Abbreviations:

AFC	:	Approved for Construction
BIS	:	Bureau of Indian Standards
DIN	:	Deutsches Institut für Normung (German Institute for Standardization)
EN	:	European Standards
IS	:	Indian Standard
ISO	:	International Organization for Standardization
MS	:	Mild Steel
PCC	:	Plain Cement Concrete
RCC	:	Reinforced Cement Concrete

Structural Standards Committee

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1.0 GENERAL

1.1 All materials supplied by the Contractor shall conform to specifications given in EIL Standard Specification No. 6-68-0002.

1.2 The Contractor shall furnish test certificates for all materials prior to their use in the works. Structural steel materials not supported by mill test certificates may be used after confirming their quality by carrying out appropriate tests in accordance with the method specified in IS:1608.

1.3 Other requirements not covered under this specification shall be in accordance with EIL Standard Specification No. 6-68-0006.

2.0 REFERENCES

As mentioned in the respective clauses.

3.0 MATERIAL

As mentioned in the respective clauses.

4.0 ANCHOR BOLTS

4.1 Material

Materials for anchor bolts, nuts, locknuts, washers, pipe sleeves and anchor plates shall conform to their respective clauses given in EIL Standard Specification No. 6-68-0002.

4.2 Fabrication

Fabrication of anchor bolts and their complete assemblies shall be strictly in compliance with the specifications and drawings/standards.

4.3 Placement

Anchor bolt assemblies shall be placed in position strictly as per drawings and securely held during pouring and vibrating of concrete with necessary templates and other dummy structures to prevent their dislocation.

4.4 Tolerances

Tolerances allowed for anchor bolts positioning shall be as below:

a) For sleeved bolts, one tenth of the bolt nominal diameter.
b) For bolts without sleeves, one twentieth of the bolt nominal diameter.

4.5 Protection

The exposed surfaces of bolts shall be properly covered (after greasing of bolts and packing of sleeves) with jute cloth so as to protect them from damage till final erection of structure/ equipment is over.

4.6 Payment

4.6.1 Payment shall be made on the basis of actual weight in metric tons of the anchor bolt/anchor bolt assembly. The rate shall include supply (as per scope of supply conditions given in the tender) of all materials, handling, transporting, fabrication, turning from available size to

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required diameter, threading, welding, fixing in position at all levels and locations, providing necessary templates, greasing, packing of sleeves, covering with jute cloth and other protective measures etc. all complete.

4.6.2 The rate shall cover bolt of any diameter and nomenclature.

4.6.3 Payment for fixing anchor bolt assembly (already fabricated and supplied by the Owner as free issue) in position shall be made on the basis of actual weight of anchor bolts/bolt assemblies in metric tons. The rate shall include handling, transporting, fixing in position at all levels and locations, welding if required, providing necessary templates, greasing, packing of sleeves, covering with jute cloth and other protective measures etc. all complete.

4.6.4 No separate payment shall be made for templates, dummy structures, supports etc. and the rate quoted shall be inclusive of all cost related to such provision required for correct and accurate installation of anchor bolts/anchor bolt assembly.

5.0 METAL INSERTS

5.1 Material

Materials required for fabricating metal inserts shall conform to their respective specification given in EIL Standard Specification No. 6-68-0002.

5.2 Fabrication

Fabrication of inserts shall be done strictly as per drawings/standards and in compliance with the requirements given in EIL Standard Specification No. 6-68-0006.

5.3 Placement

Metal inserts shall be correctly embedded (in plain concrete/ reinforced concrete) as per their location shown on the drawings. Care shall be taken that these are securely held in position and do not get disturbed during concreting. Where necessary, these may be welded to the reinforcement bars. Suitable templates, spacers, dummy structures and temporary staging shall be provided. Necessary cutting in the formwork and adjustment of reinforcement bars shall be done for the placement of metal inserts where required.

5.4 Painting

The exposed surfaces of metal inserts shall be cleaned and given one coat of primer as per EIL Standard Specification No. 6-79-0020 or job specification (wherever applicable), as specified, after fabrication.

5.5 Payment

Payment shall be made on the basis of actual weight in metric tons of the metal inserts. The rate shall include supply (as per supply conditions given in the tender) of all materials, handling, transporting, fabrication, welding, fixing in position at all levels and locations, providing necessary templates, spacers, dummy structures, adjusting the formwork and reinforcement, staging, preparation of surface for painting, applying one coat of primer as per EIL Standard Specification No. 6-79-0020 or job specification (wherever applicable), as specified, etc. all complete.

6.0 CHEQUERED PLATES

6.1 Material

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Material required for chequered plates shall conform to the specifications given in EIL Standard Specification No. 6-68-0002. Chequering shall be closed or open-ended or of any other pattern as shown on drawings.

6.2 Fabrication Drawings

As per the requirements given in EIL Standard Specification No. 6-68-0006.

6.3 Fabrication

Chequered plates shall be fabricated as per the "Approved for Construction" fabrication drawings (prepared by the Contractor based on design drawings). These shall be perfectly flat and without any dents/deformations and shall be cut to the required size and shape. Holes/ notches/ openings of the required size, if any, shown on drawings shall be made. Nosing for staircase treads shall be made by cold bending of chequered plates. All edges shall be made smooth and even. All chequered plate units shall be given distinct erection marks in accordance with the marking drawings. Stiffeners of any description shall be welded with the chequered plates where shown on drawings.

6.4 Erection/Fixing

Chequered plates shall be fixed to the bearing members by welding/ bolting/ screwing as shown on drawings. All bolts/ screws shall be of counter-sunk type so that the heads remain flush with the top of plate. Where welding is used for fixing, stitch welds of minimum 50mm length with a pitch of 150 mm shall be used. Continuous sealing run of weld shall be provided along the junction of two consecutive chequered plates parallel to the span. For removable flooring, details as shown on drawings shall be followed.

6.5 Painting

Chequered plates shall be cleaned (both the surfaces) and given one coat of primer/ galvanization as per EIL Standard Specification No. 6-79-0020 or job specification, as specified, on both surfaces.

6.6 Payment

6.6.1 Payment shall be made on the basis of actual weight in metric tons of the chequered plate. If any stiffening sections are provided below the chequered plates for strengthening, the same shall be separately measured & paid under Structural Steel item (Refer EIL Standard Specification No. 6-68-0006).

6.6.2 The rate shall include supplying (as per supply conditions given in the tender), fabricating, erecting M.S. chequered plates including transporting, handling, straightening if required, cutting to required size and shape, making holes/ notches/ opening of required size and nosing, smoothening the edges, fixing by welding/bolting/screwing, at all levels and locations, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying one coat of primer/ galvanization as per EIL Standard Specification No. 6-79-0020 or job specification (wherever applicable), as specified, etc. all complete.

6.6.3 Welds, bolts, nuts, screws, washers, clips shall not be measured. The quoted rate shall be deemed to include the same.

7.0 GRATINGS

7.1 Categories

Electroforged Carbon Steel/ Stainless Steel gratings shall be either Type-I or Type-II as per EIL Standard No. 7-68-0697 and shall be procured from approved manufacturers as per Departmental List of Approved Manufacturers.

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7.2 Material

Materials for fabrication and fixing of Gratings shall conform to EIL Standard No. 7-68-0697 and EIL Specification No. 6-68-0002.

7.3 Fabrication Drawings

As per the requirements given in EIL Standard Specification No. 6-68-0006.

7.4 Fabrication

The gratings shall be manufactured by electroforging process strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on EIL standard. All units shall be given distinct erection marks in accordance with the marking drawing. The Contractor shall submit sample gratings for inspection and approval by the Engineer-in-Charge whenever asked for.

7.5 Erection/Fixing

Gratings shall be fixed to the bearing members by welding, clamping/ disc and bolting/ studs as indicated in the Standard.

7.6 Galvanisation

Carbon steel gratings and the fixing clamps, bolts, nuts shall be cleaned as per EIL Standard Specification No 6-79-0020 or job specification (wherever applicable), as specified and galvanisation shall be done as specified in accordance with IS 2629 and tested as per IS 2633 & IS 6745. Carbon Steel Disc & Stud shall either be hot dip galvanized or shall have a coating that can withstand neutral salt spray test of 2000H as per DIN EN ISO 9227.

7.7 Payment

7.7.1 Payment shall be made on the basis of actual weight in metric tons of the gratings manufactured in accordance with EIL Standard and accepted by the Engineer-in-Charge.

The weight for payment shall also include the weight of galvanization and welding.

7.7.2 The rate shall include supplying, fabricating, erecting electroforged Carbon steel/ Stainless steel gratings (of the specified category) including transporting, handling, cutting to required size and shape, making holes/ notches/ openings, smoothening the edges, fabricating clamps/discs, fixing by welding/ clamping/ bolting/ disc & stud, at all levels and locations, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and carrying out galvanization on Carbon steel gratings, clamps, nuts & bolts and/or a coating on Carbon steel discs & studs that can withstand neutral salt spray test of 2000H as per DIN EN ISO 9227, repairing the damaged area of galvanized coating using cold galvanizing spray process for Carbon steel grating, chemical treatment of Stainless steel grating, etc. all complete.

7.7.3 Bolts, clamps/ discs, nuts/ studs and washers for both Carbon steel and Stainless steel gratings shall not be measured. The quoted rate shall be deemed to include the same.

8.0 TUBULAR HAND RAILING

8.1 Material

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Materials for fabrication and fixing of Tubular Hand Railing shall confirm to specification given in EIL Standard Specification No. 6-68-0002.

8.2 Fabrication Drawings

As per the requirements given in EIL Standard Specification No. 6-68-0006.

8.3 Fabrication

8.3.1 Hand railing shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All tubes shall be straight and without any dents/ deformations. Tubes shall be cut and ends shall be prepared to a neat and workman-like finish. All elements shall be directly welded. All welded joints shall be cleaned and filed or ground smooth, if required, to have a smooth surface and aesthetically pleasant appearance. Splicing of top rail shall not be allowed. Tubes shall be cold bent to shape and curvature in case of discontinuous ends of handrails. Ripples, kinks and/ or dents at bends shall not be accepted.

8.3.2 Lower ends of vertical posts shall be cut and splayed (for grouting in pockets in the concrete members). For removable type of hand railing, suitable base plates (with provision for bolting) shall be welded to the lower end of vertical posts. All units shall be given distinct erection marks in accordance with the marking drawing.

8.4 Erection/ Fixing

Hand railing shall be fixed to the bearing members by welding/ bolting/ grouting as indicated on the drawings. Local notching shall be made in the floor plate/ grating to accommodate vertical posts/ their base plates which shall always be welded to the main supporting member. When the posts are to be fixed in concrete members, suitable pockets shall be made in concrete for grouting as shown on drawings/standards.

8.5 Painting

All hand railing components shall be cleaned and given one coat of primer/ galvanization as per EIL Standard Specification No. 6-79-0020 or job specification (wherever applicable), as specified, after fabrication.

8.6 Payment

8.6.1 Payment shall be made on the basis of measured length in meters (m) of top rail only (Horizontal and/or inclined lengths). The rate shall include preparation of fabrication drawings, supply of all materials, handling, transporting, straightening if required, cutting to required size, bending, welding, bolting, fixing in position at all levels and locations, grouting with 1:2 (cement: sand) mortar, surface cleaning, removal of rust, scale, grease and applying one coat of primer/ galvanization as per EIL Standard Specification no. 6-79-0020 or job specification (wherever applicable), as specified, after fabrication etc. all complete.

8.6.2 The rate shall include making suitable notches in floor plates/ gratings and pockets in concrete structures for fixing the vertical posts.

9.0 MILD STEEL RUNGS

9.1 Material

All materials shall conform to specifications given in EIL Standard Specification No. 6-68-0002.

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9.2 Fabrication

Rungs shall be fabricated as per EIL standards/ drawings. Mild steel bars shall be straightened if required, cut, bent to shape and given one coat of primer and two coat of finish paints per EIL Standard Specification No. 6-79-0020 or job specification (wherever applicable) as specified, on exposed portions after fabrication.

9.3 Fixing

Rungs shall be fixed in position as per detailed drawing and firmly tied/welded with reinforcement to prevent their displacement during vibration of concrete.

9.4 Payment

Payment shall be made on the basis of actual weight in kilogram (Kg) of the M.S. rungs. The rate shall include supply of all materials, handling, transporting, straightening if required, cutting to required size, bending to shape, tying/welding with reinforcement bars, fixing at all levels and locations, adjustment of formwork, applying one coat of primer and two coats of finish paint as per EIL Standard Specification No. 6-79-0020 or job specification (wherever applicable), as specified, on the exposed portion of rungs etc. all complete.

10.0 LIGHT GAUGE STEEL STRUCTURAL SECTIONS

10.1 Material

All materials required for fabrication and fixing in position of Light Gauge Steel Structural Sections shall conform to EIL Standard Specification No. 6-68-0002.

10.2 Fabrication Drawings

As per the requirements given in EIL Standard Specification No. 6-68-0006.

10.3 Fabrication

10.3.1 Fabrication of members shall be done strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on the latest design drawings and in accordance with IS 800, IS 801 and other relevant BIS Codes.

10.3.2 All members shall be straight and free from any dents/deformations/ twists. Members shall be cut to the required sizes and ends prepared to a neat and workman like finish. Holes (for sag rods and cleat bolts) of appropriate size shall be drilled and all members/ components shall be given distinct erection marks in accordance with the marking drawings. Holes shall not be formed by gas cutting process.

10.4 Erection

Structural members shall be erected in proper sequence and aligned properly without causing any twist. Permanent bolting/ welding shall be done only after proper alignment has been achieved. Proper access, working platforms and safety arrangements shall be provided by the Contractor for working and inspection.

10.5 Painting

All structural components shall be cleaned and given one coat of primer as per EIL Standard Specification No. 6-79-0020 or job specification (wherever applicable), as specified, after fabrication.

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10.6 Payment

10.6.1 Payment shall be made on the basis of admissible weight in metric tons of the structure accepted by the Engineer-in-Charge. The weight for payment shall include all structural members, cleats, splices, gussets and sag rods and shall be determined from the fabrication drawings along with respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Engineer-in-Charge before making the payment. The weight shall be calculated as per IS 808/ IS 1161. BIS Handbook/ Manufacturer's catalogues/ charts shall be adopted in case relevant weights of sections used are not covered in IS 808/ IS 1161. No allowance in weight shall be made for rolling tolerances. In case of any doubt, actual weight of the section shall be measured at site.

The rate shall include supplying, fabricating, erecting, at all levels and locations, testing of bolted and/ or welded Light Gauge structural steel works including cleats, crook bolts, splices/ sleeves, all other fixtures and accessories, straightening if required, cutting, edge preparation, welding and bolting of joints, fixing in line and level with temporary staging and removal of the same after final alignment, handling, transporting, storage, preparation of detailed fabrication drawings and getting them reviewed by the Engineer-in-Charge, surface cleaning, removal of scale, rust, oil or grease and applying one coat of primer as per EIL Standard Specification No. 6-79-0020 or job specification (wherever applicable), etc., all complete.

10.6.2 All welds, bolts, nuts, washers, fixtures and accessories shall not be measured. The quoted rate shall be deemed to include the same.

11.0 MECHANICAL ANCHOR FASTENERS

Mechanical Anchor Fasteners shall have the approval of European Organization for Technical Approval (EOTA) / Deutsches Institut für Bautechnik (DIBt)/ Factory Mutual Laboratories (FM)/ International Code Council- Evaluation Services (ICC-ES formerly ICBO-ES).

Design of post-installed Mechanical anchor fasteners shall be provided/ verified by the approved manufacturer with installation instructions and execution shall be done by an applicator trained by the approved manufacturer (preferably in the presence of manufacturer for critical applications/ structures).

11.1 Material

Mechanical Anchor Fasteners shall be of minimum grade 5.8 galvanised to at least 5 microns or Stainless Steel (SS304 or SS316) and shall be approved for use in cracked concrete.

Stainless steel Mechanical anchor fasteners shall be preferred for sites located in coastal areas or in high rainfall zone.

11.2 Classification

11.2.1 Mechanical anchor fasteners shall be of following types:

a) Wedge/ Expansion anchor fasteners

They are most commonly used anchor fasteners and shall be utilized in safety related installations, fixing of insert or base plate for beams & columns, jacking of column, staircase railing, handrails, racks, walkways, pipe supports, ladders, jacketing, platform

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supports, strengthening of structure, knee supports, fire sprinklers, concrete formwork, telecommunication equipments, etc.

b) Screw anchor fasteners

They shall be used for installation of door & window frames, fences, facade panels, cable trays, electrical fixtures, hangers, sill plates, Signages, temporary fabrications, formwork props, Tilt ups & Prefab connectors, etc.

c) Undercut anchor fasteners

They shall be used only for critical applications with prior design assistance from the manufacturer, like for fixing pumps, turbines, industrial exhaust fans, heavy pipes, crane rails, crash & safety barriers, industrial machines, heavy platform supports, knee brackets with heavy loads, supports subjected to cyclic/dynamic loadings (shock, seismic & fatigue), etc.

11.2.2 Mechanical anchor fasteners shall be designated as medium and heavy duty depending on their usage. The broad classification is given below for general guidance.

11.2.2.1 Medium Duty for:

a) Ladders, balconies and stairs support.
b) Cables and cable trays support.
c) Electrical panels and fixtures.
d) Hangers for pipes and cable trays
e) Secondary & tertiary Pipe supports.
f) Equipment Skids
g) Formwork props, tilt ups and prefab connectors.
h) Small Industrial Equipments.

11.2.2.2 Heavy Duty for:

a) Platform supports (beam and columns)
b) Knee brackets for pipes/ multi tiers cable trays/ walkways etc.
c) Foundation anchors for heavy equipment like boiler, silos, etc.
d) Primary connection for erection of Beams & Columns for missing insert/ base plates
e) Primary pipe supports, Industrial machines
f) Safety barriers, Crash barriers, Crane rails, dorm structures
g) Elevator tracks, Car hoists, roof & slab supports

11.2.3 Necessary support shall be taken from the Manufacturer while deciding the Mechanical anchor fasteners for following applications:

a) Members supporting equipment and pipes subjected to vibrations.
b) Cantilever connections designed to cater for effective cantilever spans greater than 1m and concentrated load of more than 10KN at the free end.

11.3 Selection

The Contractor shall procure the Mechanical anchor fasteners from the approved manufacturers as per Departmental List of Approved Manufacturers.

