or precast concrete purlins. The length of the hook bolt shall be varied to suit the particular requirements.
- The bolts shall be sufficiently long so that after fixing they project above the top of the nuts by not less than 10 mm. The grip of J or L hook bolt on the side of the purlin shall not be less than 25 mm. There shall be a minimum of three hook bolts placed at the ridges of corrugations in each sheet on every purlin and their spacing shall not exceed 300 mm. Coach Screws shall not be used for fixing sheets to purlins.
- Number, spacing, length, location of hooks/ screws shall be in accordance with Manufacturer's recommendations/ guidelines.
- 3.2.6 Where slopes of roofs are less than 21.5 degrees (1 vertical to 2.5 horizontal) sheets shall be joined together at the side laps by bolts and nuts 25 × 6 mm size. As the overlap at the sides extends to two corrugations, these bolts shall be placed zig-zag over the two overlapping corrugations, so that the ends of the overlapping sheets shall be drawn tightly to each other. The spacing of these seam bolts shall not exceed 600 mm along each of the staggered rows. Holes for all bolts shall be drilled and not punched in the ridges of the corrugations from the underside, while the sheets are on the ground.
- 3.2.7 Ridges and hips of C.G.S. sheet roofing shall be covered with ridge and hip sections of plain G.S. sheet (properly bent in shape for fitting over roofing sheet) with a minimum lap of 200 mm on either side over the C.G.S. sheets. The end laps of the ridges and hips and between ridges and hips shall also be not less than 200 mm. They shall be fixed to the purlins with 8mm dia hooks, bolts, nuts and washers (similar to those used in laying the roofing sheets)
- 3.2.8 Valley shall lap with the C.G.S. sheets not less than 250 mm width on other side. The end laps of valley shall also be not less than 250 mm.
- 3.2.9 Flashings shall lap not less than 150 mm over the roofing sheets. The end laps between flashing pieces shall not be less than 250 mm.
- 3.2.10 Valley and flashings shall be fixed to roof structural members with 8mm dia hooks, bolts, nuts and washers (similar to those used in laying the roofing sheets)
- 3.2.11 Gutters shall be made leakproof and shall be supported on and fixed to mild steel flat iron (minimum size 40 mm x 3 mm) brackets bent to shape and fixed to the requisite slope. The maximum spacing of brackets shall be 1000 mm.

Hooks/ bolts/ nuts (minimum 6 mm dia) and washers for fixing shall be similar to those used in laying the roofing sheets. Connecting bolts shall be above water line of the gutter.

Gutters shall be provided with connection (drop ends/ nozzles/ funnels) to down take pipes, stop ends (made of G.S. sheets similar to the gutter) riveted to the gutter.

Gutters shall be laid with a minimum slope of 1 in 120.

3.2.12 Unless otherwise mentioned specifically, roof water drainage shall be through gutter and rain water pipes.

3.2.13 Wind ties shall be of 40 x 6 mm flat iron section or of other size as specified shall be fixed at the eaves of the sheets. The fixing shall be done with the same hook bolts which secure the sheets to the purlins.

3.2.14 The roof when completed shall be true to lines and slopes and shall be leak proof.

4.0 ALUMINIUM ALLOY SHEET ROOFING/ CLADDING

4.1 Material

4.1.1 Corrugated Aluminium alloy sheet

Unless otherwise specified in drawings, item descriptions, job specifications etc, the material of corrugated Aluminium alloy sheet for roofing and cladding shall conform to following specification.

Alloy Grade	31500 B, H4 as specified in IS: 737: 2008
Profile	Profiled/corrugated sheet shall be Industrial troughed sheet Conforming to IS: 1254 -2007
Thickness	20 SWG (0.91mm) for roofing 22 SWG (0.71mm) for wall cladding (Thickness, tolerances shall be as per IS: 2676-1981)
Pitch	125 mm
Crest Height	38 mm

Finishing of the sheets shall be plain mill or stucco embossed finish. Unless otherwise specified in drawings, item descriptions, job specifications etc, the finishing shall be stucco embossed finish in approved colour.

4.1.2 Accessories

The material for accessories like ridge, gutter, flashings etc. shall be of plain Aluminium alloy sheet of grade 31500 B / H2 conforming to IS: 737.

Unless otherwise specified in drawings, item descriptions, job specifications etc the dimensions and other specifications shall be as mentioned in the following table.

Accessory	Dimension
Ridge piece	0.91 mm thick, minimum 600 mm wide
Apron piece	0.71 mm thick, minimum 150 mm x 150 mm

Eaves piece	0.71 mm thick, minimum 150 mm x 150 mm
Corner piece	0.71 mm thick, minimum 150 mm x 150 mm
Gutter	2 mm thick, width as required.

Finishing of accessories shall be similar to that of the roofing/ cladding sheet.

4.1.3 Rain water pipes

Unless otherwise mentioned specifically, rain water pipes shall be unplasticised rigid PVC rain water pipes conforming to IS : 13592 Type A with fittings/ accessories.

4.2 Laying and fixing

4.2.1 The sheets shall be laid and fixed in accordance with Manufacturer's recommendations/ guidelines and in the manner described below, unless otherwise shown in the working drawings or directed by the Engineer-in-Charge.

4.2.2 The sheets shall be laid on the purlins to a true plane, with the lines of corrugations parallel or normal to the sides of the area to be covered unless otherwise required as in special shaped roofs.

4.2.3 The sheets shall be laid and with side and end laps as recommended by the sheet manufacturer. End lap shall be minimum 150 mm on roofs and one corrugated for sides lap. If the roof slope is less than 15 degrees, end lap shall be increased to 230 mm. Overlap of sheets shall be minimum 150 mm. Care shall be taken to match profiles and maintain alignment of profiles while overlapping the sheets.

4.2.4 Sheets shall be fixed to the purlins or other roof members such as hip or valley rafters etc. with stainless steel (SS 304 grade) or carbon steel or aluminium alloy hex head self-drilling screws and EPDM washer. For inserting the fasteners, screw driving machine to be used at permissible rpm, punching is not permissible. All drills shall be done on the crown/ crest of profile sheets.

If not mentioned specifically, carbon steel screws shall be used.

Number, spacing, length, location of hooks/ screws shall be in accordance with Manufacturer's recommendations/ guidelines.

4.2.5 Carbon steel screws shall be hex head, self drilling type with multi-layered high density anti-corrosive coating of Aluminium & Zinc (AZ), fitted with AZ150 GSM 0.8mm thick Alu-Zinc coated EPDM bonded washer.

4.2.6 Accessories like Ridges, apron pieces, corner pieces, flashings and eaves pieces etc. shall be provided at ridge, corners, eaves etc. (properly bent in shape for fitting over roofing sheet) for ensuring leakproof construction. They shall be fixed with screws and washers (similar to those used in laying the roofing sheets)

4.2.7 Gutters shall be made leakproof and shall be supported on and fixed to mild steel flat iron (minimum size 40 mm x 3 mm) brackets bent to shape and fixed to the requisite slope. The maximum spacing of brackets shall be 1000 mm.

Pieces of gutters shall be argon welded ensuring leak proof continuous gutter length.

Screws and washers for fixing shall be similar to those used in laying the roofing sheets.

Gutters shall be provided with connection (drop ends/ nozzles/ funnels) to down take pipes, stop ends (made of sheets similar to the gutter) riveted to the gutter.

Gutters shall be laid with a minimum slope of 1 in 120.

4.2.8 Unless otherwise mentioned specifically, roof water drainage shall be through gutter and rain water pipes.

4.2.9 Wind ties shall be of 40 x 6 mm flat iron section or of other size as specified shall be fixed at the eaves of the sheets. The fixing shall be done with the same hook bolts which secure the sheets to the purlins. Wind ties shall be painted with synthetic enamel paint matching the colour of the roofing/ cladding sheets.

4.2.10 The roof when completed shall be true to lines and slopes and shall be leak proof.

5.0 PRECOATED GALVANIZED STEEL SHEET ROOFING / CLADDING

5.1 Material

5.1.1 Pre-coated galvanized steel sheet

Unless otherwise specified in drawings, item descriptions, job specifications etc, the material of pre-coated galvanized steel sheet for roofing and cladding shall conform to following specification and performance properties.

Base metal	Cold rolled steel sheet conforming to IS : 513, galvanized (275 g/SqM total on both side) by hot dip process as per IS : 277.
Profile	Profiled/corrugated sheet
Pitch	195 to 255 mm (with intermediate ribs)
Crest Height	Not less than 28 mm
Base metal thickness	0.60 mm (+/- 0.03)
Overall coated thickness	0.65 mm
Weight	Minimum 5.80 Kg/ SqM
Finishing – top surface	Regular modified polyester of minimum 20 (+/- 2) microns over primer coat of 5 microns.
Finishing – bottom surface	Polyester coat of minimum 5 microns over primer coat of 5 microns
Yield strength	Minimum 550 MPa
Pencil hardness	H-2H
Bending test	2-4 T

Salt spray test	750 hours (exposed top side)
QUV – Wealterometer test	1000 hours
Humidity test	Minimum 750 hours

The sheets shall be of approved colour.

5.1.2 Accessories

The material for accessories like ridge, gutter, flashings etc. shall be of plain pre-coated galvanized steel sheet similar (except corrugation) to the sheet specified for roofing/ cladding.

5.1.3 Rain water pipes

Unless otherwise mentioned specifically, rain water pipes shall be unplasticised rigid PVC rain water pipes conforming to IS : 13592 Type A with fittings/ accessories.

5.2 Laying and fixing

5.2.1 The sheets shall be laid and fixed in accordance with Manufacturer's recommendations/ guidelines and in the manner described below, unless otherwise shown in the working drawings or directed by the Engineer-in-Charge.

5.2.2 The sheets shall be laid on the purlins to a true plane, with the lines of corrugations parallel or normal to the sides of the area to be covered unless otherwise required as in special shaped roofs.

5.2.3 The sheets shall be laid and with side and end laps as recommended by the sheet manufacturer. End lap shall be minimum 150 mm to 250 mm for a slope more than 15 degree (1 in 4) and 200 mm to 300 mm for slope less than 15 degree. Overlap of sheets shall be minimum 150 mm. Care shall be taken to match profiles and maintain alignment of profiles while overlapping the sheets.

5.2.4 Sheets shall be fixed to the purlins or other roof members such as hip or valley rafters etc. with self-drilling screws and EPDM washer. For inserting the fasteners, screw driving machine to be used at permissible rpm, punching is not permissible. All drills shall be done on the crown/ crest of profile sheets.

If not mentioned specifically, Zinc coated or Zinc- Tin alloy coated, hex head screws as per AS 3566 class -3 fasteners with EPDM washers shall be used.

Number, spacing, length, location of hooks/ screws shall be in accordance with Manufacturer's recommendations/ guidelines.

5.2.5 Accessories like Ridges, apron pieces, corner pieces, flashings and eaves pieces etc. shall be provided at ridge, corners, eaves etc. (properly bent in shape for fitting over roofing sheet) for ensuring leakproof construction. They shall be fixed with screws and washers (similar to those used in laying the roofing sheets)

5.2.6 Gutters shall be made leak proof and shall be supported on and fixed to mild steel flat iron (minimum size 40 mm x 3 mm) brackets bent to shape and fixed to the requisite slope. The maximum spacing of brackets shall be 1000 mm.

Pieces of gutters shall be argon welded ensuring leak proof continuous gutter length.

Screws and washers for fixing shall be similar to those used in laying the roofing sheets.

Gutters shall be provided with connection (drop ends/ nozzles/ funnels) to down take pipes, stop ends (made of sheets similar to the gutter) riveted to the gutter.

Gutters shall be laid with a minimum slope of 1 in 120.

5.2.7 Unless otherwise mentioned specifically, roof water drainage shall be through gutter and rain water pipes

5.2.8 Wind ties shall be of 40 x 6 mm flat iron section or of other size as specified shall be fixed at the eaves of the sheets. The fixing shall be done with the same hook bolts which secure the sheets to the purlins. Wind ties shall be painted with synthetic enamel paint matching the colour of the roofing/ cladding sheets.

5.2.9 The roof when completed shall be true to lines and slopes and shall be leak proof.

6.0 PRECOATED ZINC ALUMINIUM STEEL SHEET ROOFING / CLADDING

6.1 Material

6.1.1 Pre-coated Zinc- Aluminium steel sheet

Unless otherwise specified in drawings, item descriptions, job specifications etc, the material of pre-coated galvanized steel sheet for roofing and cladding shall conform to following specification and performance properties.

Base metal	The base metal of the roofing shall be cold rolled steel sheet conforming to AS: 1397 or IS : 513. It shall be coated with Al-Zn alloy (55.00% Aluminium, 43.40% Zinc, 1.60% Si) / Zinalume by Hot-dip process as per IS :15961 or AS:1397 or ASTM : A792M. (class AZ 150, having minimum 150 g/SqM AZ coating mass total on both sides).
Profile	Profiled/corrugated sheet
Pitch	195 to 255 mm (with intermediate ribs)
Crest Height	Not less than 28 mm
Base metal thickness	0.45 mm (+/- 0.03)

Overall coated thickness	0.52 mm
Weight	Minimum 4.50 Kg/ SqM
Finishing – top surface	Super durable polyester of minimum 20 (+/- 2) microns over polyester primer coat of 5 microns.
Finishing – bottom surface	Polyester coat of minimum 5 microns over primer coat of 5 microns.
Yield strength	Minimum 550 MPa
Pencil hardness	H-2H
T-Bending test	Maximum 5T
Salt spray test	1000 hours (exposed top side)
QUV – Wealterometer test	1000 hours
Humidity test	Minimum 1000 hours

6.1.2 Accessories

The material for accessories like ridge, gutter, flashings etc. shall be of plain Pre-coated Zinc- Aluminium steel sheet sheet similar (except corrugation) to the sheet specified for roofing/ cladding.

6.1.3 Rain water pipes

Unless otherwise mentioned specifically, rain water pipes shall be unplasticised rigid PVC rain water pipes conforming to IS : 13592 Type A with fittings/ accessories.

6.2 Laying and fixing

6.2.1 The sheets shall be laid and fixed in accordance with Manufacturer's recommendations/ guidelines and in the manner described below, unless otherwise shown in the working drawings or directed by the Engineer-in-Charge.

6.2.2 The sheets shall be laid on the purlins to a true plane, with the lines of corrugations parallel or normal to the sides of the area to be covered unless otherwise required as in special shaped roofs.

6.2.3 The sheets shall be laid and with side and end laps as recommended by the sheet manufacturer. End lap shall be minimum 150 mm to 250 mm for a slope more than 15 degree (1 in 4) and 200 mm to 300 mm for slope less than 15 degree. Overlap of sheets shall be minimum 150 mm. Care shall be taken to match profiles and maintain alignment of profiles while overlapping the sheets.

6.2.4 Sheets shall be fixed to the purlins or other roof members such as hip or valley rafters etc. with self-drilling screws and EPDM washer. For inserting the fasteners, screw driving machine to be used at permissible rpm, punching is not permissible. All drills shall be done on the crown/ crest of profile sheets.

If not mentioned specifically, Zinc coated or Zinc- Tin alloy coated, hex head screws as per AS 3566 class -3 fasteners with EPDM washers shall be used.

Number, spacing, length, location of hooks/ screws shall be in accordance with Manufacturer's recommendations/ guidelines.

6.2.5 Accessories like Ridges, apron pieces, corner pieces, flashings and eaves pieces etc. shall be provided at ridge, corners, eaves etc. (properly bent in shape for fitting over roofing sheet) for ensuring leak proof construction. They shall be fixed with screws and washers (similar to those used in laying the roofing sheets)

6.2.6 Gutters shall be made leakproof and shall be supported on and fixed to mild steel flat iron (minimum size 40 mm x 3 mm) brackets bent to shape and fixed to the requisite slope. The maximum spacing of brackets shall be 1000 mm.

Pieces of gutters shall be argon welded ensuring leak proof continuous gutter length.

Screws and washers for fixing shall be similar to those used in laying the roofing sheets.

Gutters shall be provided with connection (drop ends/ nozzles/ funnels) to down take pipes, stop ends (made of sheets similar to the gutter) riveted to the gutter.

Gutters shall be laid with a minimum slope of 1 in 120.

6.2.7 Unless otherwise mentioned specifically, roof water drainage shall be through gutter and rain water pipes

6.2.8 Wind ties shall be of 40 x 6 mm flat iron section or of other size as specified shall be fixed at the eaves of the sheets. The fixing shall be done with the same hook bolts which secure the sheets to the purlins. Wind ties shall be painted with synthetic enamel paint matching the colour of the roofing/ cladding sheets.

6.2.9 The roof when completed shall be true to lines and slopes and shall be leak proof.

7.0 FIBRE CEMENT CORRUGATED SHEET ROOFING/ CLADDING

7.1 Material

7.1.1 Fibre cement corrugated sheet

Fibre cement corrugated sheets shall conform to IS :14871 and following specification.

Composition	<p>The sheets shall be asbestos free and reinforced by organic and /or inorganic synthetic fibres.</p> <p>The product shall be composed essentially of an inorganic hydraulic binder (in case of Portland pozzolana cement Portland slag cement, addition of pozzolanic materials and slag shall not be permitted) or a calcium silicate binder formed by the chemical reaction of a silicate binder formed by the chemical reaction of a</p>
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	<p>siliceous (includes ground silica, pulverized fuel ash and amorphous silica) and calcareous material reinforced by organic and /or inorganic synthetic fibres.</p> <p>Pozzolanic materials process aids, fillers and pigments which are compatible with the fibre reinforced cement may be added.</p> <p>The inorganic hydraulic binder shall be either ; 33 grade ordinary Portland cement conforming to IS : 269 or 43 grade ordinary Portland cement conforming to IS :8112 or 53 grade ordinary Portland cement conforming to IS :12269 or Portland pozzolona (fly ash based) cement conforming to IS :1489 - part 1 or Portland pozzolona (calcined clay based) cement conforming to IS :1489 - part 2 or Rapid hardening cement conforming to IS :8041 or Portland slag cement conforming to IS :455 Fly ash used shall conform to IS 3812.</p>
Thickness	Unless otherwise specifically mentioned, the thickness shall be 6 mm (tolerance : +/- 10%)
Pitch	146 mm (tolerance : + 6 mm, - 2 mm)
Depth	48 mm (tolerance : + 4 mm, - 5 mm)
Finishing	<p>The sheets shall be free from cracks, chipped edges or corners and other damages.</p> <p>Top exposed surface shall have pre-painted finish with minimum 30 micron thick exterior grade premium quality acrylic emulsion paint.</p> <p>Bottom surface shall have factory finish.</p>

7.1.2 Accessories

Accessories such as adjustable ridges, hips, finishing pieces, eaves filler pieces, north light and ventilator curves, barge boards, expansion joint sheets, "S" type louvers, gutters etc. shall be of the same Manufacturer (unless approved otherwise by Engineer- In- Charge) as the sheet used for roofing/ cladding and as per Manufacturer's standard specification.