11.4 Testing

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If so desired by the Engineer-in-Charge, the Contractor shall carry out all the requisite tests (pullout test, torque test etc.) of specimen Mechanical anchor fasteners (representative of those to be used) from approved laboratory/ test house and submit the report to him for approval. The decision of the Engineer-in-Charge regarding the adequacy of strength and load carrying capacity of Mechanical anchor fasteners shall be final and binding to all. The cost of all such tests shall be borne by the Contractor.

11.5 Installation

The Contractor shall install Mechanical anchor fasteners at their correct location (to suit the requirement of fixtures as shown in drawings) as per the procedure laid down by the manufacturer. Location of all holes shall be pre-marked on the concrete surfaces. Scanning before drilling shall be done with appropriate ferro scanner tool to avoid rebar hits and structural damage. The holes shall then be drilled carefully with an electric drill to the correct recommended size and depth. Holes shall be exactly round and true perpendicular to the concrete surface. Edge distance and pitch of fasteners shall be as recommended by the manufacturer. The contractor shall suitably shift the hole with the approval of the Engineer-in-Charge in case any reinforcement bar is met with while drilling the hole in RCC structure. Necessary staging shall be provided for working and the Contractor shall take requisite safety precautions so as not to cause any damage to the existing structure/ equipment. Any damage done while executing the job shall be made good by the Contractor at his cost.

11.6 Protection

The exposed surfaces of Mechanical anchor fasteners shall be properly greased & covered with jute cloth so as to protect them from damage.

11.7 Payment

Payment for installing rust proof Mechanical anchor fasteners shall be made on number basis (each). The rate shall include supply of complete assembly, handling, transporting, providing necessary temporary staging, installing (as per manufacturer's specifications) in PCC/ RCC structures, at all levels and locations, testing, drilling, cleaning, covering with jute cloth, relocating and re-drilling in case of any obstruction, making good any damage done to the structure, grouting the abandoned holes and any gap left between the contact surfaces of PCC/ RCC and fixtures to be added, design assistance from the Manufacturer (wherever required), etc. all complete.

12.0 CHEMICAL ANCHOR FASTENERS AND DOWELS

Chemical anchor fasteners and Dowels shall have the approval of European Organization for Technical Approval (EOTA) / Deutsches Institut für Bautechnik (DIBt)/ Factory Mutual Laboratories (FM)/ International Code Council- Evaluation Services (ICC-ES formerly ICBO-ES) and shall have Seismic (for Zone III & above locations), Fatigue, Shock and Fire Approvals from any of the above agencies.

Design of post-installed Chemical anchor fasteners and Rebars (Dowels) shall be provided/ verified by the approved manufacturer with installation instructions and execution shall be done by an applicator trained by the approved manufacturer (preferably in the presence of manufacturer for critical applications/ structures).

12.1 Material

Chemical anchor fasteners shall be of high tensile steel rods of minimum grade 5.8 galvanised to at least 5 microns or Stainless Steel (SS304 or SS316) and shall be approved for use in cracked concrete.

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Stainless steel Chemical anchor fasteners shall be preferred for sites located in coastal areas or in high rainfall zone.

Grade of Rebars for chemical anchoring shall be as per the General Notes of the project.

12.2 Selection

The Contractor shall select the chemical anchor fasteners based on the parameters such as Loads and rebars for dowels as specified in the AFC drawings/ documents. The chemical anchor fasteners shall be procured from the approved manufacturers as per Departmental List of Approved Manufacturers.

12.3 Testing

The Contractor shall carry out, at the work place, the requisite tests like pull out test, shear test, etc. for chemical anchor fasteners and pull out test for dowels. The chemical anchor fasteners shall withstand the load specified in the drawing/ documents and the Dowels shall be tested for full tensile capacity of the rebars. The decision of the Engineer-in-Charge regarding the adequacy of strength and load carrying capacity of the anchor fasteners/ dowels shall be final and binding to all. The cost of all such tests shall be borne by the Contractor.

12.4 Installation

The Contractor shall install the chemical anchor fasteners/ dowels at their correct location (to suit the requirement of fixtures as shown in drawings) as per the procedure laid down by the manufacturer. Location of all holes shall be pre-marked on the concrete surfaces. Scanning before drilling shall be done with appropriate ferro scanner tool to avoid rebar hits and structural damage. The holes shall then be drilled carefully with an electric drill to the correct recommended size and depth. Holes shall be exactly round and true perpendicular to the concrete surface. Edge distance and pitch of fasteners shall be as recommended by the manufacturer. The contractor shall suitably shift the hole with the approval of the Engineer-in-Charge in case any reinforcement bar is met with while drilling the hole in RCC structure. Necessary staging shall be provided for working and the Contractor shall take requisite safety precautions so as not to cause any damage to the existing structure/ equipment. Any damage done while executing the job shall be made good by the Contractor at his cost.

12.5 Payment

Payment for installing chemical anchor fasteners shall be made on number basis (each). The rate shall include supply of complete assembly i.e. chemical anchor fasteners along with chemical foils as per manufacturer specifications.

Payment for installing chemical dowels shall be made on number basis (each). The rate shall include fixing of dowels by drilling/ cleaning hole and injecting odourless chemical as per manufacturer specifications. Rebars used as dowels shall be paid separately under relevant SOR item.

For chemical anchor fasteners/ dowels, the rate shall be inclusive of handling, transporting, providing necessary temporary staging, installing (as per manufacturer's specifications) in PCC/ RCC structures to a required depth with a specified hole diameter, at all levels and locations, testing, drilling holes, cleaning, covering with jute cloth, relocating and re-drilling in case of any obstruction, making good any damage done to the structure, grouting the abandoned holes and any gap left between the contact surfaces of PCC/ RCC and fixtures to be added, design assistance from the Manufacturer (wherever required), etc. all complete.

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मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

गिराने एवं तोडने सम्बंधी कार्य
DEMOLITION AND DISMANTLING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor		Standards Bureau Chairman
					Approved by		
6	03.04.25	REAFFIRMED & REISSUED	AD	MM	AS		MN
5	13.05.19	REAFFIRMED & REISSUED	TK	AS	RS		RKT
4	18.11.13	REVISED & ISSUED AS STANDARD SPECIFICATION	AJS	RS	PKM	SC	SC
3	10.06.08	REAFFIRMED & REISSUED	PKB	PKM	VK		VC
2	25.04.01	REVISED & ISSUED AS STANDARD SPECIFICATION	SKP	RS	SCJ		MI
1	16.03.98	REVISED & ISSUED AS STANDARD SPECIFICATION	SARITA	SKP	SCJ		AS
0	AUG'89	ISSUED AS STANDARD SPECIFICATION		AKV	GPL		RCPC

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Abbreviations:

C&D	:	Construction & Demolition
GI	:	Galvanized Iron
RA	:	Recycled Aggregates
RCC	:	Reinforced Cement Concrete
PCC	:	Plain Cement Concrete

Structural Standards Committee

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1.0 SCOPE

This specification covers the procedure and safety requirements for demolition and dismantling of masonry (Brick & Stone), concrete (Plain /Reinforced), structural steel (covered/ open) works.

2.0 GENERAL

2.1 Apart from this specification, the demolition and dismantling of structures (part or whole) shall be in compliance with all statutory safety regulations and any other special requirement as shown/ noted on the drawings and General Conditions of Contract. Prior consent and approval of the Engineer-in-Charge shall be obtained in writing before starting any dismantling works. Any restrictions imposed regarding working hours shall also be strictly followed by the Contractor.

2.2 All materials obtained from dismantling/demolition operations shall be the property of the Owner unless otherwise specified and shall be segregated as serviceable or unserviceable materials and kept in safe custody until handed over to the Engineer-in-Charge.

2.3 Contractor shall follow the principle of selective demolition by sequencing the demolition activities in such a way that the non-structural materials like window/ door frames, pipes, tiles, bricks, asphalt, ceramics, etc. shall be removed first before starting the main demolition activities.

2.4 Where it becomes necessary to disconnect any existing service line(s) (such as electrical, piping etc.) during dismantling/demolishing operation and where so required by the Engineer-in-Charge, suitable alternate arrangement shall be made by the Contractor to maintain the continuity and proper functioning of the affected service line(s) with the approval of the Engineer-in-Charge at no extra cost to the Owner.

2.5 Specification No. 6-68-0003 (Earthwork) shall be referred to the extent applicable.

3.0 SAFETY PRECAUTIONS

3.1 The Contractor shall adhere to safe demolishing/ dismantling practice at all stages of work to guard against accidents, hazardous and unsafe working procedures.

3.2 Necessary propping, shoring, strutting and/or underpinning shall be done for the safety of all surrounding structures (whose safety is likely to be endangered) before taking up the demolishing and dismantling works.

3.3 Temporary enclosures/ barricading made out of GI sheets, fencings, danger lights, warning tapes, etc. shall be provided by the Contractor and got approved by the Engineer-in-Charge before start of work to prevent accidents.

3.4 Contractor must ensure the availability of adequate fire fighting equipments/ arrangements before starting actual demolishing/ dismantling works. These facilities shall be made available throughout the entire operation of demolition and dismantling of structures.

3.5 All equipments, pipes, fittings and instruments, underground utilities etc. located in the vicinity shall be protected by suitable means, as decided by the Engineer-in-Charge, during demolishing/ dismantling operations.

3.6 Roads and working spaces shall be kept free of any debris/dismantled materials at the end of day's work.

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3.7 Necessary measures shall be taken to keep the dust and noise nuisance to minimum levels.

3.8 Dismantled elements/components shall not be dropped from a height or thrown from a distance. Dismantling of elements fixed by screws/bolts/hooks etc. shall be done by taking out the fixtures with proper tools only. Such fixtures may be allowed to be cut by sawing or flame cutting, in the event of their being stuck up due to corrosion etc. However, the decision of Engineer-in-Charge in this regard shall be final and binding. Welds shall be removed by flame cutting. Tearing or ripping of elements shall not be resorted to under any condition.

3.9 Dismantling of equipments/ instruments and such other fixtures shall be done with utmost care with proper tools & tackles and shall be stacked separately. Their disposal or retainment shall be as per the directions of Engineer-in-Charge.

4.0 PROCEDURE

4.1 Entire work of demolishing & dismantling shall be meticulously planned. Prior to start of work, the Contractor shall thoroughly understand the scope and nature of the work, and then prepare and submit the proposed work execution plan of demolishing & dismantling to the Engineer-in-Charge for his review. Comments if any, shall be taken care by the contractor and execution of the work shall be done based on the revised execution plan.

4.2 Demolition and dismantling shall be restricted to the extent shown on drawings or as directed by the Engineer-in-Charge.

4.3 Necessary work permits (as applicable) shall be obtained prior to start of demolishing/ dismantling activities.

4.4 Demolition of any structure shall be carried out in the sequence reverse to that followed at the time of its construction.

4.5 Dismantling shall be done in a systematic manner. All elements including equipments/ instruments shall be carefully removed without causing any damage.

4.6 Blasting in any form shall not be permitted. However, techniques like pneumatic/ hydraulic breakers, diamond cutting, etc. shall be utilized to the maximum possible extent.

4.7 Chipping of concrete/grout shall be done with precision by chiseling. The finished surfaces shall be made true to the requisite size and shape.

4.8 Pockets/holes of specified size shall be made/ cut by drilling/ chiseling/ core cutting/ diamond cutting, etc.

4.9 Cut-outs in RCC Slab/ wall shall be made by vibration-less spark-free mechanical means like core-cutting, wet cutting by diamond wall saw system, etc.

5.0 CLEANING & STACKING

All demolished/dismantled serviceable materials such as bricks, stones, reinforcement bars, structural steel, sheeting etc. shall be separated out, cleaned and stacked in separate lots within the plant boundary as directed by the Engineer-in-Charge.

6.0 DISPOSAL

All unserviceable materials shall be disposed off in spoil heaps within or outside the plant boundary as per the directions of the Engineer-in-Charge. Areas required outside the plant boundary for dumping of disposed material shall be arranged by the contractor and got approved by the Engineer-in-Charge.

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7.0 C&D WASTE MANAGEMENT

Contractor shall make all possible efforts to reduce, reuse and recycle Construction & Demolition (C&D) waste. A comprehensive Waste Management Plan shall be submitted to the Engineer-in-Charge for review. As a social responsibility, contractor shall promote and spread awareness about recycling of C&D waste that can act as a perfect substitute for depleting natural aggregate resources, shortage of dumping sites, increasing transportation & disposal cost, stringent regulations for extracting new materials and environmental pollution as a whole. Recycling equipments like jaw/ cone crushers, shaft impactors, magnetic separators, vibrating screens, washing equipments, etc. are now easily available in the market. Recycled Aggregates (RA) both coarse & fine can be used in PCC, pavements, drains, plastering, making bricks, kerb stones, pavement blocks and for soil stabilization. Residual concrete can be recycled in Ready Mixed Concrete Plants by installing Recycling Drum and rebars extracted from C&D waste can be used in drains, pavements, chairs, spacers, stirrups, etc.

8.0 PAYMENT

8.1 General

Measurement of all works shall be taken prior to start of demolishing/ chipping/ dismantling works.

8.2 Masonry/Concrete Works (Demolition)

8.2.1 Payment shall be made on the basis of actual volume in cubic metres (cu.m.) of masonry/ concrete works demolished. The thickness of plaster/ bitumen felt shall be included in measurements.

8.2.2 The rate for demolishing shall include supply of all labour, tools & tackles, necessary safety measures, propping, underpinning, scaffolding, handling, cutting, straightening, scraping & cleaning of reinforcement bars and other embedments (in case of reinforced concrete works), sorting out and stacking of all serviceable materials, disposal of all unserviceable material, clearing the site, etc. all complete as specified and directed by the Engineer-in-Charge.

8.3 Excavation & Backfilling

8.3.1 Excavation and backfilling shall be paid separately as per relevant clauses of Specification No. 6-68-0003 for Earth Work.

8.4 Chipping of Concrete Works

8.4.1 Payment shall be made on the basis of admissible area in square metres (sq.m.) of concrete surfaces chipped, pertaining to the different categories of thicknesses specified in the schedule of items.

8.4.2 The rate for chipping shall include supply of all labour, tools and tackles, necessary safety measures, scaffolding, chiseling, handling, exposing, cutting, straightening, scraping, clearing the reinforcement bars (in case of reinforced concrete works), wire brushing and washing the exposed surfaces, disposal of all unserviceable material etc. all complete as directed.

8.5 Making Pockets/Holes in Concrete Works and Cut-outs in RCC Slab/ Wall

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8.5.1 Payment for Pockets/ holes shall be made on the basis of number (Each) of pockets/ holes of sizes upto & inclusive of 200x200x500mm deep, made or cut in the concrete works at all depths & heights.

8.5.2 Payment for cut-outs in RCC slab/ wall shall be made in CuM on the basis of plan/ elevation area for a thickness upto & inclusive of 400mm at all depths & heights.

8.5.3 The rate for making pockets/holes and cut-outs shall include supply of all labour, tools & tackles, necessary safety measures, scaffolding, chiseling, drilling, core/ diamond cutting, diamond wall saw system, handling, cutting or relocating reinforcement bars, cleaning, disposal of all unserviceable material etc. all complete as directed.

8.6 Dismantling of Structural Steel Works

8.6.1 Payment shall be made on the basis of weight (MT) of the structure/components being dismantled. Assessment of weight shall be done as per the specifications or as per the direction of Engineer-in-Charge.

8.6.2 The rate for dismantling shall include supply of all labour, tools and tackles, equipment, consumables, necessary safety measures, scaffolding, propping, handling, unbolting, cutting (by sawing or flame cutting) of gussets/ plates/ bolts/ hooks/ welds, cleaning, sorting out and stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as specified and directed.

8.7 Dismantling of Roof & Wall Sheeting

8.7.1 Payment shall be made on the basis of dismantled sheeted area in square metres (sq.m.) of plan area in case of roof sheeting and area in elevation in case of side and louver sheeting.

8.7.2 The rate for dismantling shall include supply of all labour, tools and tackles, equipments, consumables, necessary safety measures, handling, scaffolding, unbolting, cutting (by saw or flame cutting) of hook bolts, removal of ridges, gutters, flashings, transporting, stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as directed.

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STANDARD SPECIFICATIONS
CIVIL AND STRUCTURAL WORKS
MISCELLANEOUS ITEMS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
6	13.03.25	REVISED & REISSUED	TARUN KAPOOR	AMARJEET	ANURAG SINHA	MAINAK NANDI
5	24.01.22	REVISED & REISSUED	TARUN	AMARJEET	ANURAG SINHA	S.MAZUMDAR
4	22.03.16	REVISED & REISSUED	MODITA	ALPANA	R.SRIVASTAVA	S.CHANDA
3	29.06.10	REISSUED	AS	PKM	SCH	N DUARI
2	26.04.01	UPDATED & REISSUED	SBJ	R SOOD	SC JAIN	MI
1	AUG 94	UPDATED & REISSUED	SBJ	R SOOD	GPL	A SONI
0	AUG 89	ISSUED AS STANDARD SPECIFICATION	-	AKV	GPL2	RCPC

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Abbreviations:

BIS	:	Bureau of Indian Standards
DPC	:	Damp Proof Course
FGL	:	Finished Ground Level
IS	:	Indian Standard
RCC	:	Reinforced Cement Concrete

Structural Standards Committee

Convenor: Mr. Anurag Sinha

Members:
Mr. Virender Goel
Mr. Deepak Agrawal
Ms. Alpana Srivastava
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Ms. Papia Mandal
Mr. Vikram Kumar Gupta
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1.0 SCOPE

The scope shall be as specified separately for different items below.

2.0 REFERENCES

2.1 BIS Codes

IS:73 : Paving bitumen - specification

IS:383 : Specification for coarse and fine aggregates from natural sources for Concrete

IS:6313 : Code of practice for Anti-termite measures in buildings

2.2 EIL specifications

6-68-0002: Materials
6-68-0004: Plain and Reinforced Cement Concrete

3.0 MATERIALS

The materials shall be as specified separately for different items below.

4.0 GENERAL REQUIREMENTS

The Contractor shall test the materials, wherever applicable, in approved laboratory as required by the Engineer-in-Charge and furnish test certificates for materials and obtain the approval of the Engineer-in-Charge prior to the use of such materials in the works. All tests shall be in accordance with relevant Indian Standards.

5.0 PRE-CONSTRUCTIONAL ANTI-TERMITE TREATMENT

5.1 Scope

This specification establishes the materials and method of accomplishing pre-constructional anti-termite treatment of soil for protection of buildings against attack by subterranean termites with the usage of chemical emulsions in accordance with the procedure laid down.

5.2 Materials

Refer EIL Specification No. 6-68-0002.

5.3 Procedure for Treatment

5.3.1 Anti-termite chemicals have an adverse effect upon health when absorbed through the skin, inhaled as vapours or spray mist or swallowed. Applicators shall wear appropriate Personal Protective Equipments (PPEs) and exercise due precautions in handling these chemicals while preparing solution and carrying out soil treatment.

The storage and application of anti-termite compounds shall be carried out by a trained professional agency possesses a valid license issued by the respective State/ Central government department of Agriculture as required under the Insecticides Act and the Rules framed thereunder. Necessary documents shall be submitted by the Contractor to the Engineer-in-Charge for review and approval.

Apart from this specification, the work shall be carried out in compliance with IS:6313. In case of any contradiction, this specification shall govern.

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5.3.2 **Site Preparation**

Prior to start of Anti Termite treatment, area(s) shall be made free from logs, stumps, timber offcuts, leveling pegs, roots of plants/ trees etc. Soil treatment shall start when foundation trenches/ pits are ready to take concrete/ masonry in foundations and plinth area ready for laying the subgrade. Treatment shall not be carried out when it is raining or the subsoil water level is at the same or higher than the level of treatment. In the event of water-logging of foundations, the water shall be pumped out and the chemical emulsion applied when the soil is absorbent.

5.3.3 **Treatment of the excavated pits/ trenches and backfill for Foundations**

a) The bottom surface and the lower 300 mm side surfaces of the excavated pits/ trenches for foundations of masonry works and RCC plinth beams supporting such masonry works, shall be treated with specified chemical emulsion @ 5 litres/m^2 of the surface area. However, no such treatment shall be required in case of pits/ trenches made for RCC foundations supporting RCC walls and/ or columns.

b) On completion of construction of masonry foundations, the backfill in immediate contact with the substructure shall be treated in layers, of 300 mm, with emulsion @ 7.5 litres/m^2 of the vertical surface of the substructure (i.e. 7.5 x 0.3 = 2.25 litres/meter of perimeter) for each side. The treatment shall be given after ramming of each layer of soil, by rodding the earth at 150 mm centres close to the wall surface and working the rod backward and forward (parallel to the wall surface) and then spraying the specified dosage of emulsion. The emulsion shall be directed towards the masonry surfaces so that the soil in contact with these surfaces is well treated with the chemical. After the treatment, the soil shall be tamped back into place. This shall be done for full depth of the fill.

c) For RCC walls and columns, the treatment as specified in (b) shall start from a depth 500 mm below the finished ground level, and shall be done upto the FGL.

5.3.4 **Treatment of Plinth/ Basement and Apron**

a) The top surface of the consolidated earth below the non-suspended floor slabs and the peripheral aprons of widths upto 750 mm, the bottom surface and side surfaces of the excavated pits for the basements shall be treated with chemical emulsion @ 5 litres/m^2 of the surface area. Holes 50 mm to 75 mm deep at 150 mm centre, both ways, shall be made on the surface with 12 mm diameter mild steel rod and then emulsion shall be sprayed uniformly over the area. At expansion joint locations, anti-termite treatment shall be supplemented by treating through the expansion joint @ 2.0 litres per linear metre of joint after the sub-grade has been laid.

b) Treatment of Junctions of plinth filling and wall/column faces shall be done after making a small channel 30 mm x 30 mm, by making rod holes 150 mm apart (upto the ground level) in the channel and then by moving the rod backward and forward to break up the earth. The chemical emulsion shall be poured along the channel @ 7.5 litres/m^2 of the vertical wall/column surface so as to soak the soil right to the bottom. The soil shall be tamped back into place after the treatment.

5.3.5 **Treatment of Soil along External Perimeter of Building**

After the building is complete, the earth along the external perimeter shall be rodded at intervals of 150 mm and to depth of 300 mm. The rod shall be moved backward and forward parallel to the wall to break up the earth and chemical emulsion poured along the

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wall @ 7.5 litres/m^2 of vertical surface (i.e. 7.5 x 0.3 = 2.25 litres/metre of perimeter). After the treatment, the earth shall be tamped back into place.

5.4 Guarantee

A Guarantee of minimum 10 years shall be provided by the contractor against the performance of the Anti-termite treatment.

5.5 Payment

This clause shall apply to Item Rate tender only.

Payment for pre-constructional anti-termite treatment shall be made on square metre (sq.m.) basis of plinth area of the building at ground floor only.

The rate shall include supplying all materials, spray pumps, tools, tackles & other accessories, labour, site preparation, rodding, tamping, mixing, spraying the specified chemical emulsion at prescribed dosage, storage facilities, handling, transporting etc. all complete as directed & specified.

6.0 ANTI-CORROSIVE LAYER

6.1 Scope

This specification covers the requirement of materials, method of preparation and procedure for laying an anticorrosive layer over top surface of tank foundations for protection of bottom plates of steel tanks against corrosion attack.

6.2 Materials

6.2.1 Sand shall be clean, dry, coarse, hard, angular, free from coatings of clay, dust and mix of vegetable and organic matter and shall conform to IS:383 - Grade III.

6.2.2 Bitumen shall be of grade VG10 conforming to IS:73.

6.3 Mixing and Laying

The bitumen shall be heated till it melts. 3% kerosene may be added if required. Sand shall be thoroughly mixed with bitumen (8% to 10% by volume) in a mixing drum to give a uniform mixture and shall be laid over clean and dry surface of tank foundation to line, grade and levels as shown on the drawings and directed by the Engineer-in-Charge. Bitumen shall not be heated beyond the specified temperature limits. The layer shall be tamped to form hard mass of specified compacted thickness.

6.4 Payment

This clause shall apply to Item Rate tender only.

The payment shall be made on square metre (sq.m.) basis of the area covered with the anticorrosive layer.

The rate shall include supplying all materials, tools, plants, labour, transportation, handling, heating, mixing, laying, tamping etc. all complete as specified.

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7.0 DRESSING & TRIMMING

7.1 Scope

This specification covers the procedure for dressing, trimming and paving with earth the peripheral area around the completed building/ structure.

7.2 Procedure

The ground all around the completed building/structure for 3 metres width or as specified by the Engineer-in-Charge, shall be cleaned and dressed to suitable slope. Over the prepared ground a layer of approved earth shall be spread, watered and well consolidated so as to achieve an average thickness of 75 mm.

7.3 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on square metre (sq.m.) basis of the actual area dressed and paved with earth.

The rate shall include supplying all materials, labour including cleaning, dressing the ground to required slope, spreading of earth, watering, ramming, consolidating etc. all complete as directed.

8.0 BREAKING PILE HEADS

8.1 Scope

This specification covers procedure for breaking pile heads of RCC piles.

8.2 Procedure

8.2.1 Head of already cast/ driven RCC piles shall be broken after 28 days of casting up to a length and elevation as shown on the drawing by chiseling or by approved mechanical means taking all necessary safety precautions. Care shall be taken that pile reinforcement is not cut or damaged during chiseling operation. All debris and loose or cracked concrete in the pile shall be removed and disposed off within the plant boundary as per the directions of the Engineer-in-Charge and site shall be left clean for casting of pile caps. The surface of reinforcement bars shall be cleaned, if required by wire brushing, so that no old concrete sticks to them.

8.3 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made per pile basis for the actual number of pile heads broken.

The rate shall include supplying all tools and tackles, labour including disposal of debris, bending the pile reinforcements for proper anchorage within the pile cap etc. all complete as directed.

9.0 BUILDING-UP PILE HEADS

9.1 Scope

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This specification covers requirements of materials and procedure for building-up of RCC Pile Heads.

9.2 Materials

9.2.1 Concrete shall be of the same grade & EIL specification shall be same as that for the pile.

9.2.2 Reinforcement shall be of the same grade as that for the pile.

9.2.3 Type of cement shall be same as that used for the pile.

9.3 Procedure

Concrete in existing piles shall be chiseled off minimum upto the lap-length of the reinforcements in the pile. In cases where reinforcements are longer than the concreted piles, the top concrete of the existing piles shall be chiseled or by approved mechanical means upto a length of 800 mm.

Concrete surface and reinforcement of pile shall be cleaned of any dirt, grease, debris etc. and concrete surface shall be made rough by hacking. Reinforcement shall be lapped/ welded as per the direction of the Engineer-in-Charge. Neat cement slurry shall be applied on top surface of concrete and using approved formwork, concreting shall be done upto the level shown on the drawing and as directed by the Engineer-in-Charge.

9.4 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on cubic metre basis for the total quantity of concrete actually poured for achieving the level as shown on drawings.

The rate shall include supply of all materials (except reinforcement which shall be paid separately as per respective item) labour, cleaning, welding, shuttering, vibrating, finishing, curing etc. all complete. Cutting of pile heads and excavation including backfilling shall be paid separately as per respective item.

10.0 HARD CORE

10.1 Scope

This specification covers the requirements of materials and procedure for laying of hard core.

10.2 Materials

Hard core shall consist of broken/ crushed stones of 150 mm and down size. Stones shall be sound, angular, hard and free from flakes, dust and other impurities.

10.3 Procedure

Hard core shall be laid to the grade, level and thickness as shown on the drawing. Broken stones of required height shall be vertically placed and blinded with approved murrum/ sand and consolidated with roller including watering, dressing etc. However, areas inaccessible by roller may be compacted by hand rammer.

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10.4 Payment

This clause shall apply to Item Rate tender only.

The hard core shall be measured on the basis of volume in cubic metres (cu.m.) of the compacted hard core laid. The rate shall include all labour, materials, consolidation by rammer/ roller, watering, dressing etc. all complete.

11.0 SAND FILLING IN PLINTH/FOUNDATIONS

11.1 For specification of sand to be used for filling, reference shall be made to EIL Specification No. 6-68-0002.

11.2 Filling shall be carried out in layers not exceeding 150 mm and shall be compacted mechanically or by saturation to specified grade and level and to obtain 90% laboratory maximum dry density or as specified in schedule of rates.

11.3 Compaction by flooding may be accepted at the discretion of the Engineer-in-Charge, provided the required compaction is achieved.

11.4 The Contractor shall not commence filling in and around any work until it has been permitted by the Engineer-in-Charge.

11.5 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on cubic metre (cu.m.) basis of the finished compact volume. The rate shall include cost of sand for any compacted thickness, wastage if any, all handling, transport for all leads, tamping, watering, flooding, dressing etc. Any brick work required for ponding shall be paid separately under relevant item.

12.0 DAMP PROOF COURSE - (DPC)

12.1 All materials used for Damp Proof Course shall comply with EIL Specification No. 6-68-0002.

12.2 The 40 mm thick Damp Proof Course shall consist of plain cement concrete of minimum grade M20 (Nominal mix) with 10mm down aggregates.

12.3 Integral water proofing compound of approved make, conforming to IS:2645, shall be mixed with concrete as per manufacturer's specification.

12.4 The Damp Proof Course shall be laid at plinth level of masonry walls, flush with the floor surface and shall not be carried across doorways.

12.5 Before laying, the top surface of wall shall be thoroughly cleaned and watered. The DPC layer of 40mm thick shall be laid, retaining the edges vertical by necessary formwork and shall be well tamped and troweled to smooth finish. The layer shall be cured by keeping the surface wet for 40 hours and after it has dried, two coats of hot bitumen of grade VG10 conforming to IS:73 shall be applied over it at the rate of 1.7 kg/sqm for each coat. Over the layer of hot bitumen, dry sharp sand shall be sprinkled evenly before hardening of top coat of bitumen paint.

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12.6 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on square metre (sq.m.) basis of the area laid with plain cement concrete. The rate shall be inclusive of formwork, providing and mixing Integral water proofing compound, curing, providing and laying bitumen, supplying and spreading sand over bitumen etc. all complete.

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STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

कंक्रीट ब्लाक चिनाई

CONCRETE BLOCK MASONRY

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	13.03.2025	REVISED & ISSUED AS SPECIFICATION	TK	AJS	AS	MN
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ABBREVIATIONS:

ASTM	:	American Society for Testing and Materials
BIS	:	Bureau of Indian Standards
EIL	:	Engineers India Limited
IS	:	Indian Standard
PCC	:	Plain Cement Concrete
RCC	:	Reinforced Cement Concrete

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1.0 SCOPE

This specification covers the technical requirements for materials, batching, mixing, dressing, laying, joining, curing, sampling, workmanship etc. for Hollow & Solid concrete blocks and Autoclaved Cellular (Aerated) Concrete blocks (AAC blocks) used in masonry works of following thicknesses:

a) 100 mm thick : Solid concrete block & AAC Blocks
b) 200 mm thick : Hollow concrete block (closed cavity) & AAC Blocks
c) 400 mm thick (fire walls) : Hollow concrete block (closed cavity) & AAC Blocks

2.0 REFERENCES

2.1 BIS Codes

IS 383, IS 455, IS 456, IS 1489, IS 2185 (Part 1), IS 2185 (Part 3), IS 2250, IS 2645, IS 3812, IS 3952, IS 6909, IS 8041, IS 8042, IS 8043, IS 8112, IS 9103 and IS 12269.

2.2 International Standards

ASTM C 1660-09

2.3 EIL Specifications

6-68-0002 : Materials
6-68-0004 : Plain & Reinforced Cement Concrete

3.0 MATERIALS

Grade of concrete block masonry units shall be as follows:

a) Solid concrete blocks : Grade C (5.0)
b) Hollow concrete blocks : Grade A (5.5) closed cavity
c) Autoclaved Cellular (Aerated) Concrete blocks : Grade I (5.0)

The nominal dimensions (length, height & width) and density of solid & hollow concrete block masonry units shall be in conformance to IS 2185 (Part 1) while that of Autoclaved Cellular (Aerated) Concrete blocks shall be in conformance to IS 2185 (Part 3) corresponding to the aforementioned grades.

4.0 GENERAL REQUIREMENTS

4.1 Cement Mortar

Cement mortar shall meet the requirements of IS 2250 and shall be prepared by mixing cement and Coarse sand by volume. Proportion of cement and sand shall be 1:6 (1 part of cement and 6 parts of Coarse sand), or as directed by the Engineer-in-Charge/ shown on the drawing, for concrete block masonry of 200 mm thickness or more, while 1:4 cement mortar (1 part of cement and 4 parts of Coarse sand) shall be used for concrete block masonry of 100 mm thickness. The sand being used for mortar shall be sieved. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within initial setting time of cement after water is added to the dry mixture. Mortar unused for more than initial setting time of cement, shall be rejected and removed from the site of work.

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4.1.1 Proportioning

The unit of measurement for cement shall be a bag of cement weighing 50 kg and this shall be taken as 0.034 cubic metre. Sand shall be measured in boxes of suitable size on the basis of its dry volume. In case of damp sand, its quantity shall be increased suitably to allow for bulkage.

4.1.2 Mixing

The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Engineer-in-Charge may, however, permit hand-mixing as a special case, taking into account the magnitude, nature and location of work. The Contractor shall take the prior permission of Engineer-in-Charge, in writing, for using hand-mixing before the commencement of work.

4.1.2.1 Mixing in Mechanical Mixer

Cement and sand in specified proportions, by volume, shall be thoroughly mixed dry in a mixer. Water shall then be added gradually and wet mixing continued for atleast one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of stiff paste. Wet mix from the mixer shall be unloaded on water-tight masonry platform, made adjacent to the mixer. Platform shall be atleast 150 mm above the levelled ground to avoid contact of surrounding earth with the mix. Size of the platform shall be such that it shall extend at least 300 mm all-round the loaded wet mix area. Wet mix, so prepared, shall be utilised within initial setting time of cement after addition of water. Mixer shall be cleaned with water each time before suspending the work.

4.1.2.2 Hand Mixing

The measured quantity of sand shall be levelled on a clean water-tight masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backward and forward, several times till the mixture is of uniform colour. The quantity of dry mix which can be consumed within initial setting time of cement shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of stiff paste.

4.2 Ready mix Adhesive/ Mortar

Packaged ready to use adhesive/ mortar conforming to ASTM C 1660-09 shall also be used for joining the concrete blocks with prior approval of Engineer-in-Charge.

4.2.1 Ingredients

Ready mix package shall consist of cement, graded sand, flyash, additive polymers or a combination thereof as per manufacturer's specification.

4.2.2 Mixing & Curing

The dry ready mix shall be added to appropriate amount of potable water (not vice-versa) as per manufacturer's specification. Mixing shall be done slowly by using manual/ electrical stirrer to form a uniform paste free from lumps. The paste shall be kept undisturbed for few minutes as specified allowing ingredients to react properly. Thin bed paste as per manufacturer's recommendation (usually 2 to 4mm thickness) shall then be applied within the specified time limit.

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Curing is generally not required as the mix contains self curing polymers. However, manufacturer's specification shall be followed.

5.0 CONSTRUCTION PROCEDURE

5.1 Soaking of Concrete Blocks

Concrete blocks shall be soaked in water before use for a period that is sufficient for the water to just penetrate the whole depth of concrete blocks as well as to remove dirt, dust and sand. Proper soaking of concrete blocks shall prevent the suction of water from the wet mortar as otherwise mortar will dry out soon and crumble before attaining any strength. The concrete blocks shall not be too wet at the time of use as they are likely to slip on mortar bed and there will be difficulty in achieving the plumbness of wall as well as proper adhesion of concrete blocks to mortar. The period of soaking shall be determined at site by a field test by immersing the concrete blocks in water for different periods and then breaking the concrete blocks to find the extent of water penetration. The least period that corresponds to complete soaking, will be the one, to be allowed for in the construction work.

The soaked concrete blocks shall be stacked over a clean place, wooden planks or masonry platforms to avoid earth, dirt being smeared into them. It shall be ensured that at the time of laying of soaked concrete blocks, they are skin dry.

5.2 Laying

Concrete block masonry units (one or more block thickness) shall be laid in English bond while half block thickness masonry units shall be laid in Stretcher bond.