7.1.3 In case, sizes of readymade non-metallic gutters by the same Manufacturer of the sheet are not adequate/ suitable for roof drainage, gutters of required size fabricated out of minimum 1 mm thick G.S. sheet (painted in same colour as that of roofing sheet or as approved) shall be provided.

7.1.4 Rain water pipes

Unless otherwise mentioned specifically, rain water pipes shall be unplasticised rigid PVC rain water pipes conforming to IS : 13592 Type A with fittings/ accessories.

7.2 Laying and fixing

- 7.2.1 The sheets shall be laid and fixed in accordance with Manufacturer's recommendations/ guidelines and in the manner described below, unless otherwise shown in the working drawings or directed by the Engineer-in-Charge.
- 7.2.2 The sheets shall be laid on the purlins to a true plane, with the lines of corrugations parallel or normal to the sides of the area to be covered unless otherwise required as in special shaped roofs.
- 7.2.3 The sheets shall be laid with side and end laps as recommended by the sheet manufacturer. End lap shall be minimum 150 mm in cases of roof with a pitch flatter than 1 vertical to 2.5 horizontal. In the cases of very exposed situations, minimum end lap shall be 200 mm. Side lap shall be minimum half a corrugation.
- 7.2.4 Sheets shall be fixed to the purlins or other roof members by means of 8 mm diameter polymer coated GI J or L hook bolts, nuts and EPDM washers or with self drilling fasteners and EPDM washers. For inserting the bolts/fasteners, screw driving machine to be used at permissible rpm, punching is not permissible. All drills shall be done on the crown of the sheets. Number, spacing, length, location of hooks/ screws shall be in accordance with Manufacturer's recommendations/ guidelines.
- 7.2.5 The free overhang of the sheets at the eaves shall not exceed 300mm.
- 7.2.6 Accessories like Ridges, apron pieces, corner pieces, flashings and eaves pieces etc. shall be provided at ridge, corners, eaves etc. (properly bent in shape for fitting over roofing sheet) for ensuring leak proof construction. They shall be fixed with screws and washers (similar to those used in laying the roofing/cladding sheets)
- 7.2.7 Unless otherwise mentioned specifically, roof water drainage shall be through gutter and rain water pipes.
- 7.2.8 Metal sheet gutters shall be made leak proof and shall be supported on and fixed to mild steel flat iron (minimum size 40 mm x 3 mm) brackets bent to shape and fixed to the requisite slope. The maximum spacing of brackets shall be 1000 mm.

Pieces of gutters shall be argon welded ensuring leak proof continuous gutter length.

Screws and washers for fixing shall be similar to those used in laying the roofing sheets.

Gutters shall be provided with connection (drop ends/ nozzles/ funnels) to down take pipes, stop ends (made of sheets similar to the gutter) riveted to the gutter.

Gutters shall be laid with a minimum slope of 1 in 120.

- 7.2.9 Wind ties shall be of 40 x 6 mm flat iron section or of other size as specified shall be fixed at the eaves of the sheets. The fixing shall be done with the same hook bolts which secure the sheets to the purlins. Wind ties shall be painted with synthetic enamel paint matching the colour of the roofing/ cladding sheets.

7.2.10 The roof when completed shall be true to lines and slopes and shall be leak proof.

8.0 MEASUREMENT

8.1 Measurement of sheets in roofing and cladding shall be the measurement of superficial area of the sheets on the flat without allowance for laps and corrugations. No deductions shall be made for openings upto 0.4 SqM. For opening areas exceeding 0.4 SqM, such areas shall be deducted.





8.2 If not mentioned otherwise, measurement of metal flashings, ridge/hip pieces, corner pieces, gutters (including all fittings and fixtures) etc. shall be the measurement of surface areas of these.

8.3 If not mentioned otherwise, measurement of readymade accessories and fittings (having standard size/profile) of fibre cement sheet shall be the measurement of their lengths.

8.4 If not mentioned otherwise, measurement of rain water pipes (including all fittings and fixtures) shall be the measurement of their actual lengths

सेनिटेरी फिटिंगों और फिक्सचर का
मानक विनिर्देश

STANDARD SPECIFICATION
FOR
SANITARY FITTINGS & FIXTURES

7	13.10.23	REVISED & ISSUED AS STANDARD SPECIFICATION	 AKHILESH MAURYA	 ATUL GUPTA	 SAMIR DAS	 SANJAY MAZUMDAR
6	03.04.12	REVISED & ISSUED AS STANDARD SPECIFICATION	RH	RG	JKB	D MALHOTRA
5	03.04.12	REVISED & ISSUED AS STANDARD SPECIFICATION	RH	RG	JKB	D MALHOTRA
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman

Abbreviations:

ASTM :	American Society for Testing & Materials
BS :	British Standards
IS :	Indian Standards
NBC :	National Building Code of India
BIS :	Bureau of Indian Standards
EN :	European Standards
ISO :	International Organization for Standardization
ABS :	Acrylonitrile Butadiene Styrene
HDPE :	High density polyethylene

Architecture Standards Committee

Convenor: Mr. Samir Das

Members: Mr. Rajesh Gujral
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1.0 GENERAL

- 1.1 This Specification covers requirements of sanitary fixtures and fittings such as Water Closets, Wash Basins, Urinals, Water Taps etc.
- 1.2 In case of Green rated buildings water efficient fixtures shall be used as required to reduce water consumption and for obtaining the green rating. All fixtures installed within the project shall have flow rates at 45 psi or 3.10 bar pressure.
- 1.3 Other than faucets, which are installed in spaces with water head heights less than 5m/17ft, in a gravity-fed system, flow rates for the fixtures shall not exceed as mentioned in the following table.

Plumbing Fixture	Flow rate
Water Closet (Solid Flush)	6 liter per flush
Water Closet (Liquid Flush)	3 liter per flush
Urinal	3.8 liter per flush
Shower head	10 liter per minute
Lavatory Faucet	8 liter per minute
Kitchen Faucet	8 liter per minute

- 1.4 The water closets/ cisterns/wash basins/ Urinals shall be of approved colour.
- 1.5 Stop cock/ valves shall be provided in all water supply lines for maintenance and operation purpose.
- 1.6 Associated plumbing works shall be concealed type.
- 1.7 Sanitary fittings and fixtures shall be procured from Manufacturer approved by the Engineer-In-Charge

2.0 REFERENCES

The codes and standards listed below contain provisions, which through reference in this specification constitute provisions of this standard specification, if not explicitly mentioned otherwise.

- 2.1 In case of similar codes of different organizations such as IS, ISO, BS, EN, BS-EN, ASTM, NFPA, NBC etc. conformity with any of the similar codes is acceptable.
- 2.2 Reference codes and standards:

Standards	Document Title
IS : 2556 Part 1-17	Specification for Vitreous Sanitary appliances (Vitreous China, Part 1-17)
IS : 2267	Specification for Polystyrene Moulding and Extrusion Materials
IS : 407	Specification for Brass Tubes for General Purposes.
IS : 774	Specification for Flushing cisterns for water closets and urinals (other than plastic cisterns)

IS: 775	Specification for cast iron brackets and supports for wash basins and sinks
IS :781	Specification for Cast copper alloy screw down bib taps and stop valves for water services
IS : 1300	Specification for Phenolic moulding materials.
IS :2064	Code of Practice for Selection, Installation and Maintenance of Sanitary appliances
IS :2548 Part-1	Specification for Plastic Seats and Covers for water closets Part-1: Thermoset seats and covers
IS :2548 Part-2	Specification for Plastic Seats and Covers for water closets Part-2: Thermoplastic seats and covers
IS :2326	Specification for automatic flushing cistern for urinals (other than plastic cisterns)
IS : 3389	Specification for Urea-formaldehyde Moulding Materials.
IS :7231	Specification for plastic flushing cisterns for water closets and urinals.
IS : 7328	Specification for High Density Polyethylene Materials for Moulding and Extrusion.
IS : 9758	Specification for flush valves and fittings for water closets and urinals.
IS : 13983	Specification for stainless steel sinks for domestic purposes.

3.0 WATER CLOSET SYSTEMS

3.1 General

- 3.1.1 Water closet Systems shall be a water tight and leakage free system consisting of squatting pans/commodos complete with water supply, flushing and drainage/ disposal system including all fittings/ fixtures required to be connected to the water supply and waste disposal system.
- 3.1.2 Flushing and disposal of the waste shall be by means of water either from direct water supply line or from flushing cisterns/ tanks through flush valves as mentioned.
- 3.1.3 Stop cock/ valves shall be provided in all water supply lines for maintenance and operation purpose.

3.2 Flushing Cisterns/ Tanks

- 3.2.1 Flushing cisterns shall either be integral with the squatting pan/ commode and shall be open or concealed tank type as mentioned. Connection between cistern and closet shall be made by means of flush pipe/ bend. Flush pipe/ bend shall be firmly fixed with clamps etc. and shall be concealed both in wall and floor.

3.2.2 The cisterns shall be complete with all necessary fittings/ fixtures etc. as required and mentioned in the table below.

Component	Material
Cisterns/ Tanks	Minimum 3 mm thick High density polyethylene (HDPE) conforming to IS 7328 or polystyrene, high impact or polypropylene conforming to IS 2267. (In case of cisterns integral with wash down type closets, the material shall be vitreous china)
Flush pipe/ bend	40mm dia High density polyethylene pipe conforming to IS 407 or unplasticised PVC plumbing pipe conforming to IS 2501
Siphon/ valve	High density polyethylene (HDPE) Conforming to IS 7328 or polystyrene, high impact or polypropylene conforming to IS 2267.
Operating mechanism/ lever	Non- ferrous, corrosion resistant material
Float valve	Polyethylene conforming to IS 7328
Coupling nut and lock-nut	Non- ferrous material
Capacity	Minimum 5 litre
Connection pipes/ tubes	Reinforced PVC/ Plastic with chrome plated non-ferrous metallic jacket matching with the finish of valves/ stop cocks etc.

3.2.3 Flushing cisterns shall be dual valve type with dual pushing button plates. In case of open type of cisterns, the valve shall be integral with the cistern. In case of concealed cistern/ tank, the valve plate (made of non ferrous metal or ABS (Acrylonitrile Butadiene Styrene) and having same finishing of the Faucets, taps etc.) shall be provided on the concealed surface at suitable location. Stop cocks/ valves shall be provided in the system for installation/ maintenance.

3.3 INDIAN WATER CLOSET (IWC)

3.3.1 Squatting Pan shall be of vitreous china and Orissa Pan type conforming to IS: 2556. The closet shall be fixed in the floor with 150 mm thick sand cushion and shall be connected with CI 'S' or 'P' trap with approximately 50 mm water seal.

3.3.2 Each pan shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flush pipes. The flushing rim and inlets shall be of the self draining type. It shall have weep hole at the flushing inlet to the pan. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to enable easy and quick disposal while flushing.

3.3.3 Water tap or health faucet with stop cock, valve shall be provided near the closet at suitable location. Connection pipes/ tubes of health faucets shall be flexible and of reinforced PVC/ Plastic with chrome plated non-ferrous metallic jacket matching with the finish of valves/ stop cocks etc.

3.4 WASH DOWN TYPE EUROPEAN WATER CLOSETS (EWC)

3.4.1 The commode shall be of vitreous china conforming to IS: 2556.

- 3.4.2 The closets shall be of one piece construction and shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flushing pipe. The flushing rim and inlet shall be of the self draining type. The water closet shall have a weep hole at the flushing inlet. Each water closet shall have an integral trap with either 'S' or 'P' outlet with at least 50 mm water seal. The inside surface of water closets and traps shall be uniform and smooth in order to enable an efficient flush.
- 3.4.3 The closets shall be floor or wall mounted with flushing cisterns either integral with the commode or separately mounted on wall or concealed cisterns/tanks connected with flush pipe as mentioned.
- 3.4.4 The commodes shall be provided with a hinged seat and cover/ lid. The seat and cover made of thermosetting or thermoplastic conforming to IS 2548. Thermosetting plastic used shall conform to grade 2 or 3 of IS 1300 when it is phenolic plastic or IS 3389 when it is of urea formaldehyde. The seat and cover shall be fitted with plastic buffers. The cover shall be hydraulically operated type.
- 3.4.5 Water tap or health faucet with stop cock, valve shall be provided near the closet at suitable location. Connection pipes/ tubes of health faucets shall be flexible and of reinforced PVC/ Plastic with chrome plated non-ferrous metallic jacket matching with the finish of valves/ stop cocks etc.
- 3.4.6 Superior quality EWCs shall be of approved design and shall have following features with respect to clause nos 3.4.1 to 3.4.5 :

Installation type	Wall hung
Commode/ Pan	Rimless with quite close seat cover having anti-bacterial coating.
Cistern	Concealed type, made of high density polyethylene, joint less construction. Water consumption – maximum 2 and 4 litre for partial and full flush respectively. Capacity – upto 10 litre. Valve/ Actuation plate – Separate pressing button for dual flushing, made of ABS (chromium plated)
Health faucet	Chromium plated ABS body with reinforced plastic/ PVC pipe in SS-304 grade jacket.

- 3.4.7 Premium quality EWCs shall be of approved design and shall have following features with respect to clause nos 3.4.1 to 3.4.5 :

Installation type	Wall hung
Commode/ Pan	Fully skirted (Traps not visible), Rimless with quite close seat cover having anti-bacterial coating.
Cistern	Concealed type, made of high density polyethylene, jointless construction. Water consumption – maximum 2 and 4 litre for partial and

	full flush respectively. Capacity – upto 10 litre. Valve/ Actuation plate – Separate pressing button for dual-flushing, made of ABS (chromium plated)
Health faucet	Chromium plated ABS body with reinforced plastic/ PVC pipe in SS-304 grade jacket.

4.0 URINAL SYSTEM

4.1 General

- 4.1.1 Urinals shall be a water tight and leakage free system consisting of urinals complete with water supply, flushing and drainage/ disposal system including all fittings/ fixtures required to be connected to the water supply and waste disposal system.
- 4.1.2 Flushing and disposal of the waste shall be by means of water from direct water supply line if not mentioned otherwise.
- 4.1.3 Stop cock/ valves shall be provided in all water supply lines for maintenance and operation purpose.
- 4.1.4 The urinals shall be made of vitreous China and half stall type conforming to IS 2556.
- 4.1.5 The urinals shall be of one piece construction, full stall type with integral flushing rim and of approved colour.
- 4.1.6 All pipe, fittings, plumbing of water supply connection to the urinals, drainage/ disposal pipes shall be concealed. Stop cock shall be provided just above the urinal for flushing.
- 4.1.7 Bottle trap and union fittings shall be provided for waste disposal from the urinals.
- 4.1.8 Urinal partitions shall be provided in between the urinals. If not mentioned specifically elsewhere, partitions made of polished granite stone shall be provided.

4.2 Sensor operated Urinals

- 4.2.1 With reference to clause no 4.1, in case of sensor operated urinals, the flushing system shall be by means of concealed type electronic type sensors. The power supply to the sensor shall be by means of direct electrical connection or by battery cell as decided by the Engineer- In-Charge.
- 4.2.2 Sensor operated urinals shall have pre-flush facility also.

4.3 Waterless Urinals

- 4.3.1 Waterless urinals shall be made of vitreous china having antibacterial /germs free ceramic surface, fixed with cartridge having debris catcher and hygiene seal.

5.0 WASH BASINS / SINKS

5.1 General

- 5.1.1 Wash basins and sinks shall be water tight and leakage free system complete with water supply and drainage/ disposal system including all fittings/ fixtures required to be connected to the water supply and waste disposal system.

- 5.1.2 Stop cock/ valves shall be provided in all water supply lines for maintenance and operation purpose.
- 5.1.3 The wash basins shall be made of vitreous China conforming to IS 2556.
- 5.1.4 The wash basins/sinks shall be of one piece construction and of approved colour with nickel chromium plated brass waste fitting for connecting with waste pipe.
- 5.1.5 All pipe, fittings, plumbing of water supply connection to the basins/ sinks, drainage/ disposal pipes shall be concealed.
- 5.1.6 Wash basins/ sinks shall be wall mounted or mounted over/ under counters as mentioned in the tender document or construction drawings. In case of wall mounted fitting, the basin/ sink shall be fixed to wall with metal (painted) brackets.
- 5.1.7 Shape, design and size of the wash basins/ sinks shall be as approved by the Engineer-In-Charge.
- 5.1.8 Wash basins shall be provided with taps/ pillar cocks/ faucets of approved design. Mixer type tap/ pillar cock shall be provided in case of hot and cold water supply.
- 5.1.9 Bottle trap and union fittings shall be provided for waste disposal from the wash basins.
- 5.1.10 In case of Sinks, taps with long and swinging neck shall be provided so that water reaches in all the areas of the Sink.
- 5.1.11 Connection pipes/ tubes shall be of flexible and of reinforced PVC/ Plastic with chrome plated non-ferrous metallic jacket matching with the finish of valves/ stop cocks etc.

5.2 Superior quality Wash Basins and faucets

- 5.2.1 Superior quality Wash Basins shall be round or oval shaped under counter top type with either electronic sensor operated or pressmatic type faucets as mentioned.
- 5.2.2 In case of sensor operated basins, power supply to the sensor shall be by means of direct electrical connection or by battery cell as decided by the Engineer- In- Charge.
- 5.2.3 Faucets shall be of brass body, chromium plated of approved design and shall be mounted over the counter or mounted on the basin itself as decided by Engineer-In-Charge.

5.3 Premium quality Wash Basins and faucets

- 5.3.1 Premium quality Wash Basins shall be over the counter top and thin rim type, of approved shape with electronic sensor electronic sensor operated.
- 5.3.2 Power supply to the sensor shall be by means of direct electrical connection or by battery cell as decided by the Engineer- In- Charge.
- 5.3.3 Faucets shall be of brass body, chromium plated of approved design and shall be wall mounted or mounted over the counter as decided by Engineer-In-Charge.

5.4 Kitchen/ Pantry/ Laboratory sinks

Kitchen/ Pantry/ Laboratory sinks shall be of stainless steel (304 -18/8) conforming to IS 13983. Nominal thickness of SS sheet shall not be less than 1 mm before forming. Thickness

at any point of the sink, after forming shall not be less than 0.75mm. Depth of the bowl shall not be less than 150 mm. Minimum internal dimensions, when measured on the bowl centre lines across the top of the bowl shall be 380mm x 340 mm for rectangular bowls and 360 mm for round bowls.