5.2.1 Concrete Block Masonry Work (200 mm & 400 mm thickness)

A layer of average thickness of 10 mm of cement mortar shall be spread on full width over a suitable length of lower course or the concrete surface. All such mortar shall contain the recommended amount of integral water-repellent admixture to assure proper bond strength. In order to check and achieve uniformity in masonry, the thickness of bed joints shall be such that four courses and three joints taken consecutively shall measure equal to four times the actual thickness of the concrete block plus 30 mm. Each concrete block, shall be properly bedded and set in position by gently tapping with handle of trowel or wooden mallet. Its inside faces shall be buttered with mortar before the next concrete block is laid and pressed against it. All required cutting of masonry units shall be done with power equipment which will produce true edges free of chipping and undamaged surfaces. Where fresh masonry joins the masonry that is partially or totally set, the exposed surface of the set masonry shall be cleaned and wet lightly so as to obtain the best possible bond with the new work. All loose masonry and mortar shall be removed. If it is necessary to "stop off" a run of masonry, this shall be done by raking back one-half unit length of each course. No toothing will be permitted. After completion of the course, all vertical joints shall be filled from top with mortar.

All iron fixtures, pipes, conduits, drains, sleeves, bolts, hold fasts of doors and windows etc. which are required to be built in walls shall be embedded in cement concrete as specified, in their correct position as the work proceeds. Other disciplines shall be consulted and provisions shall be made to permit installation of their work at a later stage.

All concrete block courses shall be truly plumb; if battered, the batter is to be truly maintained. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. The level and verticality of work in walls shall be checked up at every one metre interval.

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The masonry walls of structures shall be carried up progressively, leaving no part one metre lower than the other. If this cannot be adhered to, the concrete block work shall be raked back according to bond (and not left toothed) at an angle not more than 45 degrees, but raking back shall not start within 60 cm of a corner. In all cases returns, buttresses, counter forts, pillars etc. shall be built up carefully, course by course, and properly bonded with the main walls. The concrete block work shall not be raised more than fourteen (14) courses per day.

At the junction of any two walls, the concrete blocks shall at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. Masonry wall intersections shall be bonded with joint reinforcing.

The courses at the top of plinth and sills, at the top of the wall just below the soffit of the roof slab or roof beam and at the top of the parapet, shall be laid with concrete blocks on edge. Concrete block on edge course shall be so arranged as to tightly fit under the soffit of the roof beam or roof slab, restricting the mortar layer thickness up to 12 mm. However, any gap between the finished concrete block work and soffit of roof slab/ beam shall be suitably sealed with the mortar.

Mortar for bonding shall have an adequate composition as to develop crushing strength not exceeding that of the elements which must be joined. All fair faces of the elements in the works, either normal or special, such as elements for shoulders, lintels, corners and crossing etc. must have a solid appearance.

Hollow concrete block cells shall be filled and packed solid with mortar for a minimum width of 400 mm (i.e. full concrete block length) or as specified on drawings at the following locations:

a) At free ends of the walls
b) Each side of openings
c) At tee junctions for bedding of wall ties.
d) At all places where wall ties are specified and/ or indicated on drawings.
e) At all other areas of walls specified on drawing for fixing the wall mounted equipment and/ or fittings.

Intersecting concrete block walls shall be tied, at every fourth course, with 8 mm dia. Tor steel ties having minimum 300 mm lap well embedded in mortar.

5.2.2 Concrete Block Masonry Work (100 mm thickness)

For concrete block walls of 100 mm thickness, all courses shall be laid with stretchers. Wall shall be reinforced with 2 nos. 6 mm diameter mild steel reinforcement bars, placed at every fourth course. The reinforcement bars, shall be straightened and thoroughly cleaned. Half the mortar thickness for the bedding joint shall be laid first and then steel reinforcement, one on each face of the wall, shall be embedded, keeping a side cover of 12 mm mortar. Subsequently, the other half of the mortar thickness shall be laid over the reinforcement covering it fully.

The reinforcement bars shall be carried at least 150 mm into the adjoining walls or RCC columns. In case the adjoining wall being of 100 mm thickness, the length of bars shall be achieved by bending the bars in plan. During casting of reinforced concrete columns, 6 mm diameter mild steel reinforcement bar shall be placed at every fourth course of concrete block masonry. At the junction of two walls, the concrete block shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. The concrete block masonry work shall not be raised more than 14 courses per day.

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Concrete block course under the soffit of beam or slab, shall be laid by restricting the mortar thickness to 12 mm. However, any gap between the finished concrete block work and soffit of slab/ beam, shall be suitably sealed with the mortar.

5.2.3 Cavity Walls for Exterior Closures

Concrete block work in cavity walls shall be similar to general concrete block work. It shall consist of inner wall of 200 mm thickness while the outer wall shall be of 100 mm thickness at a clear gap of 50 mm. The concrete block work on either side of cavity shall conform to the specifications already mentioned in Clause 5.2.1. At the base of the cavity wall, the walls shall be solidly constructed upto 300 mm above the ground level. The cavity wall shall be terminated 300 mm below the soffit of roof slab/ beam and the courses over this shall be continued as normal (non-cavity) concrete block work.

Cavity should be continuous and free from obstructions. Mortar droppings shall be prevented from falling down the cavity by the use of laths or by hayhands which shall be drawn up the cavity as the work proceeds. Any mortar which may unavoidably fall on the wall-ties, shall be removed daily and temporary openings shall be provided to permit the daily removal of mortar droppings from the bottom of the cavity.

The outer and inner leaves shall be tied by means of wall ties. Ties shall be of tor steel bars of 8 mm dia. 200 mm long with hooks at both the ends. These shall be placed not more than 750 mm centres horizontally and not more than 300 mm vertically, and staggered. Additional ties shall be provided near the openings. There shall at be least 5 ties per square metre of surface area of the wall. Ties shall be given a bituminous coat before placement, to protect them from corrosion.

5.2.4 Circular Concrete Block Work

The detailed specification for concrete block work covered under Clause 5.2.1 shall also apply to circular concrete block work. Concrete blocks forming skew backs, shall be dressed or cut so as to give proper radial bearing. Defects in dressing of concrete blocks shall neither be covered up by extravagant use of mortar nor shall the use of chips etc. be permitted.

The circular concrete block work shall be carried up from both ends simultaneously and keyed in the centre. The concrete blocks shall be flushed with mortar and well pressed into their positions so as to squeeze out a part of their mortar and leave the joints thin and compact. All joints shall be full of mortar and thickness of joints shall be 5 mm to 15 mm.

5.3 Jointing

Joints shall be restricted to a width of 10 mm with concrete block work of any classification. All bed joints shall be normal to the pressure acting upon them i.e. horizontal in vertical walls, radial in circular concrete block masonry and at right angles to the face in the battered retaining walls. The vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken that all the joints are full of mortar, well flushed up. In case no pointing is to be done, cement mortar shall be neatly struck as the work proceeds. The joints in faces which are to be plastered or pointed shall be squarely raked out to a depth of 12 mm while the mortar is still green. The rake joints shall be brushed to remove loose particles. After the day's work, the faces of the concrete block work shall be cleaned on the same day with wire brush and all mortar droppings removed.

5.4 Curing

Green work shall be protected from rain or running water or accumulated water from any source. Masonry work, as it progresses, shall be kept thoroughly wet by sprinkling water at

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regular intervals, on all the faces. Curing shall be done after 24 hours of completion of day's work as per IS 2212.

5.5 Surface Finishes

Surfaces finishing shall be carried out as specified in the Archirectural drawings and specifications for Architectural finishes.

5.6 Staging/ Scaffolding

5.6.1 Staging/ scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/ scaffolding. Design of staging/ scaffolding shall be submitted for approval of the Engineer-in-Charge, before commencement of work.

Single scaffolding having one set of vertical support, shall be used and other end of the horizontal scaffolding member shall rest in a hole provided in the header course. The support shall be sound and strongly clamped with the horizontal pieces over which the scaffolding planks shall be fixed. Suitable access shall be provided to the working platform. The scaffolding shall be strong enough to withstand all loads likely to come upon it and shall also meet the requirements specified in IS 2750. The holes left in the masonry work for supporting the scaffolding shall be filled and made good with plain cement concrete of grade M15 before plastering.

Double scaffolding shall be provided for pillars less than one metre in width or for the first class masonry or for a building having more than two storeys.

The following measures shall also be considered during erection of the scaffolding/ staging:

a) Sufficient sills or underpinnings, in addition to base plates, shall be provided, particularly, where scaffoldings are erected on soft grounds.
b) Adjustable bases to compensate for uneven ground shall be used.
c) Proper anchoring of the scaffolding/ staging at reasonable intervals shall be provided in each direction with the main structure wherever available.
d) Horizontal braces shall be provided to prevent the scaffolding from swaying.
e) Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.
f) The scaffolding/ staging shall be checked at every stage for plumb line.
g) Wherever the scaffolding/ staging is found to be out of plumb line, it shall be dismantled and re-erected afresh. Physical force shall not be applied to bring it in plumb.
h) All nuts and bolts shall be properly tightened and it shall be ensured that all the clamps/ couplings are firmly tightened to avoid slippage.
i) Erection work of a scaffolding/ staging, under no circumstance shall be left totally to semiskilled or skilled workmen and shall be carried out under the supervision of Contractor's technically qualified civil engineer.

5.6.2 For smaller works or works in remote areas wooden ballies may be permitted for scaffolding/ staging by the Engineer-in-Charge at his sole discretion. The contractor must ensure the safety and suitability of such works as described under Clause 5.6.1 above.

5.7 Embedment of Fixtures

All fixtures, pipes, conduits, holdfasts of doors and windows etc. required to be built in walls, shall be embedded in plain cement concrete block of grade M15, as work proceeds.

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6.0 PAYMENT

This clause is applicable for Item Rate Tenders only.

6.1 General

The payment of concrete block masonry shall be inclusive of all labour, material (including cement mortar/ ready mix adhesive), scaffolding/ staging sampling and testing, soaking of concrete blocks, laying of concrete blocks, raking of joints, cutting of concrete blocks, providing recesses and making rectangular or round openings, sealing the gap between concrete block masonry and soffit of beam/ slab with cement mortar, curing, making of masonry platform for unloading the wet mix, embedding the fittings/ fixtures including providing PCC of Grade M15 etc, all as specified for all heights and depths as directed by the Engineer-in-Charge. Deduction for rectangular or circular openings shall be done as per relevant BIS Codes.

6.1.1 Payment for concrete block masonry works of 200 mm or more thickness, including circular concrete block work, shall be made on cubic metre basis of the work done.

6.1.2 Payment for 100 mm thick masonry work shall be made on square metre basis on the area of work done and shall also include the cost of supplying and fixing of reinforcement bars in position.

6.1.3 Payment for forming the cavity shall be in square metres and shall include the cost of laying of bitumen coated tor steel ties in position, labour required for keeping the cavity clear, providing air slots etc.

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मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

बाईपोलर कंक्रीट अंतर्वेशित क्षारण अंतर्अधिमिश्रण

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

BIPOLAR CONCRETE PENETRATING CORROSION INHIBITING ADMIXTURE

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	21.07.2025	UPDATED AND ISSUED AS STANDARD SPECIFICATION	AV	RM/SP	AS	MN
1	18.06.2019	UPDATED AND REISSUED	TK	AJS	RS	RKT
0	26.04.2012	ISSUED AS STANDARD SPECIFICATION	AJS	PKM	SC	DM

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ABBREVIATIONS:

AASHTO	:	American Association of State Highway and Transportation Officials
ASTM	:	American Society for Testing & Materials
CPCIA	:	Concrete Penetrating Corrosion Inhibiting Admixture
IS	:	Indian Standard
JIS	:	Japanese Industrial Standard
OPC	:	Ordinary Portland Cement
PPC	:	Portland Pozzolana Cement
PSC	:	Portland Slag Cement
SRC	:	Sulphate Resistant Cement

Structural Standards Committee:

Convener: Mr. Anurag Sinha

Members:
Mr. Virender Goel
Mr. Deepak Agrawal
Ms Alpana Srivastava
Dr. Sudip Paul
Mr. Prasenjit Saha (SMMS)
Mr. Charanjit Singh (Project)
Mr. Indrajit Neog (Construction)
Ms Papia Mandal
Mr. Vikram Kumar Gupta

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1.0 SCOPE

This specification prescribes the requirements and test methods including performance test for evaluating the efficiency of Bipolar Concrete Penetrating Corrosion Inhibiting Admixture (CPCIA) for protecting steel reinforcement embedded in concrete from corrosion. Non-concrete penetrating, Nitrite & Nitrate corrosion inhibitors are excluded from the scope.

2.0 REFERENCES

2.1 Codes

ASTM G1-03, ASTM G3-14, ASTM G109, ASTM G180-04, ASTM C1202, JIS Z-1535, AASHTO T259, IS 2, IS 101(Part1/Sec.5), IS 456, IS 1202, IS 1448, IS 1786, IS 9103, etc.

2.2 EIL Specifications

6-68-0001 : General Scope
6-68-0002 : Materials

3.0 SAMPLING

3.1 The representative samples of the material shall be drawn as per the table given below:

No. of containers (Lot)	No. of containers to be selected for sampling (N)
Up to 50	1
51-100	2
101-300	3
301-500	4
501& Above	5 Plus 1 for every lot of 300 containers

4.0 TESTING REQUIREMENTS

4.1 The product shall comply with the requirements specified in Annexure-A (Short Term Tests) and Annexure-B (Long Term Tests). Both the tests shall be conducted in an approved laboratory.

4.2 Unless specified otherwise, all the tests under Indian tropical conditions shall be conducted at room temperature 27 ± 2°C and relative humidity at 65 ± 5 % in a well ventilated chamber free from dust.

4.3 The contractor shall select the product from EIL approved vendor list and submit the Manufacturer Test Certificate to the Engineer-in-Charge. Approval for usage of product shall be given after satisfactory Short Term test results. Long Term tests are not mandatory for the products listed in EIL approved vendor list.

If the product is not from an EIL approved vendor, both Short term as well as Long term tests are mandatory. The contractor shall submit the Manufacturer Test Certificate to the Engineer-in-Charge and approval for usage of product shall be given after satisfactory Short Term test results. However, payment shall be released after the product complies with the requirements of Long Term test results.

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5.0 HEALTH, SAFETY & ENVIRONMENT CONSIDERATIONS

5.1 The CPCIA shall not cause harm to applicators by mean of inhalation or skin contact. All precautionary measures shall be prescribed by the manufacturers along with instructions of usage. Application methodology shall be approved by the Engineer-in-Charge.

5.2 The waste shall be discharged in accordance with applicable Environmental laws of land.

5.3 CPCIA shall not degrade or damage the construction materials like concrete, aggregates, steel reinforcement, formwork/shuttering.

6.0 PACKAGING

The product shall be supplied in air tight containers and following information shall be labeled on each container:

a) Name of the material
b) Name of the manufacturer
c) Volume/ weight of material
d) Specification number
e) Batch No. or Lot No. in bar code or otherwise
f) Month and year of manufacture
g) Ingredients & method of usage
h) Instructions for safe usage

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ANNEXURE-A

SHORT TERM TESTS

S. No .	Characteristics	Requirements	Methods of Tests
1.	Appearance	Brownish Liquid free from any visible residual deposits	Visually
2.	Odour	Mild Ammonical Odour	By smell
3.	Skin irritation	No irritation	By applying on reverse of the palm for 5 minutes.
4.	Ph i) As in supplied condition ii) 1% dilution ,w/w	 i) 9.0-12.0 ii) 9.0-12.0	 pH meter / Standard pH paper
5.	Specific Gravity at 27 ± 2ºC	1- 1.1	IS 1448
6.	Viscosity of the material as in supplied condition, by Ford cup No 4, at 27 ± 2ºC	10 - 20 sec.	IS 101(Pt.1/Sec.5)
7.	Accelerated Corrosion Test, for 21 hrs. i) Raw water without CPCIA ii) Raw water with CPCIA	 i) Excessive corrosion spots. ii) There shall not be more than 1-2 corrosion spots.	Modified accelerated corrosion test based on Japanese standard JIS Z 1535 (Refer Appendix-I)
8.	Open circuit potential ECorr Test	Minimum shift in potential by 120 mV upon addition of CPCIA	Modified ASTM G 69 (Refer Appendix-II)
9.	Reduction in Corrosion Current ICorr	Minimum reduction by 15 times upon addition of CPCIA	Modified ASTM G 69 (Refer Appendix-III)
10.	Electrical resistivity (R)	R with CPCIA ≥ R without CPCIA	ASTM C1876

Notes:

a) Tests of Sr. Nos. 7, 8, and 9 shall be performed from supplied material received at the site and witnessed by the owner's representative or Engineer in Charge.

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ANNEXURE-B

LONG TERM TESTS
(Shall be performed in triplicate)

S. No .	Characteristics	Requirements		Methods of Tests
		Without CPCIA	With 1% CPCIA	
1.	Immersion test for 720 hrs. (Rebar weight loss method)	40.00 mpy, max.	2.00 mpy, max.	Immersion Test (Rebar weight loss test) as per ASTM G1-03 (Refer Appendix-IV)
2.	Effect of Concrete admixture on compressive strength	Concrete strength in sample with CPCIA* should be ≥concrete strength in sample without CPCIA*		Test for effect on compressive strength by addition of CPCIA as per IS 9103 (Refer Appendix-V)
3.	Polarization test by Tafel polarization with 3.5% Sodium Chloride, for 20 days: Rate of corrosion shall be	45 mpy, max.	9 mpy, max.	Electrochemical polarization test conducted on steel rebars embedded in concrete as per ASTM-G 3-14 & IS 9103 (Refer Appendix-VI)
4.	Effect of CPCIA* on corrosion of embedded steel rebars exposed to chloride environments after 09 cycles (14 days wetting and 14 days drying): Rate of corrosion shall be	25 Coulombs, max.	0.50 Coulombs, max.	Long term corrosion test as per ASTM G109 (Refer Appendix-VII)
5.	Chloride Migration profile properties of concrete (for all types of cements viz. OPC, PPC, PSC, SRC) i) Chloride % in concrete at 30mm depth after 90 days. ii) Ability to resist chloride ion penetration a) Concrete grade M-30, Water cement ratio: 0.45 b) Concrete grade M-40, Water cement ratio: 0.40	0.025%, max. 1650 Coulombs, max. 1550 Coulombs, max.	Nil 1000 Coulombs, max. 1000 Coulombs, max.	AASHTO T-259 (Refer Appendix-VIII) Chloride ion penetration (Salt ponding test) as per IS 456 Electrical indication of concrete ability to resist Chloride Ion Penetration (Rapid Chloride Permeability test) as per ASTM C1202

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6.	Initial screening of CPCIA for Steel in Concrete	Meeting criteria as described in point number 8, "Interpretation of Results"	ASTM G180-04

Notes:

a) CPCIA* : The CPCIA shall be used as 1% w/w of cement or as recommended by the manufacturer for conducting the tests mentioned in Annexure-B except Immersion test for 720 hrs. mentioned at S.No.1 where it shall be used as 1% w/w of water or as recommended by the manufacturer.

b) Rebars conforming to IS 1786 shall be used for testing purposes

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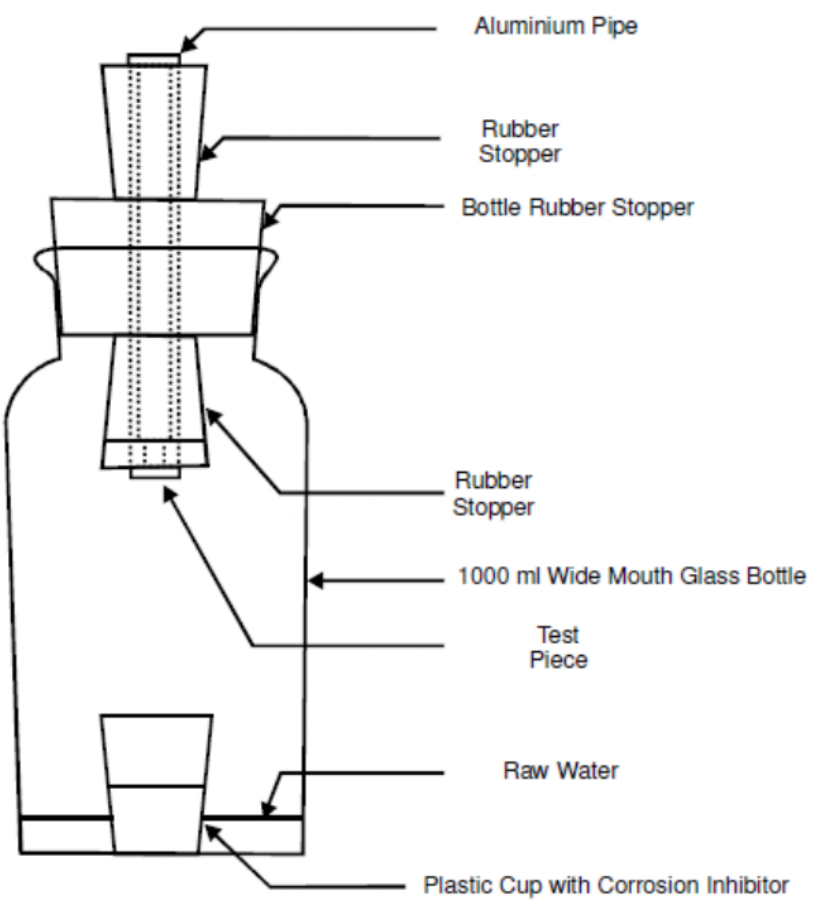
APPENDIX-I

MODIFIED ACCELERATED CORROSION TEST (BASED ON JAPANESE STANDARD JIS Z 1535)

TEST PROCEDURE

Attach steel test pieces conforming to IS 1786 (of size approx. 15mm dia and 12mm thickness drilled from one side c/c to a dia of 10mm and a depth of 10 mm to hold the Aluminium pipe) after thorough cleaning to white metal by using 1000 grade grit paper and subsequently polishing with 3/0 grade and finally with 4/0 grade grit paper to the Aluminium pipe with the help of cello tape so that it is firmly attached. The Aluminium pipe is then slid upwards till the test piece rests in the slot provided in the rubber cork, as shown in the figure.



Assembly with Corrosion Inhibitor

Pour 100 ml of tap water in both the bottles. Fill the plastic cup with 25 ml CPCIA solution as in supplied condition. In one of the bottles place the plastic cup with the CPCIA solution so that the cup is placed in the tap water. Allow to remain for 18 hours at ambient temperature. After 18 hrs. add chilled water having temperature below 1.0 ºC into the Aluminium pipes and allow to remain for 3 hrs. The temperature of the chilled water in the Aluminium pipes shall be maintained at 2.0 ± 0.5 ºC by frequently changing the chilled water with the help of the pipette. Observe the steel test pieces after the experiments i.e. 18+3=21 hrs., for any corrosion spots.

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APPENDIX-II

OPEN CIRCUIT POTENTIAL (Ecorr) TEST

This test is intended to show a live demonstration of the reduction in corrosion potential of steel under 3.5 % NaCl water with the addition of corrosion inhibitor.

Test Apparatus & Consumables

- **Working Electrode** : Polished TMT steel sample (dia. 15 ±2 mm) embedded in cast epoxy/ polymer
- **Reference Electrode** : Saturated Calomel Electrode (SCE) with KCl inserted
- **Voltmeter** : High Input resistance Digital Multimeter
- **Electrolyte Medium** : 3.5 % NaCl water solution 250 ml (Temperature 25-28^{0}C).
- **Water** : DM water or Potable water (Maximum TDS 200)
- **Salt** : Sodium chloride (lab grade) or table salt white powder
- **Test Temperature** : Ambient /At room temperature 23 to 35^{0}C

Sample Preparation

(a) Working Electrode : A working electrode shall be prepared by selecting proper available size of TMT/Carbon steel rebar, a desirable diameter is 16 mm or 20 mm, steel cutting & turning longitudinally on lathe machine to achieve desired shape & size as given in Fig.1. After that, a strong joint connection should be made by soldering or brazing a flexible, shielded and approximately 1 feet long copper wire to the steel disk over the round flat surface to achieve good electrical continuity. For masking this steel & joint connection, use a strong two-pack adhesive (polymer or epoxy system). Choose a proper size of mould and cast this probe attached steel by keeping it in the center of polymer as shown in Fig. 1. The sealed electrode should not leak from any side. Before proceeding to open circuit potential (OCP) testing, a good electrical continuity must be ensured between the exposed steel surface and the copper wire end by checking through a continuity tester or multimeter.

(b) Surface Polishing Preparation: The exposed surface of the mounted sample, the working electrode, should be polished very neatly and systematically up to the mirror finish level without any scratch marks. Follow the stepwise procedure for the preparation:

1. For polishing, keep emery paper horizontal on a clean & plain surface and start polishing with a coarser grade of emery paper 200 grit, or if necessary, start with 100 grit & use subsequent finer grades, i.e., 200, 300, 400,600, 800/1000, or 1200, & finally 02/04 grade.
2. Hold the sample tightly by hand & rub it on the exposed surface in full strokes in the forward direction and raise hand backward without rubbing on paper, similarly repeat the process until the complete grinding of the surface comes evenly in one direction.
3. To shift further to a finer grade turn the sample in perpendicular position (90 degrees) rather than previous direction & polish back and forth as in previous cycle. Continue this for subsequently every new paper and in addition to this before starting a new paper grade simultaneously wipe off surface with clean cloth or tissue paper using acetone / methanol solvent to remove any previous dirt picked up by the sample. Repeat the stepwise procedure systematically until a final mirror finish level is achieved without any scratch line mark.

Testing Procedure

1. Take a clean glass beaker of 500 ml capacity.
2. Fill the beaker with 3.5 % NaCl electrolyte water solution up to 250 ml.

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3. Prepare a working electrode of 15±2 mm dia. disk by cutting & grinding longitudinally TMT reinforced steel as per IS 1786 & solder it with a copper wire to edge of round section. It is completely bounded with epoxy/polymer casting, except the facing portion in exposed conditions. (refer Fig. 1a)
4. The exposed surface of steel must be hand polished with graded emery paper as explained in sample preparation.
5. Clean the polished surface with alcohol or any organic solvent & put the working electrode in the beaker containing the electrolyte solution.
6. For measuring E_{corr} of the polished steel surface in electrolyte solution, connect the other end (probe) of the copper wire to positive polarity of multimeter & turn the knob to the DC volt 2-5 mV range. Similarly connect the SCE banana pin to the –ve terminal of multimeter, after that immerse the SCE electrode near to exposed steel in the electrolyte solution up to the center of the exposed steel area (Refer figure 2), and ensure minimum gap between two electrodes.
7. Measure the reading. It must be more negative than -500 mV, or wait till it reaches between -500 to -550 mV (idle condition is >-550 mV w.r.t. SCE).
8. After showing Ecorr > -500 mV by multimeter, now add 2% of corrosion inhibitor by volume of the total electrolyte solution. Stir the solution slowly & wait up to 15-20 minutes.
9. The Ecorr of steel will shift towards the positive side as compared to the initial Ecorr without the addition of corrosion inhibitor (a minimum shift of -120 mV in Ecorr value is preferable for this test).

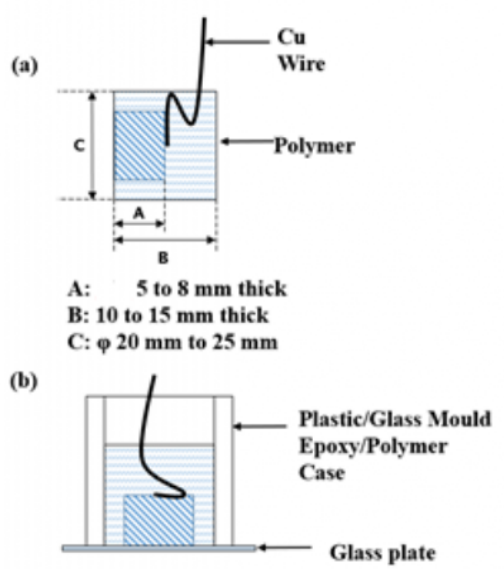

Figure 1.

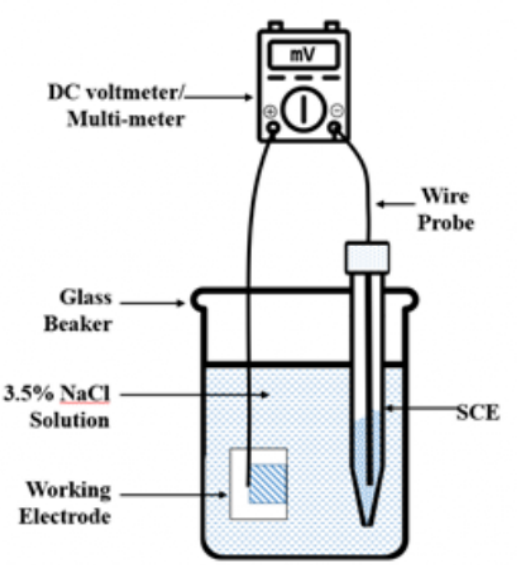

Figure 2.

Result Interpretation

Shifting of Ecorr towards the positive side by min. 120 mV clearly indicates that the corrosion inhibitor is capable of inhibiting corrosion, which displaces the corrosive ion away & chemically generates an invisible passive film on the steel surface when the corrosion inhibitor is added to the electrolyte solution.

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APPENDIX-III

INSTANT REDUCTION IN CORROSION CURRENT (I_{Corr}) AT FREE CORROSION POTENTIAL (E_{Corr}) ON SURFACE TREATED REINFORCED TMT/CARBON STEEL WITH CORROSION INHIBITOR

This test is intended to show a live demonstration of reduction in ongoing instant corrosion current when the surface attains near corrosion cell potential (E_{corr}), which is measured by SCE reference electrode of TMT/Carbon Steel under 3.5 % NaCl water solution with the addition of corrosion inhibitor. This is a short term electrochemical test which can be carried out easily in the laboratory to measure the quality and performance evaluation of corrosion inhibitor directly against TMT/Carbon steel rebar for the corrosion protection of steel in the concrete in a very short duration at ambient temperature.

Test Apparatus & Consumables

- **Working Electrode** : Surface finished TMT or Carbon steel rod sample (dia .10 mm to 16mm) treated with shot blasting or acid pickling (bright or silver finishing level)
- **Reference Electrode** : Saturated Calomel Electrode (SCE) with KCl inserted
- **Voltmeter** : High input resistance digital multimeter
- **Ammeter** : Very low resistance ammeter/ multimeter in DC micro and milliampere range
- **Counter Electrode** : Noble series metal (Nichrome/ Titanium/ SS 316 grade mesh)
- **Electrolyte Medium** : 3.5 % NaCl water solution 200 ml. (Temp. 25-28^{0}C).
- **Electrode support holder** : Non metallic or plastic disc having three hole around the disc
- **Water** : Clean potable water max. TDS 200
- **Salt** : Sodium chloride (lab grade) or table salt (white powder)
- **Test Temperature** : Ambient to 35 ^{0}C

Working electrode preparation

A surface treatment process like blasting or pickling should be carried out over the tempered martensite zone on the top of outer core surface of TMT rebar and it should be done completely free from rust & pit without any crevice marks or corrosion spots.

Since different surface treatment processes attributes significant variation in the corrosion potential and corrosion current of steel due to the intense degree of reaction taking place on the surface topography & profile across varying surface roughness as well as the rapid formation of active anodic and active cathodic cells on the metal surface when exposed to an electrolytic solution at a particular temperature, therefore the comparison shall be made between similar kinds of surface preparation treatments i.e. acid pickling, shot blasting, mechanical polishing or any other types in view to compare the inter and intra laboratory test results.

Counter electrode (CE): A counter electrode mesh made from a metal more noble than carbon steel must be used. The surface area of the CE should be at least 5 times or greater than that of the working electrode.

Testing Procedure

1. Take a clean glass beaker of 500 ml capacity.
2. Fill the beaker with 3.5 % NaCl electrolyte solution up to 350 ml.
3. Prepare the working electrode by selecting a suitable dia. of 12 mm TMT/reinforced steel up to 200 mm in length. The surface finish shall be prepared with fine shot blasting grit or acid pickling, & rinse with plenty of water prior to washing with alkaline solution.

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4. The treated surface area of steel, i.e. the area under test in the electrolyte must be cleaned thoroughly with an organic solvent (acetone/methanol or alcohol) before placing it in the chloride solution.
5. Place the cylindrical-shaped mesh as the counter electrode (SS 316 or superior metal mesh) inside the glass beaker by covering circumferential touching the beaker & shall be over around the test steel working electrode. For measuring corrosion current, extend a sufficient portion of the mesh outside the beaker for making contact with the ammeter probe.
6. Now insert the TMT steel working electrode in the centre of the beaker through a suitable nonmetallic support cover & again insert the calomel ref. electrode in between mesh & working electrode location through the nonmetallic support 12.5 mm hole.
7. First for measuring E_{corr} by using voltmeter connect the (+) polarity probe at top side of TMT steel rebar & connect banana socket pin adjoining calomel electrode to the (–) terminal of socket on voltmeter range and switch on the voltmeter by keeping the knob on the 2 or 5 DC mV range. Measure the reading, it must be more negative than -550 mV or wait till it reaches in between -550 to -625 mV (idle condition is around -600 mV w.r.t. SCE).
8. In the meantime, make connection ready for connecting DC ammeter probe, connect one terminal of the probe to the counter mesh electrode, and connect other end to the DC current socket on the ammeter through a toggle switch by keeping DC current on more than 10 mA range, the second end of probe shall be maintained in standby mode to connect directly to the working electrode when it is required. Keep watching the voltmeter reading, when it is showing around -600 mV (±10 mV), then note down the reading & immediately disconnect the TMT steel connection through the toggle switch connected with voltmeter & connect the ammeter probe to the TMT steel electrode promptly. Read out the current reading in mA range carefully and continuously. Note down the reading after 3 seconds time has elapsed right from the time of immediate connecting probe to the steel electrode. So, this current & voltage reading of TMT steel shall be considered the maximum value in 3.5 % chloride solution before the addition of the inhibitor.
9. Now add 3 % of bipolar corrosion inhibitor to the electrolyte solution & stir properly with a portable stirrer or spatula to mix the solution homogeneously. Disconnect the working electrode probe from the ammeter & connect it with the voltmeter probe. Continuously watch the E_{corr} reading, leave it in this position for 15 to 20 minutes. Finally, the E_{corr} reading will gradually decrease until maximum reduction is observed towards the positive side. At the moment when it reaches momentarily in stable condition and comes down to maximum 120 mV or more reduction in mV value versus previous E_{corr} reading then note down the final E_{corr} reading & disconnect the steel probe & immediately connect the ammeter probe to the steel electrode. Note down the current readings in microampere range after 3 seconds of visible reading at just moment of connecting probes as mentioned in point no. 8.

   To avoid jumbled wire connections & simplify the operation during testing a user can conduct this test in a more comfortable and simple way by using a SPDT switch board with a multiple probe connection setup.

Result Interpretation

The E_{corr} of steel will shift towards positive side as compared to initial E_{corr} without addition of corrosion inhibitor. The current (Icorr) will also reduce instantly, and the preferable value of reduction in current is minimum 15 times lower than the value without addition of corrosion inhibitor in the chloride solution.

Remark

Shifting of E_{corr} towards the positive side along with ongoing current which is falling rapidly, clearly indicates that the corrosion inhibitor is capable of inhibiting corrosion by displacing the corrosive ions away & chemically generating an invisible passive film on the steel surface when added to the electrolyte solution.

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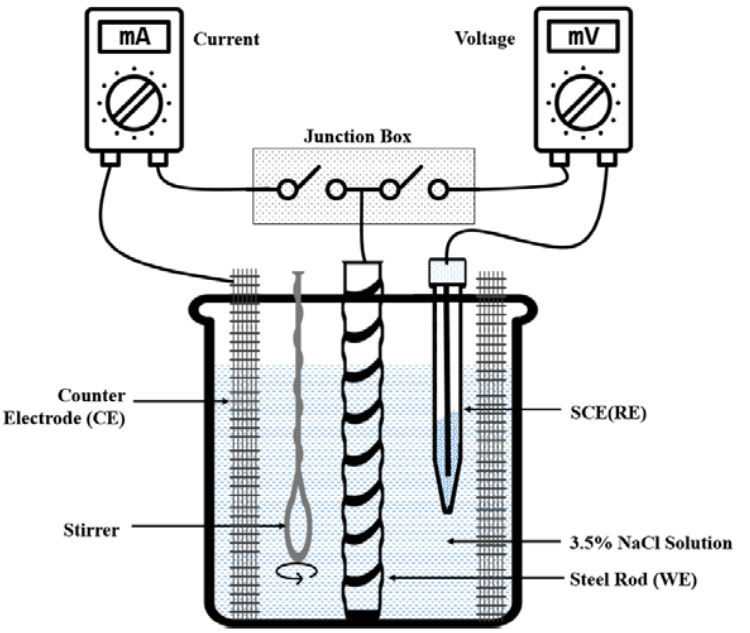

Pictures showing different surface treated TMT Steel reinforced bar

The results should include the following:

1. Type and size of rebar (diameter and length).

2. Types of surface treatment processes on steel in detail.

3. Max. E_{corr} & I_{corr} values just before the addition of the corrosion inhibitor.

4. Added dosage of corrosion inhibitor to the electrolytes.

5. Final values of reduced E_{corr} & I_{corr} measured after adding the bipolar corrosion inhibitor.

6. Lag time duration in seconds (waiting period in seconds) when taking corrosion current readings after switching on the ammeter.