6.0 FITTINGS & FIXTURES

6.1 General

6.1.1 Fittings/ fixtures such as Taps/ Valves/ Faucets/Shower roses/ bib, stop, pillar cocks etc shall be of approved design and finish and shall be procured from approved Manufacturer.

6.1.2 Fittings/ fixtures shall be provided as per table below :

WC cubicles	Bib cock or health faucet, Coat/ Robe hook, Toilet paper holder
Shower cubicles	Towel rail, Coat/Robe hook, Soap tray, Shower rose
Wash Basins	Mirror and Faucets for each wash basin, Touch less type Soap dispenser (Tissue paper dispenser in locations decided by the Engineer-In-Charge) and Hand drier near wash basin.

6.1.3 Removable floor trap covers made of stainless steel shall be provided over all floor traps.

6.1.4 Fittings/ fixtures shall be made of non-ferrous anti corrosive metallic materials with chromium plated finish if not mentioned otherwise.

6.2 Specifications of sanitary fittings/ fixtures

6.2.1 Sanitary fittings/ fixtures shall meet the following specifications if not mentioned otherwise specifically in the tender/ bid documents and construction drawings.

Fittings/ fixtures	Specification
Bib Cocks, Stop Cocks, Pillar cocks, Taps, valves, Faucets, mixers etc.	15mm dia, chromium plated Brass body conforming to IS : 781 Faucets for superior and premium quality wash basins shall be as mentioned.
Health Faucets	Chromium plated Brass body with bracket
Shower rose	Chromium plated Brass body conforming to IS : 2064 with adjustable rose and supporting arm.
Toilet paper holder	Chromium plated Brass body or stainless steel (grade – 304)
Liquid soap dispenser	Plastic body
Towel ring/ rail/ rack	Stainless steel (grade – 304)
Mirror	Made of minimum 5mm thick glass with beveled/ rounded edge.
Coat/Robe hook	Stainless steel (grade – 304)

7.0 INSTALLATION

7.1 Sanitary fittings/ fixtures shall be installed by licensed plumber.





7.2 The fixtures/ fittings shall be installed in accordance with the Manufacturer's recommendation and as approved by the Engineer-In-Charge.

7.3 All fittings/ fixtures shall be installed ensuring water tightness using sealers/ gaskets etc. as required.

- 7.4 All holes/ punctures in walls due to installation shall be concealed by stainless steel round covers matching with the fixture/ fittings.
- 7.5 Pedestals of WCs/ wash basins etc. in contact with the floor finish shall be suitably sealed.
- 7.6 All screws for fixing/ fitting etc. shall be of stainless steel fixed with anchor fasteners.

बनावटी छत, बनावटी तल, अंडरडेक इन्सुलेशन और पार्टीशनिंग का मानक विनिर्देश

STANDARD SPECIFICATION FOR FALSE CEILING, FALSE FLOORING, UNDERDECK INSULATION & PARTITIONING

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Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
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Abbreviations:

ASTM :	American Society of Testing of Materials
BS :	British Standards
CISCA :	Ceilings & Interior Systems Construction Association
CRCA :	Cold Rolled Close Annealed
EN :	European Standards
GI :	Galvanized Iron
IS :	Indian Standards
ISO :	International Organization for Standardization
MS :	Mild Steel
NABL :	National Accreditation Board for Testing and Calibration Laboratories
NRC :	Noise Reduction Coefficients
NBC :	National Building Code
NFPA :	National Fire Protection Association
PVC :	Polyvinyl Chloride
RCC :	Reinforced Cement Concrete
SS :	Stainless Steel

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1.0 GENERAL

This standard specification lays down requirements of false ceiling, false flooring, under deck insulation, and partitioning system.

2.0 REFERENCES

- 2.1 The codes and standards listed below contains provisions which through reference in this specification constitute provisions of this standard specification if not specifically mentioned otherwise.
- 2.2 In case of similar codes of different organizations such as IS, ISO, BS, EN, BS-EN, ASTM, NFPA, NBC etc. conformity with any of the similar codes is acceptable.
- 2.3 Reference codes and standards:

Sr. No.	Standards	Document Title
1	ASTM C423	Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
2	ASTM C635	Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
3	ASTM C636	Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
4	ASTM E1414	Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
5	ASTM E1477	Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers
6	BS 476 part 6/7	Fire Test
7	CISCA	The Ceilings & Interior Systems Construction Association Acoustical ceilings: Use and Practice
8	IS 277	Galvanized Steel Sheets (Plain and Corrugated)
9	IS 2095	Gypsum plaster boards
10	IS 2676	Dimension for wrought aluminium and aluminium alloy sheet and strip
11	IS 12436	Specification for. Preformed rigid polyurethane (pur). And polyisocyanurate (pir) foams
12	IS 8183	Bonded mineral wool - specification.

3.0 FALSE CEILING SYSTEMS

3.1 GENERAL

- 3.1.1 False or suspended ceiling systems shall be complete with supporting frame work / suspension system and ceiling boards/ panels/ tiles. Following types of false ceiling systems (either with only one type or in combination of various types) shall be provided as specified in design basis, job specifications, item descriptions, drawings etc.

1. Mineral Fibre board false ceiling system.
2. Gypsum board seamless false ceiling system.

3. Calcium Silicate board false ceiling system.
4. Calcium Silicate tile false ceiling system.
5. Aluminium false ceiling system. (square grid type)
6. Aluminium false ceiling system. (linear plank type)

If false ceiling type is not mentioned specifically, Mineral Fibre board false ceiling system shall be provided.

- 3.1.2 False or suspended ceiling systems shall be installed at desired heights and levels in designs, patterns and shapes in accordance with approved fabrication drawings. Fabrication drawings shall be prepared and submitted by the Contractor and approved by Engineer-In-Charge.
- 3.1.3 Fabrication drawings shall be prepared based on drawings issued by Engineer-In-Charge and in co-ordination with other system providers such as lighting, HVAC, Fire-fighting system components, fittings and fixtures of which are accommodated on the ceiling or above and below.
- 3.1.4 The ceiling system shall be sturdy, finished, levelled and aligned as per approved drawings without any undulations, sagging or other defects. Zig-zag alignment of visible supporting system or ceiling panels/ tiles shall not be permitted.
- 3.1.5 All components of the ceiling system shall be from the approved Manufacturers of the whole and full system only. Materials / components procured from other Manufacturers shall not be permitted.
- 3.1.6 The ceiling systems shall be installed by agencies approved by Engineer-In-Charge.

3.2 MINERAL FIBRE BOARD FALSE CEILING SYSTEM

The Mineral Fibre board ceiling system shall be in square grid (exposed) type with tiles having bevelled tegular edges.

3.2.1 Ceiling boards/ panels/ tiles

Ceiling boards/ panels/ tiles shall be standard product of the approved Manufacturer and as per following specification.

Sr. No.	Item/ Property	Specification
1	Base Material	Mineral Fiber
2	Panel Dimensions	600 mm x 600 mm
3	Panel Thickness	16 mm
4	Dimension tolerances	+ - 0.5 mm
5	Noise Reduction co-efficient	0.55
6	Fire Properties	Class 0/1 as per BS 476 part 6/7
7	Light Reflectance	85%
8	Humidity Resistance	RH 99%

3.2.2 Suspension system

Suspension system/ framework of the ceiling system with all required components (grid work consisting of interlocked main, cross members and perimeter members etc suspended suitably from the ceiling/roof) shall be suitable/ compatible for the ceiling panels and shall be standard product of the Manufacturer and as per following specification.

Members of the grid work shall be of galvanised steel (120 gsm on both sides as per IS: 277) mild steel, power pressed to required profile.

The exposed visible surfaces of the suspension system shall be finished with minimum 25 micron pre-painted polyester baked paint.

3.2.3 Installation

3.2.3.1 Installation of the system shall be in accordance with approved drawings, standard practice of the system Manufacturer and following specifications.

3.2.3.2 Main members shall be placed at the spacing of maximum 1200 mm securely fixed to the structural soffit using suspension arrangement (by means of threaded hanger rod and level adjuster) at 1200 mm maximum.

3.2.3.3 Cross members shall be interlocked between main runners at 600mm to form 1200 mm x 600mm module.

3.2.3.4 Short cross members shall be fixed between main runners at 600mm to form in the 1200 mm x 600 mm modules to form 600 mm x 600 mm modules.

3.2.3.5 Perimeter sections shall be secured to perimeter walls/ partitions.

3.2.3.6 Ceiling panels/ tiles shall be provided in the suspended grid work.

3.3 GYPSUM BOARD SEAMLESS FALSE CEILING SYSTEM

The gypsum board false ceiling system shall be of seamless finish.

3.3.1 Gypsum boards

Gypsum boards shall conform to IS : 2095 and shall have following properties.

Sr. No.	Item/ Property	Specification
1	Board Thickness	12.5 mm
2	Dimension tolerances	+/- 0.5 mm
3	Fire Properties	Non combustible as per BS 476 part 4
4	Finishing	Acrylic emulsion paint or laminates as specified. If not specified otherwise, premium quality acrylic emulsion paint in approved colour shall be provided.

3.3.2 Suspension system

Suspension system/ framework of the ceiling system with all required components (grid work consisting of main, intermediate, cross members and perimeter members etc suspended suitably from the ceiling/ roof) shall be suitable/ compatible for the ceiling boards and shall be standard product of the Manufacturer.

The components shall be made of galvanized steel (120 gsm on both sides as per IS: 277) power pressed to required profile.

3.3.3 Installation

- 3.3.3.1 Main members shall be placed at the spacing of maximum 1200 mm securely fixed to the structural soffit using suspension arrangement (by means of cleats and suspension angle member) at 1200 mm maximum.
- 3.3.3.2 Cross members shall be fixed main runners at the spacing of 450 mm .
- 3.3.3.3 Perimeter sections shall be secured to perimeter walls/ partitions.
- 3.3.3.4 Ceiling boards shall be fixed to the grid frame work by means of drywall screws. edges of the ceiling boards shall be jointed and finished flush with jointing tapes and compounds as recommended by the approved Manufacturer. The finished surface shall be seamless.
- 3.3.3.5 The ceiling board surfaces shall be finished with paint etc. as specified.

3.4 CALCIUM SILICATE BOARD FALSE CEILING SYSTEM

The Calcium Silicate board false ceiling system shall be of seamless finish by fixing the ceiling boards on the suspension system.

3.4.1 Calcium Silicate ceiling boards

The calcium Silicate ceiling boards shall be with durable taper edge type board having following specification.

Sr. No.	Item/ Property	Specification
1	Board Thickness	8 mm
2	Dimension tolerances	+/- 0.8 mm
3	Fire Properties	Class 0/1, Class A as per BS 476 part 6/7
4	Humidity Resistance	RH 99%
5	Finishing	Acrylic emulsion paint or laminates as specified. If not specified otherwise, premium quality acrylic emulsion paint in approved colour shall be provided.

3.4.2 Suspension system

Suspension system/ framework of the ceiling system with all required components (grid work consisting of main, intermediate, cross members and perimeter members etc suspended suitably from the ceiling/ roof) shall be suitable/ compatible for the ceiling boards and shall be standard product of the Manufacturer.

The components shall be made of galvanized (120 gsm on both sides as per IS: 277) mild steel, power pressed to required profile.

3.4.3 Installation

- 3.4.3.1 Installation of the system shall be in accordance with approved drawings, standard practice of the system Manufacturer and following specifications.
- 3.4.3.2 Main members of grid framework shall be suspended from the soffit @ 1200 mm maximum by means of angle hangers with nuts and bolts, angle hangers being fixed to angle cleats fixed on the soffit by means of dash fasteners.

- 3.4.3.3 Intermediate members of grid framework shall be fixed to main members @ 450 mm maximum in a direction perpendicular to the main members with connecting clips.
- 3.4.3.4 Perimeter members shall be fixed on perimeter surfaces.
- 3.4.3.5 Ceiling boards shall be fixed to the grid frame work by means of drywall screws. Tapered and square edges of the ceiling boards shall be jointed and finished flush with jointing tapes and compounds as recommended by the approved Manufacturer. The finished surface shall be seamless.
- 3.4.3.6 The ceiling board surfaces shall be finished with paint etc. as specified.

3.5 CALCIUM SILICATE TILE FALSE CEILING SYSTEM

The Calcium Silicate tile false ceiling system shall be of square grid type laid on the suspension system.

3.5.1 Calcium Silicate ceiling tiles

The calcium Silicate ceiling tiles shall be of approved texture having following specification.

Sr.No.	Item/ Property	Specification
1	Tile thickness	8 mm
2	Tile size	595 mm x 595 mm or 610 mm x 610 mm
3	Humidity Resistance	RH 99%
4	Fire Properties	Non combustible as per BS 476, part -4 Class 1 as per BS 476 part 7
5	Finishing	Acrylic emulsion paint or laminates as specified. If not specified otherwise, premium quality acrylic emulsion paint in approved colour shall be provided.

3.5.2 Suspension system

Suspension system/ framework of the ceiling system with all required components (grid work consisting of main, cross members and perimeter members etc suspended suitably from the ceiling/ roof) shall be suitable/ compatible for the ceiling tiles and shall be standard product of the Manufacturer.

The components shall be made of galvanized (120 gsm on both sides as per IS: 277) mild steel.

Visible areas of the frame work shall be pre-painted with polyester paint.

3.5.3 Installation

- 3.5.3.1 Installation of the system shall be in accordance with approved drawings, standard practice of the system Manufacturer and following specifications.
- 3.5.3.2 Main and cross members of grid framework shall be interlocked (as required to form the square grid suitable for the tile size) and suspended from the soffit by means of slotted galvanized steel cleats, adjustable rods fixed to soffit with anchor fasteners in accordance with approved Manufacturer's standard practice.

- 3.5.3.3 Perimeter members shall be fixed on perimeter surfaces.
- 3.5.3.4 Ceiling tiles shall be laid in the grid frame work.
- 3.5.3.5 The ceiling board surfaces shall be finished with paint etc. as specified.

3.6 ALUMINIUM FALSE CEILING SYSTEM (SQUARE GRID TYPE)

Aluminium false ceiling system (square grid type) shall be standard product of the approved Manufacturer, clip-in type in square grid consisting of Aluminium alloy ceiling panels and suspension system.

3.6.1 Ceiling Panels

Ceiling panels shall be made of aluminium alloy AA 3003- H14 (tempered) grade as per IS 2676 having following specification.

Sr.No.	Item/ Property	Specification
1	Panel type	Bevel edged, Perforated type with non-woven acoustical fleece
2	Panel dimension	600 mm x 600 mm
3	Panel thickness	0.7 mm
4	Dimension tolerances	+ - 2 mm
5	Fire Properties	Class 0/1 as per BS 476 part 6/7 or class A2-s1, d0 according to EN 13501-1
6	Light Reflectance	63% as per ASTM 1477
7	Perforations	Hole diameter- 1.5 mm, open area- 18%, linear pitch 4.3 mm, diagonal pitch – 3 mm, border area – 9.5 mm
8	Finishing	Polyester powder coating (minimum 60 micron)
9	Salt spray test	750 hours as per ASTM B 117

3.6.2 Suspension system

Suspension system/ framework of the ceiling system with all required components (grid work consisting of main, intermediate, cross members and perimeter members etc suspended suitably from the ceiling/ roof) shall be suitable/ compatible for the ceiling boards and shall be standard product of the Manufacturer.

The components of the system shall be made of galvanized (90 gsm as per IS 277) steel and finishing shall be baked polyester paint.

3.6.3 Installation

- 3.6.3.1 Installation of the system shall be in accordance with approved drawings, standard practice of the system Manufacturer and following specifications.
- 3.6.3.2 Main members shall be placed at the spacing of maximum 1200 mm securely fixed to the structural soffit using suspension arrangement (by means of hanger wire/ threaded rod and level adjuster).
- 3.6.3.3 Cross members shall be interlocked between main runners to form 600 mm x 600 mm grid.
- 3.6.3.4 Perimeter sections shall be secured to perimeter walls/ partitions.

3.6.3.5 Ceiling panels/ tiles shall be laid in the suspended grid work.

3.7 ALUMINIUM FALSE CEILING SYSTEM (LINEAR PLANK TYPE)

Aluminium false ceiling system (linear plank type) shall be standard product of the approved Manufacturer, single grid type in concealed system consisting of Aluminium alloy ceiling panels and suspension system.

3.7.1 Ceiling Panels

Ceiling panels shall be made of aluminium alloy AA 3105- H14 (tempered) grade as per IS 2676 having following specification.

Sr.No.	Item/ Property	Specification
1	Panel type	Perforated type with non-woven acoustical fleece with bevel edge and upturn
2	Panel dimension	150 mm (width)
3	Panel thickness	0.7 mm
4	Dimension tolerances	+ - 2 mm
5	Fire Properties	Class 0/1 as per BS 476 part 6/7 or class A2-s1, d0 according to EN 13501-1
6	Light Reflectance	63% as per ASTM 1477
7	Perforations	Hole diameter- 1.5 mm, open area- 18%, linear pitch 4.3 mm, diagonal pitch – 3 mm, border area – 9.5 mm
8	Finishing	Polyester powder coating (minimum 60 micron) If not specified otherwise, premium quality acrylic emulsion paint in approved colour shall be provided.
9	Salt spray test	750 hours as per ASTM B 117

3.7.2 Suspension system

Suspension system/ framework of the ceiling system with all required components (grid work consisting of main members and perimeter members etc suspended suitably from the ceiling/ roof) shall be suitable/ compatible for the ceiling boards and shall be standard product of the Manufacturer.

The components of the system shall be made of galvanized (120 gsm as per IS 277) steel and finishing shall be baked polyester paint.

3.7.3 Installation

3.7.3.1 Installation of the system shall be in accordance with approved drawings, standard practice of the system Manufacturer and following specifications.

3.7.3.2 Main members shall be placed at the spacing of maximum 1200 mm securely fixed to the structural soffit using suspension arrangement (by means of hanger wire/ threaded rod).

3.7.3.3 Perimeter sections shall be secured to perimeter walls/ partitions.

3.7.3.4 Ceiling panels shall be clipped on to the main members of the suspended grid work.

4.0 UNDERDECK INSULATION SYSTEM

Insulating material of underdeck insulation system shall be of glass wool boards or Polyisocyanurate (PIR) foam boards/slabs as specified in the design basis, item description, job specification drawings etc.

If nothing is mentioned specifically, glass wool boards shall be used.