7. Temperature of the electrolytic solution & the surrounding room temperature.

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APPENDIX-IV

IMMERSION TEST (REBAR WEIGHT LOSS TEST) (AS PER ASTM G 1)

TEST PROCEDURE

Take six pieces of Tor steel rebar conforming to IS 1786 of size approx. 40 mm length and 10 mm dia. Clean the rebar of any rust, mill scale etc., with the help of steel wire brush, till it has overall a shining surface. Now clean all the six pieces with solvent such as Benzene/Acetone to remove any loose rust /dust from the surface. Dry at 100 ± 2 ºC for 15 minutes in an oven. Cool and take the weights of all the six pieces and record it.

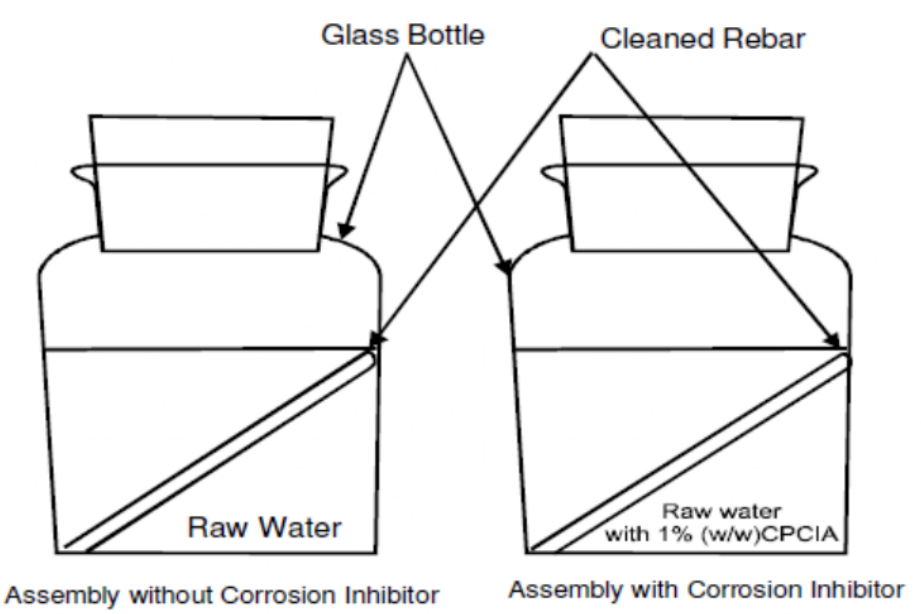
Take six transparent glass/plastic bottles of approx. 150±10 ml with air tight caps. Clean all the bottles with tap water and then fill them with 100 ml of tap water so that the bottles are approx. three fourth filled. In three of the six bottles, add CPCIA 1%, w/w or as recommended by the manufacturer of the water in the bottle. Now put one cleaned and weighed rebar test piece completely immersed in water/water + CPCIA, in all the six bottles and close the cap.

After 30 days (720 hrs.), take out all the six test pieces and put them in Clark solution (prepared by dissolving 20 gms. of Antimony Trioxide and 50 gms of Stannous Chloride in 1000 ml of Conc. Hydrochloric acid, S.G. 1.18) so that corrosion products are dissolved. After complete removal of corrosion products (in 5 minutes approximate), take out the test pieces and wash in running water and finally with distilled water. Then wash the test pieces, with solvent such as Benzene/Acetone. Dry at 100 ± 2 ºC for 30 minutes in an oven. Cool and take the weights of all the six pieces and record it.

Calculate the corrosion rate in mpy, by using the formula

Corrosion rate (mpy) = 534 (W1-W2) / DAT

Where W1-W2 is the weight loss in mg., D is the density of steel , A is the area in sq.inch and T is the time of exposure in hrs



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APPENDIX-V

TEST FOR EFFECT ON COMPRESSIVE STRENGTH BY ADDITION OF CPCIA

TEST PROCEDURE

Cast three concrete blocks of size 100mm x 100mm x 100mm each without and with CPCIA 1% (w/w) of cement or as recommended by the manufacturer, by casting the concrete of M20 grade as per Clause 6.2.3 of IS 9103.

The above casted blocks shall be demoulded after 24 hrs. These blocks shall be moist cured for 28 days. After completion of the curing period, the blocks of each type shall be tested for compressive strength in compression testing machine (Universal Tensile Machine) and data recorded.

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APPENDIX-VI

BRIEF OUTLINES OF ELECTROCHEMICAL POLARIZATION TEST CONDUCTED ON STEEL REBARS EMBEDDED IN CONCRETE (AS PER ASTM G 3)

TEST PROCEDURE

Cast three concrete cylinders, of size 75mm dia and 150mm length each without and with CPCIA 1% (w/w) of cement or as recommended by the manufacturer, by casting the concrete of M 20 grade as per Clause 6.2.3 of IS 9103, and placement of one cleaned rebar conforming to IS1786 of size 375mm length and 12mm dia (preferably cleaned by pickling in Hydrochloric acid 20% (v/v) approximately, till surface shines and washed in running water) in each block .

The above casted blocks shall be demoulded after 24 hrs. These blocks shall be moist cured for 28 days.

After completion of the curing period, the blocks shall be subjected for Polarization test for 20 days as per ASTM G-3 and observations recorded.

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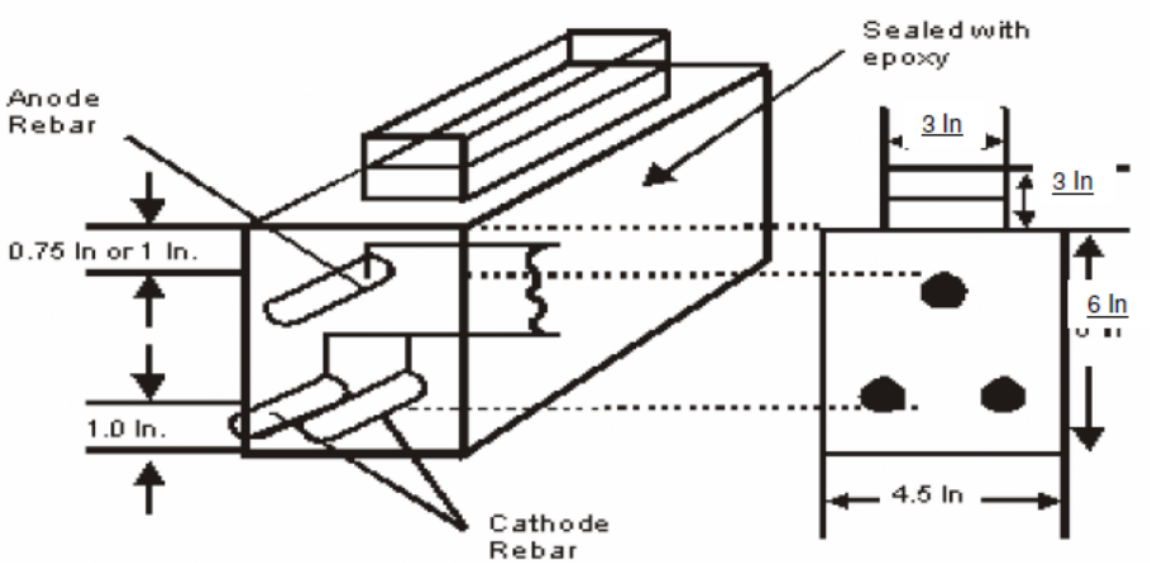
APPENDIX-VII

BRIEF OUTLINES OF LONG TERM CORROSION TEST (AS PER ASTM G 109)

TEST PROCEDURE

Three specimens each of control concrete and that of CPCIA admixed concrete (1% w/w of cement or as recommended by the manufacturer) should be cast as per the size 280mmx150mmx115mm and with placement of three cleaned reinforcement bars conforming to IS 1786 (preferably cleaned by picking in Hydrochloric acid 20% (v/v) approx, till surface shines and washed in running water) of size 12mm and length 375mm as per the details shown in the figure. Admixture shall be added as per manufacturers recommended dosage. All the casted concrete samples shall be moist cured for 28 days.

Ponding of samples with 3% NaCl solution as shown in the figure to be continued and measuring of voltage across 100-ohm resistor to be continued beginning of the second week of ponding. Calculate the current IJ from the measured voltage and record. Also measure the corrosion potential of the bars against reference electrode. The experiment should be continued till the macrocell current reaches a value of 10 µA. After the experiment break the specimens and examine the rebars for extent of corrosion, measure the corroded area and record.



Note - All Measurements in In. (25.4 mm = 1 In.)

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APPENDIX-VIII

BRIEF OUTLINES OF RESISTANCE OF CONCRETE TO MIGRATION OF CHLORIDE ION TEST (AS PER AASHTO T259)

Part-A : Chloride Ion Penetration (Salt Ponding Test As per IS 456)

TEST PROCEDURE

Cast three concrete blocks of size 300mmx300mmx75mm each without and with CPCIA 1% (w/w) or as recommended by the manufacturer, by using the concrete mix as under:

S.No.	Material	M30 (Kg)	M40 (Kg)
i)	53 Grade Cement	50	50
ii)	Coarse Sand	104	87
iii)	Aggregate, passes through 20 mm and retained on 10 mesh	160	134
iv)	Water (subject to 55±5 slump)	24	20
v)	CPCIA	0.5*	0.5*
	* as recommended by the manufacturer with each type of cement viz. Ordinary Portland Cement, Portland Pozzolana Cement, Portland Slag cement, Sulphate resisting Cement		

AASHTO T259 test (commonly referred to as the salt ponding test) is a long-term test for measuring the penetration of Chloride ions into concrete. Three slabs of 75 mm thick and having a surface area of 300 mm square shall be casted. These slabs are moist cured for 14 days and then stored in drying room at 50 percent relative humidity for 28 days. The sides of the slabs are sealed except for bottom and top face. After the conditioning period, a 3% NaCl solution is ponded on the top surface for 90 days, while the bottom face is left exposed to the drying environment (see figure below).

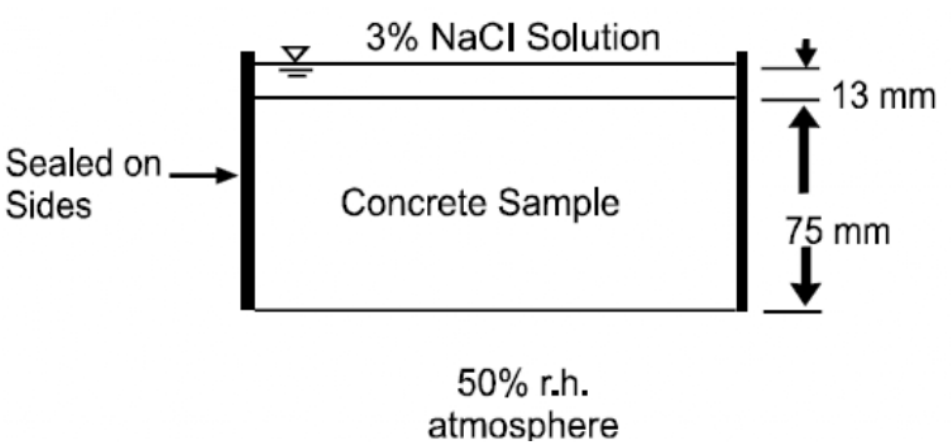

Figure: AASHTO T259 (Salt ponding) test setup

At the end of this time (90 days) the slabs are removed from the drying environment and the Chloride concentration of 10 mm thick slices is then determined (AASHTO T259). Two or three slices are taken at progressive depth. The salt ponding test does provide a crude one-dimensional chloride ion ingress profile. Test results should meet the requirements as stipulated in IS 456.

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BRIEF OUTLINES OF RESISTANCE OF CONCRETE TO MIGRATION OF CHLORIDE ION TEST (AS PER AASHTO T259)……Contd.

Part-B : Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration (Rapid Chloride Permeability test As per ASTM C-1202)

TEST PROCEDURE

Cast three concrete cylinders of size 50 mm thick, 100 mm diameter without and with CPCIA 1% (w/w) or as recommended by the manufacturer, by using the concrete mix as under:

S.No.	Material	M 30 (Kg)	M 40 (Kg)
i)	53 Grade Cement	50	50
ii)	Coarse Sand	104	87
iii)	Aggregate, passes through 20 mm and retained on 10 mesh	160	134
iv)	Water (subject to 55±5 slump)	24	20
v)	CPCIA	0.5*	0.5*
	* as recommended by the manufacturer with each type of cement viz. Ordinary Portland Cement, Portland Pozzolana Cement, Portland Slag cement, Sulphate resisting Cement		

As per ASTM C-1202, water-saturated concrete specimen is subjected to a 60 V applied DC voltage for 6 hrs. using the apparatus shown in Figure below. In one reservoir is a 3.0% NaCl solution and in the other reservoir is a 0.3 M NaOH solution. The total charge passed is determined and this is used to rate the concrete's resistance to chloride ion penetration.

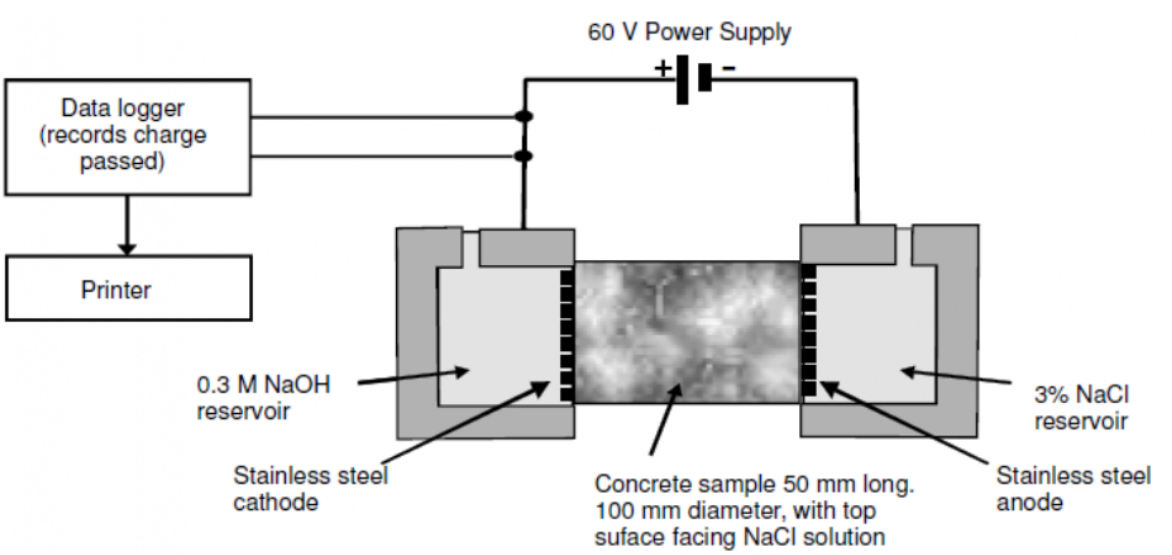

Figure: AASHTO T277 (ASTM C1202) test setup

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मानक विनिर्देशन

सिविल संरचना

STANDARD SPECIFICATION
CIVIL - STRUCTURAL

एकमुश्त टर्न-की कार्य

(एल.एस.टी.के. कार्य)

LUMP-SUM TURN-KEY WORKS
(L. S. T. K. WORKS)

सामान्य आवश्यकताएँ

GENERAL REQUIREMENTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
1	04 07 2019	REVISED AND ISSUED AS SPECIFICATION	AVM	AJS	RS	RKT
0	30 08 2013	ISSUED AS SPECIFICATION	GV	AS / RS	PKM	DM

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Abbreviations:

AFC	: Approved for Construction
BIS	: Bureau of Indian Standards
DCI	: Document Control Index
EDB	: Engineering Design Basis
EIL	: Engineers India Limited
GAD	: General Arrangement Drawing
LOI	: Letter of Intent
LSTK	: Lump-sum Turn-key
MTO	: Material Take-off
PC	: Personal Computer
RCC	: Reinforced Cement Concrete
VDMS	: Vendor Document Management System
VDR	: Vendor Document Requirement

Structural Standards Committee:

Convenor: Mr. Rajanji Srivastava

Members:
Mr. Anurag Sinha
Mr. VK Panwar
Mr. Samir Das
Mr. Amitabh Kishore
Mr. Gyasuddin
Mr. Charanjeet Singh (Projects)
Mr. Ravindra Kumar (Construction)

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1.0 GENERAL

1.1 The design considerations given hereunder establish the minimum basic requirements for civil-structural works for LSTK contracts.

This standard specification shall be read in conjunction with the Engineering Design Basis document (EDB) issued for the Job and Standard Specification No. 6-68-0022 for Material & Construction requirements.

All structures shall be designed for satisfactory performance and functions for which the same are to be constructed.

a) Whenever any reference to BIS/ other code is made, the same shall be taken as the latest revision (with all amendments issued there to) on the notified date of submission of tender.

b) Apart from the codes mentioned in particular in the EDB document, all other relevant codes related to the specific job under consideration and/ or referred to in the above-mentioned codes, shall be followed wherever applicable. Reference to some of the codes does not limit or restrict the scope of applicability of other relevant codes.

c) In case of any variation/ contradiction between the provisions of BIS codes and the requirements given in EDB document, the provisions given in EDB document shall have precedence over all others. In absence of relevant BIS codes, reference to corresponding British or American codes may be made (in that order of preference).

All designs, detailing and construction shall strictly conform to the standards, specifications and 'specific requirements' enclosed with the tender. Only if relevant information is not available in these documents, reference to relevant BIS code shall be made.