4.1 POLY- ISOCYANURATE (PIR) FOAM INSULATION SYSTEM

4.1.1 Poly- Isocyanurate (PIR) foam

Poly-Isocyanurate (PIR) foam insulation shall be in the slab form with lining of glass fibre tissue or aluminium foil lining (having 50 mm overlap) on one side.

Poly-Isocyanurate (PIR) foam shall conform to IS: 12436 and shall have following specification.

Sr.No.	Item/ Property	Specification
1	Slab thickness	Minimum 30 mm
2	Density	Not less than 32 kg/ CuM
3	Thermal conductivity (K value)	Not more than 0.023 w/mk at 10 degree C
4	Fire Properties	Class 0/1 as per BS 476 part 6/7

4.1.2 Installation

4.1.2.1 Installation of the system shall be in accordance with standard practice of the approved Manufacturer's and following specification.

4.1.2.2 Hot blown bitumen (grade 85/25) over a bituminous priming or approved cold adhesive shall be applied over the soffit and PIR board surface after cleaning the surfaces.

4.1.2.3 PIR slabs shall be pressed in position over the bitumen coat when it is still tacky or over the cold adhesive and shall be fixed to the soffit by means of approved fasteners (at four corners and at the centre of the slabs) without damaging the slabs.

4.1.2.4 Overlaps shall be covered with approved sealing compound.

4.1.2.5 The PIR shall be further secured by chicken wire mesh (24 gauge) fixed to the fasteners and tightened with lacing wire.

4.2 GLASS WOOL INSULATION SYSTEM

4.2.1 Glass wool insulation

Glass wool insulation shall be in rolls or boards and shall be pre-laminated on one side with aluminum foil.

Glass wool insulation shall conform to IS: 8183 and shall have following specification.

Sr. No.	Item/ Property	Specification
1	Thickness	Minimum 75 mm
2	Density	Not less than 24 kg/ CuM
3	Thermal conductivity (K value)	Not more than 0.034 w/mk at 25 degree C mean
4	Fire Properties	Class 0/1 as per BS 476 part 6/7

4.2.2 Installation

4.2.2.1 Installation of the system shall be in accordance with standard practice of the approved Manufacturer's and following specification.

4.2.2.2 The insulation boards/roll shall fixed underside soffit with the help of polyamide based long insulation fasteners @ 450 mm c/c.

4.2.2.3 The joints shall be sealed with self-adhesive aluminum foil tape

5.0 FALSE (RAISED ACCESS) FLOORING SYSTEM

False flooring system shall be modular and removable type and shall consist of floor panels and supporting/ understructure system.

The system shall be factory made and the full system including all components shall be sourced from approved single Manufacturer.

The system shall be strong and durable for movement and other operations.

This specification is applicable for false floorings upto 1000 mm high.

The flooring system shall be capable of supporting following loading conditions when tested as per CISCA test procedure.

- i. Concentrated load of 675 Kg. with maximum allowable deflection of 2.5mm and a factor of safety of 2.5.
- ii. Uniform load of 2025 Kg/ Square meter.

For details reference shall be made to standard no 7-75-0049.

5.1 Floor panels

Sr. No.	Item/ Property	Specification
1	Material	CRCA steel with cementitious core with hemispherical and reverse cones and 1 mm thick epoxy painted CRCA steel sheet on top. The inner empty core shall be injected with light weight fire retardant non combustible cementitious compound.
2	Size	600 mm x 600 mm x 35 mm thick. (Dimensional tolerance : +/- 0.8 mm).
3	Finishing	Top sheet shall be finished with 2 mm thick high pressure laminate or 2 mm thick conductive PVC or stone or other type of tiles as specified. If nothing is mentioned specifically, high pressure laminate shall be provided.
4	Edging	All edges of the panels shall have conductive PVC trims
5	Fire resistance/ property	Class 0 & class 1 conforming to BS 476-part-6 (Fire propagation) and BS 476-part-7 (Surface spread of flame).

5.2 Understructure/ supporting system

False floor understructure shall be installed to support the panels and shall be suitable to achieve required cavity height from the existing floor level. The system shall ensure speedy assembly and removal for relocation and maintenance. The system shall also ensure easy adjustment of levelling ($\pm 25\text{mm}$) and accurate alignment of panels in the vertical direction.

False floor understructure shall consist of Base plate, pedestals, pedestal head assembly, stringers and necessary fittings, fixtures and accessories as specified below.

Sr. No.	Item/ Property	Specification
1	Pedestal Base Assembly	Powder coated, hot dip galvanized (60-80 micron) mild steel base plate with not less than 150mm x 150mm x 4 mm of bearing area, mechanically riveted to a 32mm dia. of 2 mm thick CRCA steel pedestal designed to engage the head assembly
2	Pedestal Head Assembly	Zinc electroplated CRCA steel pedestal head assembly shall be 90mm x 90mm x 4 mm thick profiled head, mechanically riveted to a 19 mm dia. threaded bright rod, fixed to pedestal by specially designed zinc electroplated steel forged adjusting nut for leveling, locking and changing the height setting.
3	Stringers	Stringers shall be of hot dip galvanized (60-80 microns) steel, minimum 20mm x 32mm x 1.20mm thick CRCA steel.

5.3 Installation

5.3.1 False flooring systems shall be installed by agencies approved by Engineer-In-Charge.

5.3.2 False flooring systems shall be installed at desired heights and levels in designs, patterns and shapes in accordance with approved fabrication drawings. Fabrication drawings shall be prepared and submitted by the Contractor and approved by Engineer-In-Charge.

5.3.3 Fabrication drawings shall be prepared based on drawings issued by Engineer-In-Charge and in co-ordination with other system providers such as which are accommodated in the cavity of the false flooring.

5.3.4 Installation shall be done in accordance with approved system Manufacturer's standard practice, as directed by the Engineer-In-Charge and as mentioned below:

5.3.5 Installation of under structure

- The base floor and cavity between false flooring and base floor shall be properly cleaned and made dust free and dry. The base cement concrete floor shall be treated with one component polyurethane based coating.
- Pedestal base assembly shall be fixed to the base floor by fixing base plates to the base floor by minimum 50mm x 8mm anchor fasteners (4 nos. for each plate).
- The pedestal stud locations shall ensure the grid work as per flooring pattern which in general shall be of 600 mm x 600 mm dimension. The length of the pedestal studs shall be such that clear cavity between false flooring and base flooring is of desired depth. Additional pedestals as needed to support panels where floor is disrupted by columns, walls and cutouts shall be provided. Perimeter pedestal studs shall be provided along the periphery. Pedestal assemblies including pedestal heads shall be weld-free construction, corrosive resistant and shall provide an adjustment range of $\pm 25\text{mm}$ from the specified finished floor heights.

- d) The threaded bright rod with the top head attachments shall be inserted into the studs and shall be adjusted to obtain proper level of the finished floor panels by means of the adjustment nut. The nut shall provide location lugs to engage the pedestal base assembly, such that deliberate action is required to change the height setting. Threaded rod shall provide a specially designed anti-rotation device, such that when the head assembly is engaged in the base assembly, the head cannot freely rotate.
- e) The pedestal head shall have an anti vibration PVC cap for panel and stringer location. Stringers shall support each edge of panel. The stringers shall have counter sunk holes at both ends to accommodate bolting of M6 machine screws to the pedestal head assembly. Stringers shall be individually and rigidly fastened to the pedestal with one machine screw for each end of stringer. Bolts shall provide positive electrical contact between the stringers and pedestals. Stringer grid shall ensure maximum lateral stability in all directions. All the field cut panels shall be installed with an appropriate PVC end cap specially designed to accommodate the stringer and arrest Panel beam movement and will ensure the integrity and stability of the system.

5.3.6 Installation of floor panels

- a) Floor panels shall be placed over the stringer channels and bolted to pedestal head. All four edges of panels shall be finished with black conductive 5mm wide PVC edge beadings. These edge beadings are glued and sealed in place to avoid detachment.

Floor panels which are field cut (at ends, Console/ Rack location etc.) shall be marked with positional numbering on the underneath and the adjoining wall. The finished floor panels shall be perfectly levelled and aligned without any gaps in between the panels.
- b) All accessories such as outlet boxes and grommets as required, Panel lifters (at least one for each building, one number for every 500 Square meter of access floor area) etc. shall be provided in accordance with approved Manufacturer's recommendations.
- c) Each individual panel shall be removable for the purpose of maintenance of the cavity. Panel shall be easily removed by one person with a lifting device and shall be fully transferable and totally inter changeable and replaceable in any of the 4 directions at 90 degrees increments, except where cut for special conditions.
- d) Necessary cut-outs shall be made in the panels for cable routing, control panel fixation etc. as per drawing.
- e) Necessary ramps, slopes, steps etc. shall be also provided for as per drawing with raised access floor components as per approved manufacturer recommendations..
- f) Around a control panel/rack, the residual space left out shall be filled up with cut panels of uniform size as required to fully close the gap between the adjacent full panel and the control panel base channel. In this case the part floor panel shall extend upto the full width of the base channel and the cut size shall be determined accordingly. An additional structural steel framework shall be provided along the cut out on which the edge of the floor panel shall rest and over which the base channel of control panel shall be placed.
- g) Earth bonding of the system shall be in accordance with approved Manufacturer's standard practice as approved by the Engineer-In- Charge. After completion of the floor and association services, tests shall be arranged to demonstrate that the floor is electrically continuous and fully earth bonded. Points chosen for testing shall include randomly selected pedestals, stringers tops and bottoms of panels, etc.

6.0 PARTITIONING

Partitioning shall rigid, stable, true to the plumb and in accordance with design and approved drawings for all heights.

6.1 GYPSUM BOARD PARTITIONING

Partitioning shall be of gypsum partition boards fixed on galvanized steel frame work. The partitions shall be rigid and stable.

6.1.1 Gypsum partition boards

Gypsum partition boards shall conform to IS : 2095 and shall have following properties. Overall thickness of the finished partition shall be minimum 75 mm.

Sr. No.	Item/ Property	Specification
1	Board Thickness	12.5 mm
2	Dimension tolerances	+/- 0.5 mm
3	Fire Properties	Non combustible as per BS 476 part 4

6.1.2 Partition frame

Partition framework shall be in accordance with standard system of the approved Manufacturer and shall consist of profiled floor & ceiling sections and vertical sections of power pressed/ roll formed galvanized steel (minimum 120 gsm, both side inclusive as per IS:277). Minimum thickness of the sections shall be 0.5 mm.

6.1.3 Installation

6.1.3.1 Installation of the system shall be in accordance with standard practice of the approved Manufacturer's, approved fabrication drawings (prepared by the Contractor) and following specification.

6.1.3.2 Thickness, size, spacing of the frame sections shall be as required for desired height in accordance with recommendations/ standard practice of the approved Manufacturer.

6.1.3.3 Floor and ceiling sections shall be fixed with fasteners of 12.5 mm diameter, 50 mm length @ 600 mm c/c. Vertical sections shall be fixed in the floor and ceiling sections @ 610 mm c/c.

6.1.3.4 Gypsum partition boards shall be fixed on both sides of the framework by drywall screws @ 300 mm c/c.

6.1.3.5 All vertical and horizontal joints of the boards shall be staggered to avoid cracks with provisions of galvanized steel sections fixed to the vertical sections at the horizontal joints of the boards.

6.1.3.6 The jointing and finishing of the boards shall be finished using approved jointing compound, paper tape, metal corner tapes etc. and two coats of primer suitable for the boards.

6.1.3.7 Arrangements of wires/ conduits running through the cavity of the system shall be made. Cut/outs, openings for doors, windows, switches etc. shall be made with necessary framing/ stiffening of the openings.

6.1.3.8 Gypsum plaster boards on both sides of the partition frame shall be finished with painting or laminates etc. as specified. If finishing type is not specifically mentioned anywhere, acrylic emulsion paint finish conforming to specification of masonry paint finish in adjoining masonry shall be provided in approved colour

7.0 MEASUREMENT

7.1 Measurement of false/ suspended ceiling system shall be measurement of actual surface area covered by the ceiling boards/ panels/ tiles.

7.2 Measurement of underdeck insulation system shall be measurement of actual surface area covered by insulation slab/ roll/ board.

7.3 Measurement of false/ raised floor system shall be measurement of actual surface area covered by floor panels.

7.4 Measurement of partitioning system shall be measurement of actual surface area covered by partition boards of one side.

7.5 Area of cut out/ openings for door/ window, various fittings etc. shall be deducted.

अग्निरोधक दरवाजों, खिड़कियों व
पार्टीशन के लिए
मानक विनिर्देशन

STANDARD SPECIFICATIONS
FOR
FIRE CHECK/ FIRE RESISTANT
DOORS, WINDOWS &
PARTITIONS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
2	08.02.22	REVISED & ISSUED AS STANDARD SPECIFICATION	SANDEEP SHARMA	ANISH KUNDU	SAMIR DAS	SANJAY MAZUMDAR
1	14.06.14	REVISED & ISSUED AS STANDARD SPECIFICATION	AM/RH	SD	JKB	DM
0	01.02.12	ISSUED AS STANDARD SPECIFICATION	AM	SM	JKB	DM

Abbreviations:

ASTM	: American Society for Testing and Materials
BS	: British Standards
CBRI	: Central Building Research Institute
EN	: European Standards
IS	: Indian Standard
ISO	: International Organization for Standardization
GI	: Galvanized Iron
NABL	: National Accreditation Board for Testing and Calibration Laboratories
NBC	: National building Code
NFPA	: National Fire Protection Association
PVC	: Polyvinyl Chloride
PUF	: Polyurethane foam
SS	: Stainless Steel
UL	: Underwriters Laboratories
CuM	: Cubic Meter

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1.0 GENERAL

This standard specification lays down requirements of fire rated/ check/ resistant door, window and partition assemblies intended to provide safety and safe exit from buildings in case of fire.

2.0 REFERENCES

- 2.1 The codes and standards listed below contain provisions which through reference in this specification constitute provisions of this standard specification if not specifically mentioned otherwise.
- 2.2 In case of similar codes of different organizations such as IS, ISO, BS, EN, BS-EN, ASTM, NFPA, NBC etc. conformity with any of the similar codes is acceptable.
- 2.3 Reference codes and standards:

Standards	Document title
IS 2095, Part-1	Gypsum plaster boards – plain gypsum plaster boards
IS 3614	Fire Doors and Doorsets - Specification
IS 16945	Fire resistance test for glass walls
IS 16947	Fire resistance tests for doors with glass panes, openable glass, glass windows and sliding glass doors
IS 277	Galvanized steel sheets (plain and corrugated)-Specification
IS 287	Permissible moisture content for timber used for different purposes-Recommendations
IS 513	Cold reduced low carbon Steel sheet and strip
IS 8183	Bonded Mineral Wool - Specification
IS 14862	Fibre Cement Flat Sheets — Specification
BS 476, Part- 4	Fire tests on building materials and structures. Non-combustibility test for Materials.
BS 476, Part- 7	Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products.
BS 476, Part- 20	Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction. (general principles).
BS 476, Part- 22	Fire tests on building materials and structures. Method for determination of the fire resistance of non-load bearing elements of construction.
BS 6206	Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings.
SP-7 (Part-40)	National Building Code of India – part-4 – Fire & life safety
EN-1363-1	Fire resistance tests. General requirements
EN-1364-1	Fire resistance tests for non-load bearing elements. Walls
EN 1634-1	Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Fire resistance test for door and shutter assemblies and openable windows
EN 10346	Continuously Hot Dip Coated Steel Strip And Sheet Products.
EN 12600	Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings.
ISO 834-1	Fire resistance tests: Elements of Building construction- General requirement.
ISO 3008	Fire resistance tests: Door and shutter assemblies, Part 1: General requirements.
ISO 3009-1	Fire-resistance tests: Elements of building construction: Glazed elements.

3.0 FIRE CHECK/ RESISTANT/ RATED DOORS, WINDOWS & PARTITIONS

- 3.1 Fire check/ resistant/ rated door, window & partition assemblies (termed as “Fire doors, windows, partitions” hereafter) shall be of fire resistance/ rating and type (wooden/ metallic/ glazed etc.) mentioned in the drawings, job specification, item descriptions etc. and shall be complete assembly with frame, shutter/ leaves, glazing, partition panel, hardware etc.
- 3.2 If type and fire resistance/ fire rating is not specifically mentioned in the drawings, job specification, item descriptions etc., following types of fire doors/ windows/ partitions shall be provided.

Doors:

Steel fire doors having fire resistance/ fire rating of two hours (120 minutes) for Integrity and 30 minutes for insulation.

Windows:

Fully glazed fire windows having fire resistance/ fire rating of two hours (120 minutes) for Integrity and 20 minutes for insulation.

Partitions:

Solid type fire partitions made of calcium silicate board having fire resistance/ fire rating of two hours (120 minutes) for Integrity and insulation.

- 3.3 The fire doors, windows and partitions shall be in accordance with test certificate or test validity or evaluation report or assessment report (termed as “test report” hereafter) with regards to fire resistance/ rating, material, design, construction, dimension, sizes etc. and shall be complete assembly with frame, shutter/ leaf, glazing, partition panels and hardware.
- 3.4 Each Fire door, window & partition shall be provided with appropriate label mentioning name of the Manufacturer, fire rating, and year of Manufacturing/ installation.

4.0 TESTING AND CERTIFICATION

- 4.0 Prototype/ type test report shall be submitted for each type (such as wooden, steel, glazed etc.), size range and fire resistance / rating of fire doors, windows and partitions.
- 4.1 Testing for fire resistance / rating of steel and wooden doors shall be done by subjecting a full size construction to test in accordance with the procedures laid down in ISO 3008 or BS 476: part 22.
- 4.2 Testing for fire resistance/rating of glazed doors, windows and partitions shall be done by subjecting a full size construction to test in accordance with the procedures laid down in following codes as applicable:
1. EN 1634-1
 2. EN-1364-1
 3. ISO 3009
 4. BS 476 : part 20, part 22
 5. IS 16945
 6. IS 16947

Property	Value
Yield strength	Minimum 255 MPa
Tensile strength	Minimum 350 Mpa
Elongation	Minimum 38.5 %

5.6 Glass

The glass panels shall be clear, non-wired, interlayered and toughened type suitable for required fire rating/ resistance of the door/ window / partition assembly.

Each Glass panel shall carry a non-removable marking with the name of the product & the manufacturer inscribed on it.

Thickness of glass lesser than the thickness mentioned in the test report shall not be permitted.

Increase in width, height and overall area of the glass, when compared to dimensions mentioned in the test report shall also be not permitted.

Make, size and thickness of the glass panels shall be as mentioned in the test report for required assembly (door/ window/ partition) of required fire rating and shall have following properties.