1.2 A Document Control Index [DCI, i.e. detailed list of drawings/ documents, including specifications, standards, design philosophy (foundation & superstructure), general notes, design calculations, design drawings, Bulk Material Take-off (Bulk MTO), bar bending schedules (for RCC works) and fabrication drawings (for structural steel works)] indicating the document/ drawing category (review or record as applicable) together with the scheduled and actual date of submission of the documents, shall be submitted by the Contractor through the Vendor Document Management System (VDMS) and kept updated at all times in the DCIM for review by Owner/ owner's representative.

1.3 The Bulk MTO document containing Cement, Re-bars (*diameter-wise*) and Structural Steel (*section-wise*) shall be submitted within 45 days from the date of receipt of LOI. The same shall be updated at 50% & 90% stages of the engineering.

1.4 Structure-wise quantity statements (showing anticipated, released and balance quantities of concrete, structural steel and piles) shall be submitted by the Contractor and kept updated at all times in the Vendor Document Management System (VDMS) for review by Owner/ owner's representative. The DCI shall also indicate the document/ drawing category (review or record as applicable) together with the scheduled and actual date of submission of the documents.

1.5 Vendor Document Management System (VDMS) is a web application that lets suppliers/ contractors manage their Document Control Index (DCI) through an interface, submit their documents for review/ record and get the reviewed/ approved documents/ drawings.

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2.0 DESIGN & DOCUMENT REVIEW

2.1 Before proceeding with design and drawing preparation, the Contractor shall submit detailed philosophy of design of various parts of (all) the structures and foundations (including equipment foundations) along with explanatory sketches for review by Owner/ owner's representative. Only after the approval (including review and incorporation of comments as offered during the review) of the design philosophy, the Contractor shall submit any design document and/ or drawing for review or record or issue the same for construction.

2.2 The Contractor shall carry out the structural design of all structures and prepare complete set of civil and structural approved for construction (AFC) drawings needed for correct and accurate construction. The design/ drawing shall be strictly in accordance with the approved design philosophy prepared for the structure (including "Design Criteria" given in the EDB) and architectural/ structural general arrangement and shall incorporate all the comments/ suggestions given by Owner/ owner's representative without any extra cost to the Owner and without any implication on the time-schedule for completion of works.

2.3 Design and detailing of the structures and foundations shall fulfill all functional requirements for which the same is intended and it shall be ensured that adequate accesses, clearances, clearing of interferences, provision of cutouts, etc. have been provided to make the structure/ foundation fully operational.

2.4 Construction of units/ structures identified for design/ drawing review (as referred in Vendor Document Requirement (VDR) attached in the bid document or DCI) by Owner/ owner's representative shall not be taken up at the site till these documents are reviewed by Owner/ owner's representative and comments/ suggestions given by Owner/ owner's representative are incorporated along with submission of compliance sheet indicating incorporation of all comments. For all other foundations and structures the Contractor shall directly submit the AFC drawings to Engineer-in-Charge and construction of such works shall be taken up immediately. Design and drawings for such foundations/ structures shall also be simultaneously submitted in VDMS for Owner/ owner's representative's record. In the event Owner/ owner's representative offers any comment on documents/ drawings of record category, it shall be ensured by the Contractor that these comments are duly incorporated in the documents/ drawings and revised set of document/ drawing is issued to site for construction and simultaneously submitted in VDMS for Owner/ owner's representative's record.

2.5 Submission of typical review category documents shall be taken up prior to corresponding record category documents. Owner/ Owner's representative comments on typical review category documents shall be duly taken care in all relevant record category documents as well before issuing them for construction and simultaneously submitted in VDMS for Owner/ owner's representative's record.

Wherever review is carried out the same shall be restricted to following:

a) Conformance of general arrangement of the structure to approved design philosophy and design basis.
b) Overall framing of the building/ conceptual foundation system.
c) Detailed design and drawings including input/ output of computer analysis and design vis-a-vis actual drawing.

Irrespective of the identified structures requiring review, the Contractor shall submit complete set of design and drawings of all structure/ foundation systems.

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2.6 To facilitate an overall systematic review, the Contractor shall ensure the following:

a) Structural design/ drawings for any structure/ foundation are submitted for review only if referenced input (e.g. architectural drawing, equipment layout, piping general arrangement drawing (GAD), equipment data sheet, vendor drawing, etc.) have been reviewed by the concerned Owner's specialist in approval/ review Code-2 or Code-1 and are available in the VDMS on or before the date of submission of structural design/ drawings.

b) Complete set of design and drawings of each independent building/ structure are submitted simultaneously

c) Relevant checklist(s) duly filled-up, signed (by the approver of civil-structural design/ drawing) & stamped, shall accompany each deliverable of civil-structural document/ drawing submitted by the contractor. The checklist(s) are to be used as a guide while performing the related activities. The same are attached as annexure. All points listed therein are mandatory check point. Other points/ observations/ comments may be added based on need and judicious discretion depending on the importance of activity/ deliverables.

d) Soft copy of files created as input for computer analysis/ design are also part of the respective design documents.

e) All re-submissions are accompanied with a compliance statement (a document stating point-wise compliance to all comments by Owner/ owner's representative on previous submission)

2.7 In case the referenced input (e.g. geotechnical recommendations, architectural drawing, equipment layout, piping general arrangement drawing (GAD), equipment data sheet, vendor drawing, etc.) as applicable, reviewed by the concerned Owner's specialist in approval/ review Code-2 or Code-1 are not available in the VDMS on or before the date of submission of structural design/ drawings for any structure/ foundation, the date of submission of structural design/ drawings shall deemed to be considered as the date of submission of approved reference drawing.

2.8 To ensure accuracy, correctness and completeness of documents before submission to Owner/ owner's representative, the Contractor shall ensure that all such submitted designs and drawings are complete in all respects, thoroughly checked, stamped APPROVED FOR CONSTRUCTION, and signed APPROVED by the Contractor's own responsible civil/ structural graduate (minimum) engineer (irrespective of the fact that the same are prepared in the Contractor's own design office or by an approved agency/ sub-contractor).

Incomplete, unchecked, unsigned and unstamped design documents/ drawings shall not be reviewed/ accepted for construction and shall be deemed to be considered as void/ withdrawn.

2.9 The accuracy/ correctness of all designs and drawings shall be the sole responsibility of the Contractor and any delay/ loss/ damage to the Owner in respect of any mistake/ discrepancy/ anomaly in such designs and drawings shall be entirely borne by the Contractor.

2.10 Owner/ owner's representative reserves the right to review any/ all or none of the designs and drawings. Review by Owner/ owner's representative shall not relieve the Contractor of his responsibility for correct design and execution of the works.

2.11 Revision of any design/ drawing/ detailing shall not be permitted unless the same is necessitated due to comments on review of such documents by Owner/ owner's representative. Such revisions shall be restricted to incorporation of these comments only and no new details shall be added in the drawings unless called for by comments during review. All revised portion shall be clearly marked and clouded on the respective drawing for easy

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identification. Subsequent review of such revised documents, if required shall be limited to revision as clouded.

2.12 All fabrication/ erection drawings and bar bending schedules shall be prepared by the Contractor and shall be directly issued through VDMS for construction to the work. Such drawings together with design calculations for all splices, joints and gusset plates shall simultaneously be reviewed by Owner/ owner's representative at site (Resident Construction Manager). The Owner/ owner's representative at site at his discretion may review all or some or none of these designs & drawings.

Wherever such review is carried out the same shall be restricted to the following:

a) Structural layouts, orientation, elevation of structural members.
b) Section/ size of members.
c) Adequacy of few critical connections and joints for their required strength.

2.13 For analysis and design of structures, latest version of internationally accepted commercial software viz. STAAD.PRO or equivalent are permitted.

In case software packages (commercially available or in-house developed) other than above are intended to be used for analysis and design, the same shall be informed in writing to Owner/ owner's representative. A validation report consisting of calculations and relevant computer files containing input and detailed output (also refer clause 2.14) shall be submitted by the Contractor through VDMS. Only after getting written approval from Owner/ owner's representative, to this effect, such intended software be put to use for detailed analysis and design.

2.14 The following minimum documentation shall be submitted through VDMS for computer aided analysis and design as a part of structural analysis & design document:

a) Complete input and output files in native format.
b) Relevant sketches of structure geometry with node and member numbering, loading, bending moment, shear force, deflected shape diagrams, etc.
c) Summary of member end forces, support reactions, stress ratio, deflections, etc.

2.15 Contractor shall depute the concerned Civil-Structural design engineer to the review office of Owner/ owner's representative as and when required for review of contractor's documents. During such reviews involving computer aided analysis/ design/ drafting of structures, the contractor shall make his own arrangement of Personal Computer (PC) in the form of Lap-top in the premises of review office of Owner/ owner's representative. This is required to expeditiously resolve all the comments including those involving the use of PC by contractor in his submission. The contractor shall ensure that these PC's are fully operational along with necessary software already loaded including the input/ output/ drawing files of the structures being reviewed. The contractor shall revise and re-submit the analysis/ design and drawings as required during review, through VDMS.

Reviewing of designs/ drawings is not obligatory on the part of Owner/ owner's representative and complete correctness/ soundness of the designs/ drawings and their execution at the site shall be the sole responsibility of the Contractor irrespective of the fact whether the same has been reviewed by Owner/ owner's representative or not. Any defect observed during construction or till the defect liability period of works' shall be rectified and removed by the Contractor. The Contractor shall carry out whatever modification or reconstruction is needed for the purpose, to the entire satisfaction of the Engineer-in-Charge/ Owner without any extra cost and/ or time implication to the Owner.

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Filled-up, signed (by the approver of civil-structural design/ drawing) & stamped checklist shall accompany each submission of civil-structural document/ drawing by the contractor:

Project:		Job No.:	
Document No.:		Rev. No.:	
Document Title:			

Sl. No.	PMC Requirement	Contractor's Response	Remarks
1.	The submission is as per submission schedule as per approved DCI.	□ Yes	
2.	The submission is as per submission sequence as per approved DCI.	□ Yes	
3.	Basic documents prepared by the contractor (e.g. design philosophy, specifications, standards, general notes, etc.) are already approved.	□ Yes	
4.	Bulk MTO has been submitted.	□ Yes	
5.	All the referenced input (e.g. geotechnical recommendations, architectural drawing, equipment layout, piping general arrangement drawing (GAD), equipment data sheet, vendor drawing, etc.) as applicable have been reviewed by the concerned Owner's specialist in approval/ review Code-2 or Code-1 and are available in the DCIM on or before the date of submission of structural design/ drawings.	□ Yes	
6.	The design calculations being submitted herewith are complete in all respects, thoroughly checked and confirm to approved engineering design basis, relevant approved input documents and applicable codes & standards, stamped APPROVED FOR CONSTRUCTION, and signed APPROVED by the Contractor's own responsible civil/ structural graduate (minimum) engineer (irrespective of the fact that the same are prepared in the Contractor's own design office or by an approved agency/ sub-contractor).	□ Yes	
7.	The drawings being submitted herewith are complete in all respects, thoroughly checked and confirm to approved design calculations, approved general arrangement, stamped APPROVED FOR CONSTRUCTION, and signed APPROVED by the Contractor's own responsible civil/ structural graduate (minimum) engineer (irrespective of the fact that the same are prepared in the Contractor's own design office or by an approved agency/ sub-contractor).	□ Yes	
8.	The documents/ drawing being submitted are complete with respect to the whole structure.	□ Yes	
9.	In case this submission is for drawings only, the related analysis & design have already been submitted.	□ Yes	
10.	Structure-wise quantity statements (showing anticipated, released and balance quantities of concrete, structural steel and piles) are updated & submitted.	□ Yes	
11.	In case this submission is of record category document/ drawing, similar review category documents/ drawings have already been submitted.	□ Yes	

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Sl. No.	PMC Requirement	Contractor's Response	Remarks
13.	In case this submission is of record category document/ drawing, the submitted document/ drawing incorporates comments on the similar review category document/ drawing.	□ Yes	
14.	The accuracy/ correctness of all designs and drawings shall be the sole responsibility of the Contractor and any delay/ loss/ damage to the Owner in respect of any mistake/ discrepancy/ anomaly in such designs and drawings shall be entirely borne by the Contractor. Review by Owner/ owner's representative shall not relieve the Contractor of his responsibility for correct design and execution of the works	□ Yes	

Date: Name & Signature

Note:

Contractor to check & confirm that the submission meets the above requirements of PMC and categorically tick ☑ mark in the "☐ Yes" response.

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Filled-up, signed & stamped compliance sheet shall accompany each re-submission of civil-structural document/ drawing by the contractor:

Document No. :

Rev. No.:

Date of Submission:

Date of Review:

Review Code: □ 1 □ 2 □ 3 □ R □ V

Sl. No.	Reference Clause	PMC Comments	Contractor's Response
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

Review Code Legend:

Code 1 : No comments.

Code 2 : Proceed with manufacture/ fabrication as per commented document. Revised document required.

Code 3 : Document does not confirm to basic requirement as marked. Resubmit for review.

R : Retained for Records.

V : Void.

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Project:		Job No.:	
Document No.:		Rev. No.:	
Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
1	Founding level/ depth of foundation with respect to HPP/ FGL/ NGL/ EGL/ FFL (strike out whichever is not applicable).	
2	Requirement & Level of plinth/ tie beams.	
3	Type, Shape & Dimensions of footing.	
4	Adequacy of loading for foundation.	
5	Correctness of the design forces as per analysis.	
6	Selection of critical loading cases/ combinations.	
7	Long/ short column effect for pedestal.	
8	Size of pedestal: a) type of anchor bolts b) bolt spacing (with respect to clearance between the bolts) c) edge distance of anchor bolts d) depth of embedment of anchor bolts	
9	Location co-ordinates & Orientation with respect to North direction.	
10	Conformance to Geotechnical recommendations: a) check for SBC at founding depth (w.r.t. settlement/ shear) b) consideration of ground water table. c) check for FOS against overturning, sliding d) increase in SBC (limited to 25% for wind or seismic/ 100% for blast) e) spacing of piles (within group & inter-group) f) pile cut-off level g) load check conforming to pile capacity h) increase in pile capacities (limited to 50% for vertical & 25% for lateral for wind/ seismic/ 50% for blast)	
11	Projection of foundation outside battery limit is co-ordinated with Civil Department for under-ground piping, etc.	
12	Ductile detailing requirements for reinforcement, wherever applicable.	
13	Internal co-ordination with all concerned departments.	

Date: Name & Signature

Legend :

✓ : Check carried out and found OK

✓ NA : Check carried out and found not applicable

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Project:		Job No.:	
Document No.:		Rev. No.:	
Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
1	Approved (at least review code 2) inputs available.	
2	Complete loading data: a) reference line of machine, base frame dimensions and suction side & discharge side (for pumps) b) size of block/ deck, pedestal above HPP c) static/dynamic loads (or dynamic load factor) & their location of application (as per vendor) d) permissible limiting values of vibration parameters e) pocket dimensions, locations f) grout type & thickness g) whether anti-vibration pads are provided	
3	Founding level/ depth of foundation w.r.t. HPP/ FGL/ NGL/ EGL/ FFL	
4	Value of C_u & net SBC from soil recommendations. For pile foundations, the pile stiffness value.	
5	Amplitude of vibration and resonance check in required modes.	
6	No fouling with adjacent foundation as per equipment layout.	
7	Check for limiting size of element(s).	
8	Check for critical speed, whether the machine is variable speed or fixed speed? If variable speed motor is used, whether amplitude has been checked considering the machine speed same as the natural frequency of the foundation system.	
9	Minimum reinforcement requirement as per IS:2974.	
10	Specified number of construction joints & their details.	
11	Note for single pour.	
12	Internal co-ordination with all concerned departments.	

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✓ NA : Check carried out and found not applicable

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Project:		Job No.:	
Document No.:		Rev. No.:	
Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
1	Design method (cracked or un-cracked) to be identified for each element.	
2	Check for stability & uplift as per respective structure/ pit/ tank w.r.t. water table at various stages of construction.	
3	Requirement of minimum thickness & reinforcement.	
4	Reinforcement provided on both faces (for slab & walls).	
5	Treatment to be given on surfaces in contact with earth.	
6	Anti-corrosive treatment for structures storing corrosive liquids.	
7	Requirement of joints, water stops, puddle flanges, giving notes for execution sequences.	
8	Internal co-ordination with all concerned departments.	

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Project:		Job No.:	
Document No.:		Rev. No.:	
Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
1.0	**Availability of Inputs**	
1.1	Approved Architecture drawings of building	
1.2	Approved Plot Plan	
1.3	Approved related Area Drawings	
1.4	Contour plan	
1.5	Approved Geotechnical Recommendation	
1.6	Approved Electrical Drawings for Substation Building	
1.7	Approved Instrumentation Drawings for Control Room Building	
1.8	Vendor Inputs for: a) Air Conditioning Equipments b) Transformers etc. c) Lift	
2.0	**Correctness of Inputs**	
2.1	With respect to Architecture Drawings: a) Framing arrangement. b) Level & Location: i) Co-ordinate of building ii) Finished Ground Level iii) Finished Floor Level iv) Approach Road Level c) Brickwork arrangement i) Length/ height of brickwork. ii) Stability check for brickwork with Steel frame. iii) Flushing of Brickwork with frame structure. iv) Brick supporting arrangement for Rain water Pipe encasing. d) Requirement of expansion joints as per codal provisions. e) Arrangement & levels of false flooring & false ceiling. f) Clear height of floors. g) Cross-checking of elevations at FFLs of Ground Floor, Upper Floors, Roof etc., w.r.t. FGL, Approach Road Level. h) Monorail location & extent of monorail beam for Substation building.	
2.2	With respect to Mechanical Drawings: a) Lift Pit Size and loading available in Approved Mechanical/ Vendor Drawing. b) Machine Room Details available in Approved Mechanical/ Vendor Drawing. c) Cut-out details for duct in AC Plant room/ AHU rooms in Approved Mechanical/ Vendor Drawing. d) Details of pedestals for AC Plant/ AHU in Approved Mechanical/ Vendor drawing. e) Monorail location & Capacity as per Approved Mechanical drawing.	