Property	Value
Impact resistance	Minimum 2B2 category (When tested in accordance with EN 12600)
Light transmission ratio	Minimum 85% (When tested in accordance with EN 410)

5.7 Insulation

Insulation or infill material shall be resin bonded like resin bonded honeycomb paper core, mineral wool or ceramic wool as mentioned in the test report. Proprietary material may be used, provided they satisfy the requirement of fire resistance/ rating and is mentioned in the test certificate.

Polyurethane foam (PUF) shall not be permitted as infill or insulation material.

Mineral wool and Rock Wool used for insulation shall conform to IS 8183 and density shall be minimum 48Kg/ CuM. Higher density of insulation is permitted.

5.8 Fire & smoke seal

Fire & smoke seals shall be of the same dimensions and configuration as mentioned in the test report.

6.0 WOODEN FIRE DOORS

6.1 Wooden fire doors shall conform to IS: 3614 and this specification. In case of contradiction, this specification or decision by Engineer- In-Charge shall govern.

6.2 Door assembly

6.2.1 The door assembly including door frame, shutter/ leaf, insulation, fire & smoke seal etc. shall be in accordance with test report which is appropriate to the required type, size and fire resistance/

rating (with regards to material, design, construction, dimensions, size range etc.) and following specification.

6.2.2 Door frame

Door frames shall be of first grade teakwood and shall be fixed in position by means of anchor fasteners on jambs and head member. Sizes and profiles of the members of the frames shall be as mentioned in the test report. Intumescent fire and smoke seal shall be fitted in the frame in accordance with test certificate.

6.2.3 Door shutter/ leaves

Door shutters/ leaves shall be non-metallic and asbestos free type. They shall be composed of Calcium Silicate boards on both sides and insulation core. Overall thickness of the shutter, thickness of insulation and thickness of calcium silicate boards shall be as mentioned in the test report.

The shutter composition shall have painted/ polished teak wood lipping around the periphery fitted with intumescent fire & smoke seal in accordance with test certificate. The intumescent fire seal may not be required at the bottom of the door leaf.

If not mentioned otherwise, vision panels shall be provided in the door shutters.

6.3 Finishing

The door frames and teak wood lipping around the periphery of the shutters shall be finished with approved quality fire resistant paint conforming to IS 12777 including primer in desired colour.

Both sides of the door shutters/ leaves shall be faced with 3mm thick commercial ply finished with either 1mm thick laminate of approved color, texture and design, or teak ply (finished with fire retardant transparent paint conforming to IS 12777) as mentioned in the drawings, job specification, item descriptions etc.

If finishing of door shutter/ leaf is not specifically mentioned in the drawings, job specification, item descriptions etc., laminate finishing shall be provided.

6.4 Hardware

Reference shall be made to clause no 13.0

6.5 Fire resistance/ rating

If not mentioned otherwise, wooden fire doors shall have fire resistance/ fire rating of two hours (120 minutes) for integrity and 30 minutes for insulation.

7.0 STEEL FIRE DOORS

7.1 Steel fire doors shall conform to IS: 3614 and this specification. In case of contradiction, this specification or decision by Engineer- In-Charge shall govern.

7.2 Door assembly

7.2.1 The door assembly including door frame, shutter/ leaf, insulation, fire/smoke seal etc. shall be in accordance with test report which is appropriate to the required type, size and fire resistance/

rating (with regards to material, design, construction, dimensions, size range etc.) and following specification.

7.2.2 Door frame

Door frames shall be of galvanized steel sheet press formed to required profile. The minimum sheet thickness for frames shall be 1.2 mm (18 gauge) for frame depth upto 150mm. for depth of frame higher than 150 mm, minimum sheet thickness shall be 1.6 mm (16 gauge).

Dimensions and profile of the door frames shall be as mentioned in the test report. However, increase in sheet thickness and frame profile size (compared to the test certificate) is permitted

Door frame shall be provided with stiffeners for hardware/ lock mounting and for fixing of fasteners. Necessary provisions for fixing fire/ smoke seal shall also be kept in the frame.

Hollow door frames shall be filled up with insulation as and if mentioned in the test certificate. Even if the insulation filling is not mentioned in the test certificate, such filling is permitted.

Door frames shall be fixed in position by means of anchor fasteners on jambs and head member.

7.2.3 Door Shutter/ leaf

Door shutters shall be minimum 45 mm thick with outer skins made of minimum 1.2 mm (18 gauge) thick galvanized steel sheet with infill/ insulation. Internal construction of the shutter shall be provided with rigid reinforcement in addition to the core/ infill. Rigid reinforcement pads shall be provided for receiving hardware like hinges, locks, door closers etc.

Higher thickness of the outer screens (compared to the test certificate) is permitted.

Double leaf shutters shall be provided with astragals.

Intumescent seals shall be provided on all three sides of the leaves and on the meeting stiles of the double leaf door or as per test certificate. Alternatively, the same can provided on the frame and meeting stile of the double leaf door.

If not mentioned otherwise, vision panels shall be provided in the shutters/ leaves.

Louvers shall be provided in the shutters/ leaves if mentioned specifically and test report of the doors with louver is available.

7.3 Finishing

The frame and the shutters shall be finished with minimum 50 microns powder coating in desired colour.

7.4 Fire resistance/ rating

If not mentioned otherwise, steel fire doors shall have fire resistance/ fire rating of two hours (120 minutes) for integrity and 30 minutes for insulation.

7.5 Hardware

Reference shall be made to clause no 13.0.

8.0 VISION PANEL

Glass for vision panels shall be in accordance with test certificate Maximum area of vision panel shall be 0.06 square meter. Maximum width shall be 200 mm, maximum height shall be 400mm.

In case of change in glass with respect to test report, the changed glass shall be appropriate to the specified fire resistance/ rating and supporting test report of the changed glass shall be submitted.

9.0 LOUVERS

Louvers shall be in accordance with test certificate when tested as a complete assembly on the fire door. Maximum area of the louvers shall not exceed 0.135 square metre. Maximum width and height shall be 300 mm and 450 mm respectively.

10.0 GLAZED FIRE DOORS

10.1 Door assembly

10.1.1 The door assembly including door frame, shutter/ leaf, stiles, rails, glazing, insulation, fire/smoke seal etc. shall be in accordance with test report which is appropriate to the required type, size and fire resistance/ rating (with regards to material, design, construction, dimensions, size range etc.) and following specification.

10.1.2 The glazed fire doors shall be fully glazed type with required frame, shutter/ leaf, stiles, top and bottom rails, insulation, fire & smoke seal, hardware etc. Intermediate middle/ lock rails shall not be provided.

10.1.3 Door Frame

Door frame shall be either of galvanized steel sheet or cold rolled low carbon steel sheet press formed to requisite profile.

Minimum thickness of galvanized steel sheet for frames shall be 1.2 mm (18 gauge) for frame depth upto 150mm. for depth of frame higher than 150 mm, minimum sheet thickness shall be 1.6 mm (16 gauge).

Minimum thickness of cold rolled low carbon steel sheet for frames shall be 1.5 mm.

However, increase in steel sheet thickness (compared to the test certificate) is permitted.

Dimensions and profile of the door frames and frame members shall be as mentioned in the test report. Increase or reduction in dimensions and change in profile when compared to the test report shall not be permitted.

Hollow door frames shall be filled up with insulation as and if mentioned in the test certificate. Even if the insulation filling is not mentioned in the test certificate, such filling is permitted.

Door frame shall be provided with stiffeners for hardware/ lock mounting and for fixing of fasteners. Necessary provisions for fixing fire & smoke seal shall also be kept in the frame.

Door frames shall be fixed in position by means of anchor fasteners on jambs and head member.

10.1.4 Door Shutter/ leaf

The shutter/ leaf frame (stiles and rails) shall be either of galvanized steel sheet or cold rolled low carbon steel sheet press formed to requisite profile. Thickness of steel sheet shall be minimum 1.2 mm.

Dimensions and profile of the stiles and rails shall be as mentioned in the test report. Increase in dimensions and change in profile when compared to the test report shall not be permitted.

However, increase in steel sheet thickness (compared to the test certificate) is permitted.

Width of the stile and rail shall not exceed 100mm. In case of bottom rail width/ height may be upto 125mm.

Intermediate middle/ lock rails shall not be provided.

Hollow sections of stiles and rails shall be filled up with insulation as and if mentioned in the test certificate. Even if the insulation filling is not mentioned in the test certificate, such filling is permitted.

Glass shall be single piece and increase in glass panel size compared to the size mentioned in the test report shall not be permitted. Glass shall be fixed with beading, clips/ screw etc. in accordance with test reports.

10.2 Finishing

The frame and the shutters/ leaves shall be finished with minimum 50 microns powder coating in desired colour.

10.3 Hardware

Reference shall be made to clause no 13.0.

10.4 Fire resistance/ rating

If not mentioned otherwise, glazed fire doors shall have fire resistance/ fire rating of two hours (120 minutes) for integrity and 20 minutes for insulation.

11.0 GLAZED FIRE WINDOW

11.1 Window assembly

11.1.1 The window assembly including frame, glazing, insulation, fire/smoke seal etc. shall be in accordance with test report which is appropriate to the required type, size and fire resistance/ rating (with regards to material, design, construction, dimensions, size range etc.) and following specification.

11.1.2 Specification of window frame shall be similar to the specification of door frame as mentioned in clause 10.0

11.1.3 The glazed fire windows shall be fully glazed type (fixed glazing) with required frame, hardware etc. Glass shall be single piece and increase in glass panel size compared to the size mentioned in the test report shall not be permitted. Glass shall be fixed with beading, clips etc. in accordance with test reports.

11.2 Finishing

The frame shall be finished with minimum 50 microns powder coating in desired colour.

11.3 Fire resistance/ rating

If not mentioned otherwise, glazed fire doors shall have fire resistance/ fire rating of two hours (120 minutes) for integrity and 20 minutes for insulation.

12.0 GLAZED FIRE PARTITION

12.1 Partition assembly

- 12.1.1 The partition assembly shall consist of metal framework and glass panels in accordance with approved design and pattern.
- 12.1.2 The partition assembly including frame, glazing, insulation etc. shall be in accordance with test report which is appropriate to the required type, size and fire resistance/ rating (with regards to material, design, construction, dimensions, size range etc.) and following specification.
- 12.1.3 Glazed fire partitions shall be fully glazed unless otherwise mentioned specifically. Specification of partition frame shall be similar to the specifications of door frame mentioned in clause no 10.0. Specification of glass shall be as mentioned in clause 5.5.
- 12.1.4 Glass shall be single piece in a panel and increase in glass size compared to the size mentioned in the test report shall not be permitted. Glass shall be fixed with beading, clips/ screws etc. in accordance with test reports.
- 12.1.5 Size of individual glass panels and overall size of the partition shall not exceed the sizes mentioned in the test report.
- 12.1.6 The partition shall cover the full height and length mentioned in the drawing etc and shall be fixed on top and bottom also. In case, the height and length mentioned in the drawing etc are more when compared to the test report, solid type partition or other construction having fire rating (120 minutes for both integrity and insulation) shall be provided as/ approved design so that dimensions of both glazed and solid partition/ other construction do not exceed the dimensions mentioned in the test report.
- 12.1.7 Doors provided in this partition system shall also be fire rated and shall meet the requirements mentioned in relevant causes in this specification.
- 12.1.8 The partition assembly shall be sturdy, rigid, stable and shall be installed plumb in true alignment.

12.2 Finishing

The partition frame shall be finished with minimum 50 microns powder coating in desired colour.

12.3 Fire resistance/ rating

If not mentioned otherwise, glazed fire partitions shall have fire resistance/ fire rating of two hours (120 minutes) for integrity and 20 minutes for insulation.

13.0 HARDWARE

- 13.1 Fire Doors, windows and partitions shall be provided with all required hardware for stability, proper operability and safety ensuring the fire resistance / rating.
- 13.2 All hardware used on Fire doors, windows and partitions shall be fire rated and certified except for hinges, if it is of minimum 100 mm x 75 mm x 3 mm size and in stainless steel of grade 304 and above. Similarly, pull handles may not require specific fire rating if it is in stainless steel of grade SS 304 and above.
- 13.3 All other hardware like locks, panic devices, lever handles, door closers etc. if not tested with the fire door, window or partition shall be type tested and certified for use on those specific fire rated doors, windows and partitions.
- 13.4 Tower/ flush bolts, Aldrops, side bolts and chain with padlocks shall not be provided in Fire doors. However, in case of double shutter/ leaf doors without panic bar, tower/ flush bolts shall be provided on inactive leaf.
- 13.6 Fire doors in exits (component of means of egress which is between the exit access and the exit discharge), doors opening into exits, staircase enclosure, exit access and exit discharge shall be provided with following hardware.

Sr. No	Hardware	Specific requirement
1	Hinges	Hinges shall be as per test report, If not mentioned in the test report, hinges shall be as per Manufacturer's standard practice. No. of hinges : 1. For doors upto 2400 mm height – 04 Nos per leaf 2. For doors above 2400 mm height – as per Manufacturer's practice.
2	Panic Bar	1. For single leaf door : - Single point panic bar "push to open" push bar, single leaf type – 01 No. 2. For active leaf of double leaf door : - Single point panic bar "push to open" push bar type – 01 No. 3. For inactive leaf of double leaf door Openable locks, trims with handle for panic bars to operate the bar from outside shall also be provided.
3	Door closer	Heavy duty type - 01 No. per leaf
4	Door Stopper	Floor mounted, 45 mm dia, half dome in SS 304 grade - 01 No. per leaf
5	Flush/ Tower bolt	Not required for Doors with Panic Bar, in case of double shutter/ leaf doors without panic bar, SS 304 grade, minimum 300mm long concealed tower/ flush bolts shall be provided on inactive leaf at top and bottom.

- 13.7 Internal fire doors which are not in the exits and do not open into the exits shall be provided with following hardware.

Sr. No	Hardware	Specific requirement
1	Hinges	Hinges shall be as per test report, If not mentioned in the test report, hinges shall be as per Manufacturer's standard practice. No. of hinges : 1. For doors upto 2400 mm height – 04 Nos per leaf 2. For doors above 2400 mm height – as per Manufacturer's

		practice.
2	Mortice lock	Heavy duty mortice dead lock and D type (SS 304 grade, minimum length 300mm and 22mm dia) handle on both faces (Offset type handle – For all Glazed fire doors) Note: Instead of door handle with mortice dead lock, SS 304 grade lever handle with mortice sash lock on both faces (Offset type handle – For all Glazed fire doors) may be used.
3	Door closer	Heavy duty type - 01 No. per leaf
4	Door Stopper	Floor mounted, 45 mm dia, half dome in SS 304 grade - 01 No. per leaf
5	Flush/ Tower bolt	SS 304 grade minimum 300mm long concealed flush bolt (in inactive shutter of double shutter Doors) at top and bottom.

14.0 SOLID TYPE FIRE PARTITION (Calcium Silicate)

14.1 Partition assembly

- 14.1.1 The partition assembly shall be made of frame work of galvanized steel or cold rolled low carbon steel sheet profiled horizontal and vertical members, layers of calcium silicate partition boards on both sides and insulation in-fill all as mentioned in the test report in accordance with approved design and pattern. However, increase (when compared to test certificate) in sheet thickness or profile size of steel sections, thickness of insulation, thickness and number of layers of partition) is permitted.
- 14.1.2 The partition assembly including frame, partition boards, insulation, fire & smoke seal etc. shall be in accordance with test report which is appropriate to the required type, size and fire resistance/ rating (with regards to material, design, construction, dimensions, size range etc.) and following specification.
- 14.1.3 Overall size of the partition shall not exceed the sizes mentioned in the test report.
- 14.1.4 Doors and windows provided in this partition system shall also be fire rated and shall meet the requirements mentioned in relevant causes in this specification.
- 14.1.5 The partition framework shall comprise of vertical studs, intermediate horizontal members, floor and ceiling channels as mentioned in test certificates with regards to material, sizes, thickness, spacing etc.
- 14.1.6 Minimum thickness of the calcium silicate boards shall be 12mm.
- 14.1.7 The board's joints shall be staggered, horizontally as well as vertically, to avoid through passage.
- 14.1.8 Minimum thickness of insulation shall be 50 mm. Insulation material, density etc. shall be as mentioned in test certificates.
- 14.1.9 Over all thickness of the partition shall not be less than 93 mm and shall be as mentioned in the as mentioned in test certificates. Increase in the thickness is permitted.
- 14.1.10 If mentioned specifically, this partition system may be used in combination of fire rated glazed partition system with suitable detailing for combining these two partition systems.
- 14.1.11 The partition assembly shall be sturdy, rigid, stable and shall be installed plumb in true alignment.

14.2 Finishing

- 14.2.1 Calcium Silicate partition boards on both sides of the partition frame shall be finished with painting or laminates etc. as specified.
- 14.2.2 If finishing type is not specifically mentioned anywhere, acrylic emulsion paint finish conforming to specification of masonry paint finish in adjoining masonry shall be provided in approved colour.
- 14.2.3 The calcium silicate boards shall be jointed and finished with jointing compound, fibre tape etc. so as to have a flush and even look after finishing.
- 14.2.4 Any cut-out (such as for switchbox, AC duct etc.), gap in the periphery on the partition and joints between structural member and partition shall be properly sealed with fire sealant as mentioned in the test certificates or in accordance with Partition manufacturer's standard practice.

14.3 Fire resistance/ rating

If not mentioned otherwise, solid type partitions shall have fire resistance/ fire rating of two hours (120 minutes) for integrity and insulation.

15.0 SOLID TYPE FIRE PARTITION (Gypsum Plaster Board)

15.1 Partition assembly

- 15.1.1 The partition assembly shall be made of frame work of galvanized steel or cold rolled low carbon steel sheet profiled horizontal and vertical members, layers of fire resistant Gypsum plaster boards on both sides and insulation in-fill all as mentioned in the test report in accordance with approved design and pattern. However, increase (when compared to test certificate) in sheet thickness or profile size of steel sections, thickness of insulation, thickness and number of layers of partition) is permitted.
- 15.1.2 The partition assembly including frame, partition boards, insulation, fire & smoke seal etc. shall be in accordance with test report which is appropriate to the required type, size and fire resistance/ rating (with regards to material, design, construction, dimensions, size range etc.) and following specification.
- 15.1.3 Overall size of the partition shall not exceed the sizes mentioned in the test report.
- 15.1.4 Doors and windows provided in this partition system shall also be fire rated and shall meet the requirements mentioned in relevant causes in this specification.
- 15.1.5 The partition framework shall comprise of vertical studs, intermediate horizontal members, floor and ceiling channels as mentioned in test certificates with regards to material, sizes, thickness, spacing etc.
- 15.1.6 Minimum thickness of the fire resistant Gypsum plaster boards shall be 12.5 mm.
- 15.1.7 The board's joints shall be staggered, horizontally as well as vertically, to avoid through passage.
- 15.1.8 Minimum thickness of insulation shall be 50 mm. Insulation material, density etc. shall be as mentioned in test certificates.
- 15.1.9 Even if insulation in-fill is not mentioned in the test certificate, minimum 50 mm thick insulation of density 48kg/cuM shall be provided in the cavity of the framework.

- 15.1.10 Over all thickness of the partition shall not be less than 102 mm and shall be as mentioned in the as mentioned in test certificates. Increase in the thickness is permitted.
- 15.1.11 If mentioned specifically, this partition system may be used in combination of fire rated glazed partition system with suitable detailing for combining these two partition systems.
- 15.1.12 The partition assembly shall be sturdy, rigid, stable and shall be installed plumb in true alignment.

15.2 Finishing

- 15.2.1 Gypsum plaster boards on both sides shall be sealed with paper tape, corner edges with metal corner tape and with three-layers of all purpose jointing compound to reinforce the board joints so as to have a flush and even look.
- 15.2.2 Gypsum plaster boards on both sides of the partition frame shall be finished with painting or laminates etc. as specified.
- 15.2.2 If finishing type is not specifically mentioned anywhere, acrylic emulsion paint finish conforming to specification of masonry paint finish in adjoining masonry shall be provided in approved colour.
- 15.2.4 Any cut-out (such as for switchbox, AC duct etc.), gap in the periphery on the partition and joints between structural member and partition shall be properly sealed with fire sealant as mentioned in the test certificates or in accordance with Partition manufacturer's standard practice.

15.3 Fire resistance/ rating

If not mentioned otherwise, solid type partitions shall have fire resistance/ fire rating of two hours (120 minutes) for integrity and insulation.

16.0 INSTALLATION

- 16.1 Shop drawings of the Fire doors, windows and partitions in accordance to the prototype/ type test report and design drawings shall be prepared and submitted for approval by the Engineer-In-Charge. The shop drawings shall include all details of construction, anchoring, connections, fastenings etc. The fire doors, windows, partitions shall be fabricated in accordance with the approved shop drawings.
- 16.2 Fire doors, windows, partitions shall be installed by the Manufacturer or agency recommended by the Manufacturer and approved by the Engineer- In-Charge.
- 16.3 Frames shall be installed plumb, level, rigid and in true alignment and shall be fixed to the adjacent construction so as to retain their position and stability. Fixing of the frames with masonry/ concrete may be done with suitable fasteners. The complete assemblies shall also be installed plumb, level, rigid and in true alignment.
- 16.4 The maximum allowable gap between the frame and masonry/ concrete work shall not be more than 5-8 mm and shall be sealed with sealant as mentioned in the test certificates/codes & standards or in accordance with the manufacturer's standard practice if not mentioned in the certificates and codes/ standards.
- 16.5 The door shutters/ leaves, window and partition panels shall be installed and fastened to maintain alignment with frames to achieve maximum operational effectiveness and appearance.

- 16.6 Installation of hardware shall be in accordance with hardware Manufacturer's recommendations.
- 16.7 When the smoke/ fire/ intumescent seals are fitted on site, they shall be fitted strictly in accordance with the Manufacturer's recommendations.

17.0 DELIVERABLES BY THE CONTRACTOR

Following documentation/ drawings shall be furnished by the Manufacturer:

1. Prototype/ type Test Certificate of the door, window and partition assembly from test laboratory/ house.
2. Shop drawings.
3. Specification/ Manufacturer's literature, Test certificates and other documentation for materials and items used in the system.
4. Certificate indicating that design and installation of Doors and hardware as per the test reports submitted.
5. Manufacturer's inspection report
6. Manufacturer's Guarantee.

18.0 GUARANTEE

The door/ window/ partition assembly including all hardware shall be guaranteed for a period of 12 months from the date of installation against any manufacturing defect.

In case of any such defect within the guarantee period, the defected part shall be replaced or repaired as required by the Contractor at his own cost.

19.0 MEASUREMENT

Unless otherwise mentioned, measurement of fire doors, windows and partition shall be as below:

- 19.1 Fire rated doors shall be measured by area of the doors (inclusive of the frame, fixing arrangement, glazing and all fittings).
- 19.2 Fire rated windows shall be measured by area of the windows (inclusive of the frame, fixing arrangement, glazing and all fittings).
- 19.3 Fire rated partition shall be measured by area of the partitions (only one side, inclusive of the frames, partition panels, fixing arrangement, glazing and all fittings. Area of doors, windows and other openings shall be deducted).
- 19.4 Hardware such as door closer, door stopper, locks and trims, panic bar etc., shall be measured in numbers.

एल्यूमीनियम समग्र पैनल (एसीपी)
क्लैडिंग सिस्टम के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR
ALUMINIUM COMPOSITE PANEL
(ACP) CLADDING SYSTEM

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
0	03.03.23	ISSUED AS STANDARD SPECIFICATION	SANDEEP	ANISH MAHALA	SAMIR DAS	SANJAY MAZUMDAR

Abbreviations:

ASTM	:	American Society for Testing and Materials
AAMA	:	American Architectural Manufacturers Association
ACP	:	Aluminium Composite Panel
BS	:	British Standard
BIS	:	Bureau of Indian Standards
EN	:	European Standards
IS	:	Indian Standards
NBC	:	National Building Code of India
PVDF	:	Polyvinylidene Fluoride
RCC	:	Reinforced Cement Concrete
SS	:	Stainless Steel

Architecture Standards Committee

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1.0 GENERAL

This Specification covers requirements of ACP cladding on building facades, building or Architectural or structural elements and as interior or exterior finishing or decorations etc. This specification shall be read in conjunction with project specific job specification.

2.0 REFERENCES

The codes and standards listed below contain provisions which through reference in this specification constitute provisions of this standard specification if not specifically mentioned otherwise.

2.1 In case of similar codes of different organizations such as IS, ISO, BS, EN, BS-EN, ASTM, NFPA, NBC etc. conformity with any of the similar codes is acceptable.

2.2 Reference codes and standards:

Standards	Document title
ASTM E 330	Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
AAMA 501.1	Standard Test Method For Water Penetration Of Windows, Curtain Walls And Doors Using Dynamic Pressure
AAMA 501.4	Recommended static testing method for evaluating curtain wall & storefront systems subjected to seismic & wind induced interstory drift
AAMA 501.2	Quality assurance & Diagnostic Water leakage field check of Installed storefronts, curtain walls , and sloped glazing systems
ASTM E547	Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.
ASTM E283	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E547	Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.
EN 485	Aluminium and aluminium alloys - Sheet, strip and plate - Part 1: Technical conditions for inspection and delivery
EN 13501-1	Fire classification of construction products and building elements - Part 1
IS 1608	Metallic materials - tensile testing at ambient temperature
IS 8402	Methods of Sampling and Test for Pressure Sensitive Adhesive Tapes
IS 17682	Aluminium Composite Panel Specification
ISO 868	Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness)

3.0 MATERIALS

3.1 Aluminium Composite Panel (ACP)

ACP shall be external grade mineral core fire retardant type. The panels shall consist of two outer aluminium alloy skins and mineral filled core in between the skins and shall meet the requirements below:

Property	Specification
Grade of the panel	Grade 3 (external grade mineral core fire retardant ACP) conforming to IS 17682 Or Grade B- s1, d0 conforming to EN- 13501-1
Thickness	Overall thickness – 4 mm (+/- 0.2mm)
Outer skins	0.5 mm thick aluminium alloy sheets of any of the following designations. 1. 3150B with conditions H x 6 or H x 8 conforming to IS 737 2. 3105 with H14/16 conforming to EN485
Mineral core	Minimum 3 mm thick, Non combustible type, comprising of 70% inorganic compound 30% virgin polymer laminated and bonded to outer skins. Density of core – 1.5-1.7 gram/ cubic centimeter
Weight of the panel	Minimum 7.5 Kg per square metre
Tensile strength	Minimum 45 N/ square mm when tested as/ IS 1608 (part 1)
Yield strength	Minimum 38 N/ square mm when tested as/ IS 1608 (part 1)
Elongation %	Minimum 5 when tested as/ IS 1608 (part 1)
Peel strength N/10 mm width	Minimum 6 when tested as/ IS 8402
Coating on front side of aluminium alloy skin	PVDF – Minimum 25 microns Pencil hardness – 2H The coating shall consist of chromate conversion, inhibitive primer and fluoropolymercolour coats in approved colour, texture.
Finishing on backside of aluminium alloy skin	Bare aluminium finish
Peel-off protection	The finished surfaces of ACP shall be factory protected with self adhesive peel-off foil having a thickness of 80 microns.
Profiling of panels	The panels shall be in tray/pan profiles. They shall be adequately reinforced at their back side meeting structural design and deflection criteria.

3.2 Supporting frame work

Materials for supporting framework shall be as tabulated below:

Aluminium sections and profiles	Aluminium profiles shall be of Aluminium (6063 T 5 grade as per EN 485-2). Permissible deflection shall be L/175. They shall be coated with PVDF (minimum 45microns).
Brackets	Mild steel or Aluminium
Screws and fasteners	Stainless steel (SS), 304 grade
Anchor bolts	Stainless steel (SS), 316 grade
Weather sealant	Non bleeding and non staining type having minimum tearing strength of 4.00 N/ mm and shore A hardness of 24 (as/ ISO 868) as approved by the Engineer-In- Charge.
Structural sealant	In accordance with design load as approved by the Engineer-In- Charge.

Other components of the frame work not listed in the table shall be in accordance with the detail design and specification of the system prepared by the Contractor and approved by Engineer- In- Charge.

4.0 DESIGN AND DETAILING OF ACP CLADDING SYSTEM

- 4.1 Design, structural analysis and detailing including preparation of fabrication drawings of the complete system shall be done by the Contractor or agencies engaged by the Contractor subjected to approval by the Engineer- In- Charge.
- 4.2 The design, finished surface (pattern, shape, colour, texture etc.)and detailing shall be in accordance with the drawings, requirements of this specification and other requirements issued by Engineer-In-Charge for the purpose.
- 4.3 ACP cladding system shall comprise of ACP fixed on background (such as masonry, block-work, RCC, steel etc) by means of supporting framework in accordance with approved design and drawings.
- 4.4 Design shall also include structural analysis and design of the supporting frame work in accordance with relevant Indian or International codes as mentioned or as agreed by the Engineer-In-Charge considering stability, durability, water tightness and other design conditions.
- 4.5 Contractor or agency engaged by him shall do and submit all necessary structural analysis, calculations and prepare all detailed fabrication drawings for approval by the Engineer-In-Charge.
- 4.6 The finished surface shall be either with open type grooves or with closed grooves (silicone filled grooves) as mentioned in drawings, item descriptions etc.

If not mentioned specifically, open type grooves shall be provided.

In both the cases grooves shall be in the pattern / design in accordance with approved design and drawing.

5.0 INSTALLATION

- 5.1 Installation of the complete system shall be done by agency approved by the Engineer-In-Charge.
- 5.2 Installation shall be done in accordance with design and drawings approved by the Engineer-In- charge.

- 5.3 The finished surface shall be true to the plane, water-tight. The groove lines of panels shall be uniform and truly aligned in the continuity.
- 5.4 The aluminium profiles of framework shall be fixed to background surface by means of fixing to brackets (fixed to the background surface) with SS bolts and nuts. The brackets shall be with serrations and serrated washers for arresting wind load movement.
- 5.5 Nylon separators shall be provided to prevent bi-metallic contacts in the system.
- 5.6 The panels shall be cut to size and shape, routed, corners notched and bent as required. Aluminium cleats shall be fixed to the backside edges of the panels using aluminium pop rivets. The panels shall be fixed to the framework using SS screws.
- 5.7 The gaps (12 – 16 mm) in between the panels shall be uniform in width.
- 5.8 In case of closed groove system, the gaps between panels shall be filled up with closure profile, backer rod and weather sealant.
- 5.9 Gaps upto 10 mm between the peripheral panels and backing surface shall be sealed by inserting adequate sized backer rod and sealant. Gaps more than 10 mm shall be sealed by providing and fixing of 2 mm thick aluminium sheet (finished with 60-8- micron thick super durable polyester coating) flashing profiled as per site requirement.
- 5.10 The termination of the panels shall be suitably detailed and executed using flashing, bending/ continuing the panels etc. for stopping water ingress.
- 5.11 Necessary weep holes shall be provided in the system for draining out trapped water/ moisture.
- 5.12 After the installation is completed, peel-off foils shall be removed from the panels and the panel surfaces shall be cleaned and washed with mild soap water with soft dry cotton cloth.

6.0 TESTING

The completed ACP system shall be tested for water tightness as per following method.

Testing Method	Document title
ASTM E283	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 330	Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
AAMA 501.1	Standard Test Method For Water Penetration Of Windows, Curtain Walls And Doors Using Dynamic Pressure
AAMA 501.4	Recommended static testing method for evaluating curtain wall & storefront systems subjected to seismic & wind induced interstory drift
AAMA 501.2	Quality assurance & Diagnostic Water leakage field check of Installed storefronts, curtain walls , and sloped glazing systems
ASTM E547	Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential.

In case water penetrations are noticed, necessary rectifications shall be done by the Contractor to stop such water ingress as acceptable to the Engineer- In – Charge.

7.0 DELIVERABLES BY THE CONTRACTOR

With regards to documents and drawings, the Contractor shall furnish following deliverables:

1. Structural analysis and calculations
2. Fabrication or shop drawings
3. Test certificates in support of compliance with the specifications.

8.0 WARRANTY

The complete system including ACP, framework, sealants, fittings and fixtures and all components shall be warranted by the Contractor for a period of 5 years. Any defective work or material found within this period shall be repaired/ replaced/ re-done by the Contractor at his own cost.

मानक विनिर्देशन सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION CIVIL AND STRUCTURAL WORKS

सामान्य परिधि GENERAL SCOPE

6	28.02.2025	REVISED AND REISSUED AS SPECIFICATION	Riya ROA	Vikram VIKRAM	AS	MN
5	04.07.2019	REAFFIRMED AND REISSUED AS SPECIFICATION	AVM	AJS	RS	RKT
4	28.03.2013	REAFFIRMED AND REISSUED AS SPECIFICATION	AJS	RS	PKM	DM
3	26.02.2008	REAFFIRMED AND REISSUED AS SPECIFICATION	PKB	PKM	VK	VC
2	08.06.2001	REAFFIRMED AND REISSUED AS SPECIFICATION	DPN	RPM	SCJ	MI
1	02.03.1994	ISSUED AS STD. SPECIFICATION		HM	GPL	AS
Rev No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

IS : Indian Standards

Structural Standards Committee:

Convenor: Mr. Anurag Sinha

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Mr. Deepak Agrawal
Ms. Alpana Srivastava
Dr. Sudip Paul
Mr. Charanjit Singh (Projects)
Mr. Indrajit Neog (Construction)
Ms. Papia Mandal
Mr. Vikram Kumar Gupta

1. These specifications establish and define the material and constructional requirements for CIVIL and STRUCTURAL WORKS.
2. Methods of measurements are indicated in these specifications; however, if not specified, latest revision of IS 1200 shall be applicable.
3. Providing and operating all necessary measuring and testing devices/ equipments including all materials and consumables are included in the scope of work. No separate measurement or payment for testing the quality of work and materials shall be made; rates quoted for various items shall be deemed to include the cost of such tests which are required to ensure achievement of specified quality.
4. All materials shall be of standard quality, manufactured by renowned concerns conforming to Indian Standards or equivalent, and shall have IS mark as far as possible unless otherwise approved by the Engineer-in-Charge. Wherever Vendor List is attached in the Tender document, the same shall be followed. The Contractor shall get all materials approved by the Engineer-in-Charge prior to procurement and use. The Contractor shall furnish manufacturer's certificates for the materials supplied by him when asked for. Further to that he shall get the materials tested from an approved test house if asked for by the Engineer-in-Charge. The cost for all the tests and test certificates for the material procured by the Contractor shall be borne by the Contractor. No separate payment shall be made for the testing. The Engineer-in-Charge shall have the right to determine whether all or any of the materials are suitable. Any materials procured or brought to site and not conforming to specifications and satisfaction of the Engineer-in-Charge shall be rejected and the Contractor shall have to remove the same immediately from site at his own expense and without any claim for compensation due to such rejection.
5. Wherever referred to in the tender document, only the latest version of BIS Specifications, Codes of Practice, etc. shall be applicable.
6. Wherever the Contractor executes civil and structural works involving buildings, equipment foundations, supporting structures, pipe racks, etc., the following works are deemed to have been included in the quoted rates for various works.
 - Marking of centre lines of foundations etc.
 - Establishing layout and levels of foundations and superstructure etc., including establishment of reference lines, bench marks on various floors, platforms etc.
 - General upkeep of the construction site, till completion of works and handing over.
 - Preparation of BBS.
 - Preparation of Fabrication drawings and getting approval from Engineer-in-Charge after incorporating all the comments.
 - Preparation of "As-Built" scheme of civil-structural drawings indicating constructed details including levels, centre lines, layouts, member sizes, MTO etc. complete.
7. The provisions of Schedule of Rates, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, clarification shall be obtained from the Engineer-in-Charge whose decision shall be final and binding. However, the following procedure may generally be followed:
 - Description of items in schedule of rates shall be followed when provisions therein are different from those in specifications.

- Where the description of item does not call for some specific requirement but the same is given in specifications, the specifications shall be followed in addition to the requirement given in description of item.
- Where drawings call for requirements different from or additional to those given in item description and specifications, the decision of the Engineer-in-Charge shall be obtained as to what shall be followed.
- All relevant General notes and Safety notes shall be followed

मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

सामग्री
MATERIALS

7	13.03.25	UPDATED & REISSUED	MI	AJS	ANURAG SINHA	M. NANDI
6	25.02.21	UPDATED & REISSUED	TK	AJS	AS	S.MAZUMDA R
5	16.05.16	UPDATED & REISSUED	MK	AJS	RS	R.NANDA
4	21.08.14	UPDATED & REISSUED	ASR	AS	PKM	S.CHANDA
3	19.06.09	REAFFIRMED & REISSUED	AS	SCH	VINAY KUMAR	N. DUARI
2	18.02.00	UPDATED & REISSUED	DPN	SKP	SC JAIN	A. SONI
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
						Approved by

Abbreviations:

API	:	American Petroleum Institute
ASTM	:	American Society for Testing & Materials
BIS	:	Bureau of Indian Standards
BS	:	British Standard
C&D Waste	:	Construction and Demolition Waste
DIN	:	Deutsches Institut' für Normung
EC	:	Emulsifiable Concentrate
IS	:	Indian Standards
PCC	:	Plain Cement Concrete
PVC	:	Poly Vinyl Chloride
RA	:	Recycled Aggregates
RCA	:	Recycled Concrete Aggregates
RCC	:	Reinforced Cement Concrete

Structural Standards Committee

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1.0 SCOPE

- 1.1 This specification establishes and defines the requirements of various materials to be used in Civil and Structural works.
- 1.2 Whenever any reference to BIS Codes is made, the same shall be taken as the latest revision (with all amendments issued thereto) as on the date of submission of the bid.
- 1.3 Apart from the BIS Codes mentioned in particular in the various clauses of this specification, all other relevant codes related to specific job under consideration regarding quality, tests, testing and/ or inspection procedures shall be applicable. Reference to some of the Codes in the various clauses of this specification does not limit or restrict the scope of applicability of other referred or relevant codes.
- 1.4 In case of any variation/contradiction between the provision of BIS Codes and this specification, the provision given in this specification shall be followed.
- 1.5 All materials shall be of standard quality and shall be procured from renowned sources/ manufacturers approved by the Engineer-in-Charge. It shall be the responsibility of the Contractor, to get all materials/ manufacturers approved by the Engineer-in-Charge prior to procurement and placement of order.
- 1.6 Whenever called for by the Engineer-in-Charge all tests of the materials as specified by the relevant BIS Codes shall be carried out by the Contractor in an approved laboratory and test reports duly authenticated by the laboratory, shall be submitted to the Engineer-in-Charge for his approval. If so desired by the Engineer-in-Charge, tests shall be conducted in the presence of the Engineer-in-Charge or his authorized nominee.
- 1.7 Quality and acceptability of materials not covered under this specification shall be governed by the relevant BIS Codes. In case BIS code is not available for the particular material, other codes e.g. BS or DIN or API/ ASTM shall be considered. The decision of Engineer-in-Charge, in this regard, shall be final and binding on the Contractor.
- 1.8 Whenever asked for, the Contractor shall submit representative samples of materials to the Engineer-in-Charge for his inspection and approval. Approval of any sample does not necessarily exempt the Contractor from submitting necessary test reports for the approved material, as per the specification/relevant BIS Codes.
- 1.9 The Contractor shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendation on storage, application, workmanship etc. for the intended use. Submission of manufacturer's test reports does not restrict the Engineer-in-Charge from asking fresh test results from an approved laboratory of the actual material supplied from an approved manufacturer/ source at any stage of execution of work.
- 1.10 All costs relating to or arising out of carrying out the tests and submission of test reports and or samples to the Engineer-in-Charge for his approval during the entire tenure of the work shall be borne by the contractor and included in the quoted rates.
- 1.11 Materials for approval shall be separately stored and marked, as directed by the Engineer-in-Charge and shall not be used in the works till these are approved.
- 1.12 All rejected materials shall be immediately removed from the site by the Contractor at his own cost.

2.0 REFERENCES

As mentioned in the respective clauses.

3.0 WATER

- 3.1 Water used in construction for all civil & structural works shall be clean and free from injurious amount of oil, acids, alkalies, organic matters or other harmful substances which may be deleterious to concrete, masonry or steel. The pH value of water sample shall be not less than 6. Potable water shall be considered satisfactory. Underground water can also be used with the prior approval of Engineer-in-Charge, if it meets all the requirements of IS 456.
- 3.2 Tests on water samples shall be carried out in accordance with IS 3025 and they shall fulfill all the guidelines and requirements given in IS 456.
- 3.3 The Engineer-in-Charge may require the Contractor to prove, that the concrete prepared with water, proposed to be used, shall have average 28 days compressive strength not lower than 90% of the strength of concrete prepared with distilled water.
- 3.4 The Engineer-in-Charge may require the Contractor to get the water tested from an approved laboratory before starting the construction work and in case the water contains any oil/ organic matter or an excess of acid, alkalies or any injurious amount of salts etc., beyond the permissible maximum limits given in IS 456, the Engineer-in-Charge may refuse to permit its use. In case the water is supplied by the owner, contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. In case there is any change in source of water, water samples shall be tested again to meet the specified requirements.
- 3.5 Water shall be stored in tin barrels, steel tanks or water-tight reservoirs made with bricks / stone or reinforced concrete. Brick/ stone masonry reservoirs shall have RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand and finished with neat cement punning. These reservoirs shall be of sufficient capacity to meet the water requirement, at any stage of construction.
- 3.6 Water for curing shall be of the same quality as used for concreting and masonry works. Sea water shall not be used for preparation of cement mortar, concrete as well as for curing of plain/reinforced concrete and masonry works. Sea water shall not be used for hydrotesting and checking the leakage of liquid retaining structures also.

4.0 AGGREGATE

4.1 General

- 4.1.1 Coarse and fine aggregates for Civil and Structural Works shall conform in all respects to IS 383 (Specification for coarse and fine aggregate for concrete). Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or a combination thereof or manufactured aggregates produced from other than natural sources. These shall be chemically inert, hard, strong, dense durable, clear and free from veins, adherent coatings, injurious amount of disintegrated pieces, alkalies, free lime, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells etc. Naturally occurring aggregates shall be obtained from an approved source known to produce the same satisfactorily.

Manufactured aggregates shall consist of Iron and Steel slag aggregates, Copper slag aggregates or aggregates made from Construction & Demolition (C&D) waste such as Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA). RA shall comprise of waste from concrete, brick, tiles, stone, etc. and RCA shall be derived from concrete after requisite processing. Extent of utilization of manufactured aggregates in RCC and PCC works shall be as per Table-1 of IS 383.

- 4.1.2 Source and type of aggregates shall be got approved by the Engineer-in-Charge prior to procurement. Change in source and type of aggregates, at later stage, shall not be generally permitted; but under specific circumstances, Engineer-in-Charge can allow a change in source and type of aggregate. Contractor shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit fresh mix design for approval of the Engineer-in-Charge. Any such change, if permitted by the Engineer-in-Charge, shall be without any time and cost implication to the owner.
- 4.1.3 Aggregates which may chemically react with alkalis of cement or might cause corrosion of the reinforcement, shall not be used. If so desired by the Engineer-in-Charge, the Contractor shall carry out alkali reactivity tests and submit the results to him for approval.
- 4.1.4 The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS 2386 - Part II (Methods of Test for aggregates for concrete), shall not exceed the limits defined in IS 383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, the contractor shall submit necessary test results as per IS 383 and IS 2386 to the Engineer-in-Charge prior to his acceptance and approval. The method of Sampling shall be in accordance with the requirements given in IS 2430.
- 4.1.5 Coarse and fine aggregates shall be batched separately. All-in-aggregate shall be used only where specifically permitted by the Engineer-in-Charge.

Separate sieve analysis and grading curves shall be prepared by the Contractor for any/ all batches of coarse and fine aggregates, and submitted to the Engineer-in-Charge, whenever asked for, to ensure conformity with those submitted along with the mix design.

- 4.1.6 Whenever required by Engineer-in-Charge, the aggregates (coarse/ fine) shall be washed and/ or sieved by the contractor before use in the works to obtain clean and graded aggregate at no extra cost to the owner.
- 4.1.7 Aggregates not in conformity with the specifications shall be rejected and the Contractor shall immediately remove them from the site of work.

4.2 Coarse Aggregates

- 4.2.1 Coarse aggregates are the aggregates, which are retained on 4.75 mm BIS Sieve. It shall have a specific gravity not less than 2.6 (saturated surface dry basis).

The grading of the aggregates shall be as per IS 383 or as required by the mix design, to obtain densest possible concrete. For this purpose, the contractor shall submit to the Engineer-in-Charge at least three sets of mix design and test results, each with different gradings of coarse aggregates, proposed to be used. The Engineer-in-Charge may allow "All-in-aggregates" to be used provided they satisfy the requirements of IS 383.

- 4.2.2 Coarse aggregates may be obtained from
- Uncrushed gravel or stone which results from natural disintegration of rock
 - Crushed gravel or stone which results from crushing of gravel or hard stone
 - Partially crushed gravel or stone which results from blending of (a) and (b) above
 - Manufactured from other than natural sources, by processing materials, using thermal or other processes such as separation, washing, crushing and scrubbing. Manufactured coarse

aggregate may be RCA or RA processed from C&D waste and may be supplied as single sized or graded.

4.3 Fine Aggregates

4.3.1 Fine aggregates are the aggregates which pass through 4.75 mm BIS sieve but not more than ten percent (10%) pass through 150 micron BIS sieve. These shall comply with the requirements of grading zones I, II and III of IS 383. Fine aggregates conforming to grade zone IV shall not be used for reinforced concrete works.

Sand from sea shores, creeks or river banks affected by tides, shall not be used for filling or concrete works.

4.3.2 Fine aggregates shall consist of

- a) Natural Sand : Fine aggregate resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies. This may also be called as uncrushed sand.
- b) Crushed Sand –
 - i) Crushed Stone Sand : Fine aggregate produced by crushing hard stone
 - ii) Crushed Gravel Sand : Fine aggregate produced by crushing natural gravel
- c) Mixed Sand : Fine aggregate produced by blending natural sand and crushed stone sand or crushed gravel sand in suitable proportions.
- d) Manufactured Fine Aggregate : Fine aggregate manufactured from other than natural sources, by processing materials, using thermal or other processes such as separation, washing, crushing and scrubbing. Manufactured fine aggregate may be RCA processed from C&D waste.

4.4 Sampling and Testing

The Contractor shall carry out all tests including mix designs of concrete, at his own expense, at the start of work as well as during any stage of construction as required by the Engineer-in-Charge. Test shall be carried out in accordance with IS 516 - Methods of test for strength of concrete and IS 2386 - Methods of test for aggregates for concrete. Testing shall be carried out from laboratories approved by the Engineer-in-Charge. The method of sampling shall be in accordance with the requirements given in IS 2430.

4.5 Storage of Aggregates

4.5.1 Storage of all types of aggregates at site of work shall be at contractor's expense and risk and shall be stored as specified in IS 4082. Aggregates shall in no case be stored near to the excavated earth or directly over ground surface.

4.5.2 The Contractor shall maintain sufficient quantities of aggregates, near to the place of work, required for the continuity of the work. Each type and grade of aggregate shall be stored separately on hard, firm surface having adequate slope for drainage of water.

4.5.3 Aggregates delivered at site in wet condition or becoming wet due to rain or any other means, shall not be used for atleast 24 hours. The Contractor shall obtain prior approval of the Engineer-in-charge for the use of such aggregates and shall adjust the water content in accordance with IS 2386 to achieve the desired mix. In the absence of test results, and to allow variation in mass of aggregates and water content on account of moisture content, the

Contractor can make suitable adjustment in the masses as per IS 456, for preparation of nominal mix concrete only.

5.0 SAND

5.1 Sand for Masonry Mortars

5.1.1 The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS 2116.

5.1.2 The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.

5.1.3 Unless found satisfactory as a result of further tests as may be specified by the Engineer-in-Charge, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine silt, fine dust and organic impurities in the sand, when tested in accordance with IS 2386, shall not be more than 5% by mass in natural sand, or crushed gravel sand or crushed stone sand. For organic impurities, when determined in accordance with IS 2386, colour of the liquid shall be lighter than that indicated by the standard solution specified in IS 2386.

5.1.4 Grading of Sand

The particle size grading of sand for use in mortars shall be within the limits as specified below:

GRADING OF SAND FOR USE IN MASONRY MORTARS

IS SIEVE DESIGNATION IS 460 (PART I)	PERCENTAGE PASSING BY MASS	REF. TO METHOD OF
4.75 mm	100	IS 2386 (Part I)
2.36 mm	90 to 100	
1.18 mm	70 to 100	
600 micron	40 to 100	
300 micron	5 to 70	
150 micron	0 to 15	

In case of a sand whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles, this shall be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable sizes of natural sand particles or crushed stone screenings which are by themselves unsuitable. Based on test results and in the light of practical experience with the use of local materials, deviation in grading of sand may be considered by the Engineer-in-Charge. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

5.1.5 Sampling and Testing

The method of sampling shall be in accordance with IS 2430. The amount of material required for each test shall be as specified in relevant parts of IS 2386. Any test which the engineer-in-charge may require in connection with this, shall be carried out in accordance with the relevant parts of IS 2386.

If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) may be made in accordance with IS 2250 using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

5.2 Sand for Filling

Sand for filling shall meet the requirements of IS 383 and shall be natural sand, hard, strong, free from any organic and deleterious materials. Any sand proposed for filling, shall be used only after it is approved by the Engineer-in-Charge. Sand obtained from sea shores, creeks or river banks affected by tides, shall not be used for filling. Fine aggregates suitable for concreting works shall be suitable for filling also. No sand below grading zone-III as per IS 383 shall be allowed for filling.

6.0 CEMENT

Cement to be used for civil and structural works shall be one of the following. Specific requirement for the type of cement to be used shall be as shown in the drawings or as specified in the contract or as directed by the Engineer-in-Charge.

- Specification for 33/43/53 grade ordinary portland cement IS 269
- Specification for portland slag cement IS 455
- Specification for Portland pozzolana cement (fly ash based) IS 1489 Pt.1
- Specification for Portland pozzolana cement (calcined clay based) IS 1489 Pt.2
- Specification for Masonry Cement IS 3466
- Specification for high alumina cement for structural use IS 6452
- Specification for rapid hardening portland cement IS 8041
- Specification for Sulphate Resisting Portland cement IS 12330

6.1 Storage at Site

6.1.1 The storage of cement (lifted from the Owner's godown or procured by the Contractor himself) at the site of work shall be at contractor's expense and risk and shall meet the requirements of IS 4082. The cement shall be stored above ground in a suitable weather tight building or godown and in such a manner as to permit easy access for proper inspection and also to prevent deterioration due to moisture. In the event of any damage occurring to the quality of cement due to faulty storage or on account of negligence on the part of the contractor, such damages shall be borne by the contractor himself.

6.1.2 All approved cement shall be arranged in batches with type, brand and date of receipt flagged on them. A maximum of eight bags shall be stacked one over the other. Cement bags shall be used in the same order as received from the manufacturer/ owner. The contractor shall maintain a register, on day-to-day basis, giving the details of the receipt/ consumption, source of supply and type of cement etc. The register shall always be accessible to the Engineer-in-Charge for verification.

6.2 Tests after Delivery

Each consignment of cement supplied by Owner or contractor, shall, after delivery at site and at the discretion of the Engineer-in-Charge, be subjected to any or all of the tests and analyses, required by the relevant Indian Standard Codes. In case the cement is supplied by the owner, the contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. The contractor shall carry out and bear the cost of all tests and

analyses required to ensure quality of cement before using in actual works, irrespective of the fact whether the cement is supplied by the Owner or procured by him.

6.3 Rejection

The Engineer-in-Charge may reject at his discretion any cement, notwithstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of cement. He may similarly reject any cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or any other cause. Any cement which is considered defective, shall not be used and shall be promptly removed from the site by the contractor.

7.0 STEEL

7.1 General

All steel bars, sections, plates, and other miscellaneous steel materials, etc shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing etc, for all materials covered under this section, shall conform to respective BIS Codes. Steel sections shall be conforming to IS 808 or IS 12778.

7.2 Reinforcement Bars

Reinforcement bars, to be used for civil and structural works shall be one of the following or in combination thereof.

- Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement IS 432
- Specification for hard drawn steel wire fabric for concrete reinforcement IS 1566
- Specification for plain hard-drawn steel wire for prestressed concrete. IS 1785
- Specification for High strength deformed steel bars and wires for concrete reinforcement. IS 1786
- Specification for indented wire for prestressed concrete. IS 6003
- Specification for fusion bonded epoxy coated reinforcing bars IS 13620

7.3 Structural Steel

Structural steel to be used for general structural purposes shall be one of the following or in combination thereof.

Structural steel sections shall conform to following BIS Codes:

- Steel tubes for structural purposes. IS 1161
- Mild Steel Tubes, tubulars and other wrought steel fittings. IS 1239
- Steel for general structural purposes (Grade A/BR/B0). IS 2062
- Hollow steel sections for structural use. IS 4923

7.4 Miscellaneous Steel Materials

Miscellaneous steel materials shall be conforming to the following BIS Codes.

- Expanded Metal Steel Sheets for General purposes. IS 412
- Mild steel bars of anchor bolts, rungs, metal inserts, grating etc.) IS 2062
- Hexagonal head bolts, screws & nuts of product grade C. IS 1363

- Cold formed light gauge structural steel sections. IS 811
- Technical supply conditions for threaded steel fasteners. IS 1367
- Plain washers IS 2016
- Steel wire ropes for general engineering purposes IS 2266
- Thimbles for wire ropes. IS 2315
- Bulldog grips. IS 2361
- Mild Steel Tubes, tubulars and other wrought steel fillings. IS 1239
(For Hand rail tubular sections).
- Drop forged sockets for wire ropes for general engineering purposes. IS 2485
- Steel chequered plates. IS 3502
- Hexagonal bolts and nuts (M42 to M150). IS 3138
- High Strength Structural Bolts IS 3757
- High Strength Bolts IS 4000

7.4.1 Anchor Bolts

Material for Anchor Bolts such as MS bars, washers, nuts, pipe sleeves and plates etc. shall be as per relevant BIS Codes mentioned above.

7.5 Storage

The storage of all materials at site of work shall be at the contractor's expense and risk and shall be done as per the requirements given in IS 4082. The contractor shall maintain the proper records of receipt/consumption. The records shall always be accessible to the Engineer-in-Charge for verification.

The reinforcement bars, structural steel sections and other miscellaneous steel materials etc, shall be stored in such a way as to avoid and prevent deterioration, corrosion, bending, twisting and wrapping. In case of any damage occurring to the material on account of faulty storage or negligence by the contractor, same shall be borne by the contractor himself.

7.6 Tests after Delivery

Materials supplied by the Owner or Contractor, shall, after delivery at site and at the discretion of Engineer-in-Charge, be subjected to any or all of the tests, required by the relevant BIS Codes. The Contractor shall carry out and bear the cost of such tests irrespective of the fact whether the material is procured by the Owner or the contractor. In case steel is supplied by the Owner, the Contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense.

7.7 Rejection

The Engineer-in-charge may reject at his discretion any material, notwithstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of materials. He may similarly reject any material, which has deteriorated or corroded etc., due to improper storage, handling or transport. Defective materials shall not be used and removed from the site by the contractor at his own expense.

8.0 BRICK

8.1 General

All Bricks used for masonry works shall conform to the requirements of following BIS Codes:

- Common Burnt Clay Bricks- Specifications IS 1077

- Pulverized Fuel Ash Cement Bricks- Specifications IS 16720
- Pulverized Fuel Lime Ash Bricks- Specifications IS 12894
- Burnt Clay Fly Ash Bricks- Specifications IS 13757

8.1.1 Common Burnt Clay Bricks

Bricks for masonry works shall conform to IS 1077 - Specification for common burnt clay building bricks and shall be of class 5.0 (with minimum compressive strength of 5.0 N/mm²). Specific requirement for any other class of bricks shall be as shown in drawings or as described in the contract for a particular site or type of work. Physical requirements, quality, dimensions, tolerances etc. of common burnt clay building bricks shall conform to the requirements of IS 1077.

Bricks shall be hand - moulded or machine moulded and shall be made from suitable soils. The bricks shall have smooth rectangular faces with sharp corners and shall be well burnt, sound, hard, tough and uniform in colour. These shall be free from cracks, chips, flaws, stone or humps of any kind.

8.1.2 Pulverized Fuel Ash Cement Bricks

Pulverized fuel ash-cement bricks shall conform to IS 16720. The bricks shall be sound, free from visible cracks and uniform in shape and colour. The brick shall have total pulverized fuel ash content not less than 35 percent of the mass of bricks. Pulverized fuel ash shall conform to IS 3812 (Part 1) or IS 3812 (Part 2).

8.1.3 Fly Ash Lime Bricks (FALG Bricks)

The Fly Ash Lime Bricks (FALG Bricks) shall conform to IS 12894. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. Fly ash shall conform to IS 3812.

8.1.4 Burnt Clay Fly Ash Bricks

The burnt clay fly ash bricks shall conform to IS 13757. The bricks shall be sound, compact and uniform in shape and colour. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter, the bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides. If made by extrusion process may not be provided with frogs. Fly Ash shall conform to grade I or grade II of IS 3812.

8.1.5 Mechanized Autoclave Fly Ash Lime Brick

These bricks shall be machine moulded and prepared in plant by appropriate proportion of fly ash and lime. The autoclave fly ash bricks shall conform to IS 12894. Visually, the bricks shall be sound, compact and uniform shape, free from visible cracks, warpage and organic matters. The brick shall be solid with or without frog, and of 100/80 mm in length, 40 mm width and 10 to 20 mm deep one of its flat side as per IS 12894. The brick shall have smooth rectangular faces with sharp corners and shall be uniform in shape and colour. Fly ash shall conform to IS 3812 and lime shall conform to class 'C' hydrated lime of IS 712.

8.2 Tests after Delivery

The Contractor shall take samples of each type of brick as directed by the Engineer-in-Charge as per the requirements of IS 5454 and tests shall be carried out as per IS 3495. The cost for carrying out any or all the tests, shall be borne by the Contractor. The bricks, when tested, as

per IS 3495 shall have a minimum average compressive strength, as given in the Code, for a particular class of brick. Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24 hours.

Brick samples so approved, shall be deposited with the Engineer-in-Charge. All subsequent deliveries shall be upto the standards of the approved samples.

8.3 Stacking of Bricks

Bricks shall be stored at site as per the requirements given in IS 4082 and shall not be dumped at site. They shall be unloaded from trucks to a place on a levelled surface near to the work site. They shall be stacked in regular tiers even as they are unloaded, to minimise breakages and defacement of bricks. The supply of bricks shall be so arranged that as far as possible, at least two days' requirements of bricks are available at site at any time. Bricks, of different class & types, shall be stacked separately.

8.4 Local Bricks/ Class 3.5 Bricks.

Where shown on drawings, locally available bricks of non modular size (230 mm x 110 mm x 70 mm) in place of bricks of modular size (190 mm x 90 mm x 90 mm) can be used in case the bricks satisfy the other requirements of respective BIS codes. Minimum compressive strength of these bricks shall not be less than 3.5 N/mm².

8.5 Concrete Block Masonry

Concrete Block Masonry shall be as per EIL Specification No. 6-68-0016.

9.0 STONE

9.1 General

All Stones used for masonry works shall conform to the requirements of following BIS Codes.

- Method of identification of natural building stones. IS 1123
- Recommendations for dimensions and workmanship of natural building stones for masonry work. IS 1127
- Recommendations for dressing of natural building stones. IS 1129

9.2 Quality of Stones

Stones shall be of approved quality, hard, dense, strong, sound, durable, clean and uniform in colour. They shall also be free from veins, adherent coatings, injurious amount of alkalis, vegetable matters and other deleterious substances such as iron pyrites, coal, lignite, mica, sea shells etc. Unless otherwise approved, stones from one single quarry shall be used for any one work. The strength of stones should be adequate to carry the imposed load and shall meet all the requirements of IS 1905, taking into account the appropriate crushing strength of stone and type of the mortar used. The percentage of water absorption, when tested in accordance with IS 1124, shall not exceed 5 percent.

Stones normally used, shall be small enough to be lifted and placed by hand. The length of the stone shall not exceed 3 times the height. Width of stone on base shall not be less than 150 mm and in no case exceed 3/4th thickness of the wall. Height of the stone shall not be more than 300 mm.

9.3 Unloading/Stacking

The stones shall be unloaded from the trucks to a site near to the place of work as defined in IS 4082 and shall be stacked on a firm ground having adequate slope for drainage. The supply of stones shall be so arranged that as far as possible, at least two days' requirements of stone are available at site at any time.

10.0 ADMIXTURES

10.1 General Requirements for Admixtures

10.1.1 All concrete admixtures shall in general comply with the following BIS Codes unless otherwise stipulated in this specification.

- Specification for integral cement water proofing compounds. IS 2645
- Specification for other admixtures for concrete. IS 9103

10.1.2 Generally, admixtures shall have ISI certification marks. However, even in case of BIS certified admixtures, Engineer-in-Charge may require the Contractor to carry out and submit any or all the tests (as specified in relevant BIS Codes), from BIS approved laboratories, over and above the manufacturer's test certificate, before giving his final approval.

In case, admixtures certified by BIS are not available, the contractor shall submit to the Engineer-in-Charge the type and/or proprietary brand of the admixture from only reputed manufacturers along with necessary test certificates from BIS recognized/ BIS approved laboratories or any other document directed by Engineer-in-Charge for the latter's final approval. In such cases, names of at least two manufacturers shall be submitted to the Engineer-in-Charge for his selection. In case, both the names are rejected, the contractor shall submit a fresh list of two manufacturers for approval by the Engineer-in-Charge.

The Engineer-in-Charge may direct the contractor to submit test results as required by IS 2645 or IS 9103 for any admixture proposed to be used in the concrete in any approved laboratory at his discretion at any stage of the work. The cost of any/all tests required to satisfy compliance with this specification shall be borne by the Contractor.

In case of non-availability of any BIS code for testing and acceptability criteria, relevant American, British or German Code shall be applicable.

10.1.3 Prior approval of the Engineer-in-Charge shall be obtained while using water reducing admixtures in the concrete (PCC/ RCC) or mortar. Other type of admixtures such as accelerating admixtures, retarding admixtures or air entraining admixtures, shall not be used unless specified on the design drawings or prior approval taken from the design approving authority. Once approved, utmost care shall be exercised at site by the Contractor to maintain the consistency in the quality of admixture and the concrete/ mortar so produced.

10.1.4 The suitability and effectiveness of any admixture shall be verified by trial with the designed concrete mixes using cement, aggregates together with any other materials to be actually used in the works as per the direction of Engineer-in-Charge. If two or more admixtures are to be used simultaneously in the same concrete mix, the Contractor must submit necessary test results from an approved laboratory to show their interaction and compatibility. Any/all tests specified in BIS Codes shall be carried out only with the type of material and mix design, to be actually used in the work site.

10.1.5 No admixture shall impair the durability of the concrete nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of reinforcement. Use of admixtures shall not reduce the dry density of concrete. Once the proportion of admixture has

been established, strict check shall be maintained not to alter the proportions of ingredients and water-cement ratio of the Design Mix during execution.

10.1.6 The chloride contents in admixtures shall not exceed 2% by mass of the admixture or 0.03% by mass of the cement.

10.1.7 Admixtures which do not meet the requirements stipulated in this specification shall be rejected and shall not be used.

10.2 Water Proofing Compounds

10.2.1 Water proofing compounds shall be mixed with cement only.

10.2.2 The permeability of the specimen with the admixture shall be less than half of the permeability with similar specimen without the use of these compounds. These compounds shall be used in such proportion as recommended by manufacturer but in no case it shall exceed 3% by weight of cement.

10.2.3 The initial setting time of the cement with the use of these compounds shall not be less than 30 minutes and final setting time shall not be more than 10 hours. Test shall be carried out in accordance with IS 4031.

10.2.4 Compressive strength of specimen at 3 days shall not be less than 160 kg/sq.cm nor 80% of the 3 days compressive strength of mortar cubes prepared with same cement and sand only, whichever is higher. Similarly compressive strength at 7 days shall not be less than 220 kg/sq.cm nor less than 80% of the 7 days compressive strength prepared with the same cement and sand only, whichever is higher. The test to determine the compressive strength shall conform to IS 4031.

10.3 Concrete Penetrating Corrosion Inhibiting Admixture shall be as per EIL Specification No. 6-68-0017.

11.0 WATER BARS (WATER STOPS)

11.1 PVC water bars shall be used in reinforced concrete construction of liquid retaining structures or any other structure to safeguard them from hydrostatic pressure and water leakage and any relative movement between two parts of the structure due to thermal loading shrinkage or differential movement of foundations. Wherever desired or shown in the drawings, they shall be used at expansion/contraction/construction joints. These shall be pre-formed and shall provide a permanent water tight seal along the entire joint in the poured concrete structures. These shall also be flexible enough to withstand deflection/displacements at joints arising due to variation of temperatures or settlement of foundations. The minimum thickness of water bar shall be as shown on drawings or described in the schedule of rates and unless otherwise mentioned, these shall be able to withstand a water head of at least 12 meters.

11.2 Performance requirements of PVC water bars shall meet the requirements of IS 12200. These shall be of approved make and of ribbed/ serrated/ plane type with a bulb at the centre. The thickness and width of water bars shall be as per schedule of rates/ drawings but in no case the thickness shall be less than 5 mm and width less than 150 mm. The joining of the water bars shall be carried out by vulcanising strictly as per the manufacturer's specifications. Lapped joints shall not be allowed under any circumstances.

12.0 BITUMEN/BITUMINOUS MATERIALS

Bitumen to be used for various types of work shall meet all the requirements of relevant BIS Codes as given below:

- Specification of Paving Bitumen IS 73
- Specification for bitumen mastic for flooring IS 1195
- Specification for Bitumen felts for water proofing and damp proofing IS 1322
- Specification for Bituminous compounds for water proofing and caulking purposes IS 1834
- Specification for preformed fillers for expansion joint in concrete pavements and structures IS 1838
- Specification for bitumen mastic for use in water proofing of roofs IS 3037
- Specification for bitumen primer for use in water proofing and damp proofing IS 3384
- Specification for Bitumen Mastic for Tanking and Damp proofing IS 5871
- Specification for Glass fibre base coal tar pitch & bitumen felts IS 7193
- Code of practice for damp proofing using bitumen mastic IS 7198
- Specification for bitumen Mastic, Anti-Static and electrically conducting grade IS 8374

The type and grade shall be as shown on the drawings or as indicated in schedule of quantities or as directed by Engineer-in-Charge. Tests and acceptable criteria shall be as per relevant BIS Codes.

13.0 PVC PIPES

PVC Pipes shall conform to the requirements of IS 4985.

14.0 WOOD/ TIMBER

14.1 Wood recommended for platforms of cold vessels or below cold vessels/ exchangers shall be hard and shall be of group A, grade I, and shall have safe permissible stress of 7 N/mm² in compression, perpendicular to grains on outside location as per IS 883. General characteristics like durability, treatability etc. shall conform to IS 883 and IS 3629.

14.2 Timber required to be used for formwork shall be fairly dry before use. It should maintain its shape during the use and even when it comes into contact with moisture from the concrete. Storage of Wood/Timber shall be as per the requirements of IS 4082.

For proper identification and selection of suitable timber for formwork, following codes shall be referred.

- Classification of commercial timbers and their zonal distribution IS 399
- Specification for ballies for general purposes. IS 3337
- Specification for Ply wood for concrete shuttering work. IS 4990

15.0 EPOXY COMPOUNDS

Refer EIL Specification No. 6-68-0056.

16.0 PAINT

16.1 Refer EIL Specification No. 6-79-0020 or the job specification whichever applicable.

17.0 ANTITERMITE COMPOUNDS

17.1 Following chemicals as per IS 6313 (Part 2 & 3) shall be used for treatment of soil for protection of buildings against attack by subterranean termites:

S.No.	Chemical	Relevant Standard	Dosage* (Chemical Emulsion)
1	Chlorpyrifos 20% Emulsifiable Concentrate (EC)	IS 8944	250ml in 5 litre water 50ml in 1 litre water
2	Imidacloprid 30.5% Suspension Concentrate (SC)	IS 16131	10.5ml in 5 litre water 2.1ml in 1 litre water
3	Bifenthrin 2.5% Emulsifiable Concentrate (EC)	IS 15936	100ml in 5 litre water 20ml in 1 litre water

(*Dosage as specified above or as per Manufacturer's recommendation, whichever is stringent)

18.0 POLYSULPHIDE SEALANTS

Polysulphide Sealants shall conform to IS 12118 and be of approved make. Test conditions and requirements shall be as given in the above referred BIS code.

मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य
STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

मिट्टी का कार्य

EARTHWORK

6	18.03.21	REVISED & REISSUED	TK	AJS	AS	SM
5	21.08.14	REVISED & REISSUED	AJS	AS	PKM	SC
4	19.06.09	REVISED & REISSUED	AS	SCH	VINAY KUMAR	N. DUARI
3	22.01.02	UPDATED & REISSUED	R SOOD	R SOOD	H MATHUR	GRR
2	AUG'94	UPDATED & REISSUED	-	H MATHUR	GP LAHIRI	A. SONI
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
						Approved by

Abbreviations:

CNS : Cohesive Non Swelling

Structural Standards Committee

Convenor : Mr. Anurag Sinha

Members: Mr. C Damodaran
Mr. V.K.Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjit Singh (Projects)
Mr. Ravindra Kumar (Constn.)

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1.0 SCOPE

This specification deals with earth work in excavation and filling.

2.0 CLASSIFICATION OF SOIL

2.1 Ordinary Soil

2.1.1 Soft Soil/ Loose Soil

Generally any soil which yields to the ordinary application of pick and shovel, or to phawra, rake or other ordinary digging implements such as:

- Sand, gravel, loam, clay, mud, black cotton soil
- Vegetables or organic soil, turf, peats, soft shale or loose murrum
- Mud concrete below ground level
- Any mixture of soil mentioned above.

2.1.2 Hard/ Dense Soil

Generally any soil, which requires close application of picks or jumpers or scarifier and rippers to loosen the same, such as:

- Stiff heavy clay, hard shale or compact murrum requiring grafting tool and/ or pick and shovel
- Shingle and river or nallah bed boulders
- Soling of roads, paths etc. and hard core
- Macadam surface of any description (water bound, grouted tarmac etc.)
- Lime concrete, stone masonry in lime or cement mortar below ground level
- Soft conglomerate when the stone can be detached from the matrix with picks and shovels

2.2 Soft Rock

This is fissured/ disintegrated rocky strata, boulders (volume more than 0.028 m^3 and less than 0.400 m^3) and also which cannot be quarried/ excavated by using above manual tools but can be quarried/ excavated manually by using crow bars is classified as soft rock. Soft rock shall include all kinds of stiff and stratified rock, such as shales, thinly bedded phillites, laterite hard conglomerate, lime stone, sand stone and unreinforced cement concrete below ground level. Soft rock may be quarried or split with crow bar or picks and can also be excavated by rippers, dozers and other mechanical equipment, but without the aid of blasting. If required and permitted, light blasting may be resorted to, for loosening the materials, but this will not, in any way entitle the material to be classified as "Hard Rock".

2.3 Hard Rock

2.3.1 Hard Rock (Not Requiring Blasting)

This shall include all types of hard and compact rock, having closely spaced fissures or joints, on account of which blasting is not considered necessary and shall not be resorted unless permitted by the Engineer-in charge.

2.3.2 Hard Rock (Requiring General Blasting)

This shall include all types of hard and compact rock occurring in unfissured masses or similar foundations, boulders (volume more than 0.4 m^3) for excavation in which blasting is

considered necessary such as quartzite, granite, basalt stones, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.

2.3.3 Hard Rock (Requiring Controlled Blasting (Explosive/ Non-explosive))

This type of excavation becomes necessary when excavation is done in formations, mentioned in Clause 2.3.2, in the vicinity of existing foundations/ structures. Mode of blasting shall be decided by Engineer-in-Charge, keeping in view the sensitivity of structures.

2.3.4 Hard Rock (Blasting Prohibited)

Hard rock requiring blasting as described in clause 2.3.2 above, but where blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging, pneumatic/ hydraulic/ electro-mechanical breaking by using splitter or by chemical means or any other agreed method.

The use of excavation shall not be considered as a reason for classification under hard rock requiring blasting unless clearly found necessary in the opinion of Engineer-in-Charge.

3.0 BACKFILLING MATERIAL

3.1 Suitable Materials:

3.1.1 Back filling suitable material shall be approved by the Engineer-in-charge. Additionally, they shall be free from refuse, large stones or rocks or other material which might prevent proper compaction or cause the compacted fill or embankment to perform inadequately or to have insufficient stability or bearing capacity for the superimposed loads to which it is likely to be subjected.

3.1.2 Back filling of excavation in trenches, foundations and elsewhere shall consist of one of the following materials as shown on drawing, or directed by the Engineer-in-charge.

- i) Soil
- ii) Selected earth from heaps or brought from borrow areas.

In case i) or ii) are not available, the Engineer-in-charge may approve use of any of the following:

- iii) Stone/ Gravel
- iv) Sand
- v) CNS material.

3.1.3 The material shall be free from refuse, debris, roots, hard lumps and any other foreign organic material.

3.2 Unsuitable Materials

Unsuitable material shall include particles in excess of 75 mm size and that which is:

- a) Organic material, logs, stumps and perishable materials.
- b) Material susceptible to spontaneous combustion
- c) Materials with undefined properties
- d) Materials having a moisture content greater than the maximum specified
- e) Building rubble and domestic and industrial wastes
- f) Soils and rock susceptible to deterioration/ change of their properties.