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SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
2.3	With respect to Electrical Drawings: a) Transformer details. b) LT-HT Switch gear panel location. c) Cable trench layout.	
2.4	With respect to Instrumentation Drawings: a) Panel resting arrangements. b) Cable tray details. c) Pipe sleeves details. d) MCT location. e) Cable tray in superstructure. f) Cable trench layout.	
2.5	With respect to General Civil Area Drawings: a) Co-ordinates of building b) Orientation of building with respect to North direction. c) Approach Road level/ Finished Ground Level. d) Contour for NGL from Plot Plan. e) Fouling with existing/ proposed facilities from Area/ Foundation drawing. f) Underground facilities from Area Drawing.	
2.6	With respect to Geotechnical Recommendation: a) Type of foundation (Shallow or Pile). b) Depth of foundation. c) Net Allowable SBC for foundation from Geotechnical Report. d) Pile Capacity from Geotechnical Report. e) Diameter of Pile & Spacing of Piles from Geotechnical Report. f) Specification of Piling. g) Drawing of Pile.	
3.0	**Design Aspects**	
3.1	Structure is analysed as 3D Framed Structure.	
3.2	Uses of Codes as per approved EDB: a) For Concrete (IS:456/ IS:13920) b) For Steel (IS:800)	
3.3	Grade of Material as per approved EDB: a) Concrete b) Reinforcement c) Structural Steel	
3.4	Covers as per approved EDB: a) Foundation b) Column c) Beam d) Slab e) Wall	
3.5	Checking of Minimum thickness as per approved EDB: a) Foundation b) Column c) Beam d) Slab e) Wall	
3.6	**Loadings**	

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SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
3.6.1	Dead Load: a) Self weight b) Slab load c) Brick load d) Gutter/ Parapet load	
3.6.2	Live/ Imposed load as per approved EDB for panels, ducts, cables etc. on floor, roof canopy, passage, lobby & stair case: a) Office Building b) Administrative building c) Substation building d) Control room	
3.6.3	Seismic Load as per approved EDB: a) Method of Seismic Analysis (Seismic Coefficient/ Response Spectra). b) Importance factor (Mention Value). c) Response reduction factor accordingly consideration of ductile detailing (Mention Value). d) Damping factor (Mention Value). e) Type of soil. f) Type of structure. g) Time period for frame structure as per IS:1893.	
3.6.4	Wind load for Shed type Building a) Basic Wind Speed (Mention Value). b) Probability Factor (k_1) (Mention Value). c) Terrain, Height, Structure Size Factor (k_2) (Mention Value). d) Topography Factor (k_3) (Mention Value).	
3.6.5	Blast load for Control Room shall be as per RRA report (Mention Blast Pressure).	
3.6.6	Load combination shall be as per approved EDB:	
3.7	Design of concrete member of building shall be as per IS:456/ IS:13920.	
3.8	Ductile detailing requirements for Reinforcement, wherever applicable.	
3.9	Slenderness check for design of columns.	
3.10	Crack width of beam/ slab.	
3.11	Deflection of slab/ staircase.	
3.12	**Foundation design.**	
3.12.1	Fouling of under-ground cable trench with foundations/ plinth beams etc.	
3.12.2	Alignment of plinth beams with brick walls.	
3.12.3	Factor of safety against overturning & Sliding as per approved EDB.	
3.12.4	Checking of SBC/ pile capacity as per approved Geotechnical Recommendation.	
3.12.5	Maximum allowable settlement of soil as per approved EDB	
3.12.6	Checking of modified pressure calculation in case of tension occurred.	
3.12.7	Increase in stress shall be as per Geotechnical Recommendation.	
3.12.8	Minimum percentage of reinforcement as per approved EDB	
3.12.9	Minimum spacing of reinforcement bar as per approved EDB.	
4.0	Internal coordination with other departments.	

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SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
5.0	MTO for super structure & Substructure a) Area of building b) Concrete in foundation c) Concrete in superstructure d) Reinforcement in foundation e) Reinforcement in superstructure f) Reinforcement per Cu. M. of Concrete for foundation g) Reinforcement per Cu. M. of Concrete for superstructure	

Date:

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Project:		Job No.:	
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Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
A	**SUB-STRUCTURE**	
1	Refer separate checklist for foundation.	
2	Check fouling with machine/equipment foundation.	
B	**SUPER-STRUCTURE**	
1	Check the clear gap for isolation of rotating machine foundation.	
2	Requirement of roof monitor, extent of side cladding & height of parapet wall.	
3	Identification of braced bay & maintenance bay.	
4	Whether provision of extension of shed by one bay considered (for future).	
5	Live loads & superimposed loads at various locations, including crane loading & centerline distance between rails	
6	Check the critical load combination for design.	
7	Check the horizontal (transverse & longitudinal) deflections.	
8	Check flooring details conforming to likely superimposed load.	
9	Compatibility between pedestal level & anchor bolts with base plate details.	
10	Check whether correct limiting values of slenderness ratios for structural elements (columns, beams, bracings, etc.) used in design.	
11	Check whether correct effective lengths of structural elements (columns, beams, bracings, etc.) used in design.	
12	Check whether minimum 90% mass participation achieved (in both horizontal directions) for calculating seismic forces.	
13	Check over-all compliance to approved Architectural drawings.	
14	Internal co-ordination with all concerned departments.	

Date:

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Project:		Job No.:	
Document No.:		Rev. No.:	
Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
A	**SUB-STRUCTURE**	
1	Refer separate checklist for foundation.	
2	Check fouling with equipment foundation.	
B	**SUPER-STRUCTURE**	
1	Material of construction as per engineering design basis of the project and departmental guidelines.	
2	Check the application of equipment load (correction, magnitude & location).	
3	Live load/ superimposed load considered for respective level/ floor, air-coolers, fire proofing load, etc. where applicable.	
4	Whether loading due to one extra floor considered (for future expansion).	
5	Check the estimation of seismic/ wind force to be applied at respective level/ floor.	
6	Check whether critical design forces from various likely load combinations have been considered for the design of structural element/ foundation.	
7	Identify critical areas where limiting beam sizes need to be provided for avoiding any fouling.	
8	Location of braced bay, co-ordinated with Piping. Bracing angle is within 30° & 60°. Plan bracing considered.	
9	Check the horizontal (transverse & longitudinal) deflections.	
10	Check the capacity of overhead mono-rails & its location with extent (in & outside plan dimensions) w.r.t. the respective equipment.	
11	Verify whether all vertical & horizontal piping loads have been correctly & completely taken care.	
12	Equipment supporting arrangement - check fouling with bottom nozzle or hood.	
13	Arrangement of intermediate/ secondary beams to clear opening requirements.	
14	Inter-connection with pipe rack.	
15	Compatibility between pedestal level & anchor bolts with base plate details.	
16	Joint details: a) reference standard no. is furnished b) details for connections not available in standard are furnished	
17	Compatibility between member sizes in General Arrangement & Reinforcement Details (in drawing).	
18	Whether integrated analysis done with equipment/ piping.	
19	Check whether correct limiting values of slenderness ratios for structural elements (columns, beams, bracings, etc.) used in design.	
20	Check whether correct effective lengths of structural elements (columns, beams, bracings, etc.) used in design.	
21	Check whether minimum 90% mass participation achieved (in both horizontal directions) for calculating seismic forces.	

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SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
22	Check requirement of ductile detailing for reinforcement (for concrete elements).	
23	Summation of applied forces matched with reactions.	
24	Internal co-ordination with all concerned departments.	

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Document No.:		Rev. No.:	
Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
A	**FOUNDATION**	
1	Refer separate checklist for foundation.	
B	**SUPER-STRUCTURE**	
1	Layout and configuration of pipe rack conforming to piping inputs/ approved equipment layout.	
2	Levels of pipe rack/ tiers conforming to piping inputs/ approved equipment layout.	
3	Whether load due to one extra tier considered (for future expansion) to be confirmed by Piping/ PMC.	
4	Location of expansion joints and braced bays coordinated with Piping department.	
5	Material of construction as per engineering design basis of the project, including fire-proofing requirements.	
6	Check the loading considered given by piping conforming to the requirement of design basis, including for fire proofing where applicable.	
7	Check consideration of friction/ anchor/ guide loads as per design basis and as forwarded by piping.	
8	Check the layout & loading of Air-coolers including supports required for inlet & outlet piping.	
9	Check the routing of electrical cable trays & instrument duct to be supported on the pipe rack and their respective loading as per design basis.	
10	Check the horizontal & vertical clearances at road/ railway crossings.	
11	Location and arrangement of vertical & horizontal bracing fulfilling design requirements and confirmed by piping	
12	Check whether additional load due to extra length of pipes have been considered or not at the location where pipes are rising or getting dropped.	
13	Check the level at top of grout w.r.t. actual profile of ground levels for off-site pipe rack.	
14	Local design checks at junction locations	
15	Whether any two-phase flow lines are there? If yes, have these been taken care as per the Design basis.	
16	Compatibility between pedestal level & anchor bolts with base plate details.	
17	Joint details: a) reference standard no. is furnished b) details for connections not available in standard are furnished	
18	Compatibility between member sizes in General Arrangement & Reinforcement Details (in drawing).	
19	Transverse beams are designed for horizontal bending.	
20	Tray support members are provided as per electrical guidelines.	
21	Battery Limit platform & approach for the same.	
22	Bracing angle is within 30° & 60°.	
23	Inter-connection with technological structures.	

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SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
24	Fouling of vertical bracing with anchor bolt in pedestal (in drawing).	
25	Check whether correct limiting values of slenderness ratios for structural elements (columns, beams, bracings, etc.) used in design.	
26	Check whether correct effective lengths of structural elements (columns, beams, bracings, etc.) used in design.	
27	Check whether minimum 90% mass participation achieved (in both horizontal directions) for calculating seismic forces.	
28	Check requirement of ductile detailing for reinforcement (for concrete elements).	
29	Internal co-ordination with all concerned departments.	

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Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
A	**SUB-STRUCTURE**	
1	Refer separate checklist for foundation.	
B	**SUPER-STRUCTURE**	
1	Check wind & seismic parameters considered.	
2	Check estimation of wind forces.	
3	Check estimation of seismic loads.	
4	Check structural configuration and bracing system (vertical & horizontal).	
5	Check analysis corresponding to critical wind/ seismic direction.	
6	Check whether correct limiting values of slenderness ratios for structural elements (columns, beams, bracings, etc.) used in design.	
7	Check whether correct effective lengths of structural elements (columns, beams, bracings, etc.) used in design.	
8	Check whether critical maximum design forces have been considered from various load combinations for the design of respective elements.	
9	Check for permissible horizontal (transverse & longitudinal) deflections.	
10	Internal co-ordination with all concerned departments.	

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Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
A	**SUB-STRUCTURE**	
1	Refer separate checklist for foundation.	
B	**SUPER-STRUCTURE**	
1	Check the system stability & dynamic analysis as per design basis/Job specification.	
2	Check the correctness in estimation of wind pressure corresponding to right shape factor for exposed members.	
3	Check the lateral load transfer from gallery to top of trestle.	
4	Check the supporting arrangement of gallery for keeping proper provision for expansion, check limiting vertical deflection.	
5	The analysis & design shall conform to the erection scheme being adopted.	
6	Internal co-ordination with all concerned departments.	

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Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
1	Check equality of bottom pressure below ring wall and intermediate compacted soil mass.	
2	Check the detailing/ arrangement of ring wall w.r.t. anchor bolts and clean out drain, requirement of minimum edge clearance for Anchor Bolt.	
3	Check the thickness, size, shape and spacing of piers with protective coating/ lining for tanks storing corrosive liquid.	
4	Check the special requirements/ consideration (size, solid concrete slab below bottom plate, anchorage, counter weights etc.) for storage tanks storing liquids at high pressure and/ or high/ low temperature.	
5	Location co-ordinates & Orientation w.r.t. North direction.	
6	Internal co-ordination with all concerned departments.	

Date: Name & Signature

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Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
1	Design loads as per approved data sheet.	
2	Check the input files for: a) depth of foundation b) depth of water table c) wind/ seismic load as per Design Basis d) support details as per data sheet	
3	Check the out-put file for: a) SBC conforming to Geo-Tech Recommendations b) FOS against overturning c) size restriction for likely fouling	
4	Internal co-ordination with all concerned departments.	

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Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
1	Loading as per approved data sheet of equipment	
2	Additional load due to supported ducts/ lining	
3	Check for SBC at founding level and FOS against overturning	
4	Size limitations if any to avoid fouling	
5	Internal co-ordination with all concerned departments.	

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Document Title:			

SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
1	**GENERAL**	
a	Drawing number is as per approved DCI	
b	Electronic file number is as per approved DCI	
c	Draughting is as per design requirements	
d	North line/ orientation as per input data	
e	Notes comply with Job Specifications and General Notes	
f	Field notes for specific instructions/ scope of work defined	
g	Layout of grids and spacing/ dimensions/ equipment location, support, orientation etc. as per input data	
h	Referenced Drawings specified	
i	Referenced Standards specified	
j	If not adequately clear in General Notes, grade of concrete and grade of reinforcement bars specified	
k	Bill of materials furnished (for the detailed portion)	
l	Necessary internal co-ordination done with relevant departments as per requirements	
m	Resolution/ incorporation of comments received	
2	**FOUNDATIONS**	
a	Coordinates/ location is as per input data, suction side & discharge side (for pump foundations) as per layout drawing	
b	Referenced level and elevations specified are as per approved General Civil/ Architectural drawings/ Piping GAD (viz. NGL/ FGL/ HPP)	
c	Elevation/ depth of foundation bottom furnished	
d	Fouling with surrounding foundations/ services cleared	
e	Any extra cover for rebar required and specified	
f	Any extra minimum cement content required and specified	
g	Thickness, projection and grade of lean concrete specified	
h	Anchor bolt location and orientation specified	
i	Adequacy of foundation depth checked to accommodate anchor bolt assemblies	
j	Anchor bolt description (as per standard) specified	
k	Depth of pockets specified	
l	Minimum cover on anchor bolts/ pockets checked	
m	Fouling between anchor bolt assembly and pedestal rebar checked	
n	Grout thickness specified	
o	Reinforcement provided as per design/ codal requirements	

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SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
p	Links and ties detailed	
q	Dowel lengths for column rebars staggered and specified	
r	Depth of machine foundations with respect to building foundations checked	
s	Separation detail for machine foundations and pouring sequence given	
t	Requirement of water bars at construction joints for liquid retaining structures furnished	
u	Requirement of protective painting	
v	Field note for sequence of construction, if adjoining foundations are at different level	
w	For pump foundations, following field note shall compulsorily be added in foundation drawings: "The pump discharge nozzle is facing towards North/East/West/South". (appropriate direction shall be selected as per layout drawing, in case discharge is upwards, direction of suction nozzle shall be specified)	
3	**SUPER STRUCTURE Reinforced Cement Concrete**	
a	Layout is as per approved Piping GAD/ Architectural drawings	
b	Requirement of expansion/ separation joints checked	
c	Anchor bolt location and orientation specified	
d	Anchor bolt description (as per standard) specified	
e	Pockets for bolts located/oriented and specified	
f	Depth of pockets/ length of bolts in RCC members checked	
g	Minimum cover on anchor bolts/ pockets checked	
h	Fouling between anchor bolt assembly and rebar checked	
i	Grout thickness specified	
j	Reinforcement provided as per design/ codal requirements	
k	Cut-outs as per requirement provided with edge protection	
l	Slope has been provided over RCC roof	
m	Curb around all openings	
n	Insert plates & pipe sleeves provided wherever required	
o	Extra reinforcement around cut-outs & openings	
p	Dowel bars for lap length & anchorage length	
q	Nominal links in column, stirrups for beams & their arrangement	
4	**SUPER STRUCTURE Structural steel**	
a	Layout is as per approved Piping GAD/ input drawings	
b	Requirement of expansion/ separation joints checked	
c	Bolting details for equipments specified	
d	Member sizing and connection details furnished	
e	Grating/ chequered plate requirements with supporting members furnished	
f	Welding requirements furnished	
g	Fire-proofing requirements furnished	

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SR. NO.	CHECK/ CONTROL POINTS	Tick Mark as per Legend
h	Requirement of removable floor/ handrails checked	
i	Requirement of grouting holes in base plates specified	
j	Vertical & Horizontal bracings provided as per piping clearance	
k	Splicing location has been proposed/ suggested	
l	Approach staircase/ ladder provided with proper landing at entry point	
m	Toe plate around openings	
n	Stiffness/ diaphragm plates have been suitably provided	
o	Vertical clearance below monorail beam checked	
p	Capacity of monorail specified & structurally stable cantilever projection given	
5	Drawing issued through DCIM (Document Control Index Module)	

Date: Name & Signature

Legend :

✓ : Check carried out and found OK
✓ NA : Check carried out and found not applicable

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मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL - STRUCTURAL

लंप–सम टर्न–की कार्य
(एल.एस.टी.के. कार्य)

LUMP-SUM TURN-KEY WORKS
(L. S. T. K. WORKS)

समाग्री एवं निर्माण
MATERIAL & CONSTRUCTION

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	13-03-2025	REVISED AND REISSUED	AM	AH	AS	MN
1	27.08.2018	REVISED AND ISSUED AS STANDARD SPECIFICATION	AV	AS	RS	RKT
0	26.07.2013	ISSUED AS STANDARD SPECIFICATION	AS	RS	PKM	DM

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Abbreviations:

BIS	: Bureau of Indian Standards
CPCIA	: Concrete Penetrating Corrosion Inhibiting Admixture
C&D Waste	: Construction and Demolition Waste
EIL	: Engineers India Limited
HSFG	: High Strength Friction Grip
IS	: Indian Standard
LSTK	: Lump-sum Turn-key
OISD	: Oil Industry Safety Directorate
PCC	: Plain Cement Concrete
PVC	: Polyvinyl Chloride
RA	: Recycled aggregate
RCA	: Recycled concrete aggregate
RCC	: Reinforced Cement Concrete
STD	: Standard
TMT	: Thermo-mechanically Treated

Structural Standards Committee

Convenor: **Mr. Anurag Sinha**

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Mr Deepak Agrawal
Ms Alpana Srivastava
Dr Sudip Paul
Mr Prasenjit Saha *
Mr Charanjit Singh
Mr Ravindra Kumar

*** For Fireproofing Specifications**

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1.0 GENERAL

1.1 The material and construction considerations given hereunder establish the minimum basic requirements for reinforced cement concrete (RCC), structural steel and masonry structures/ works.

This specification shall be read in conjunction with the Engineering Design Basis (EDB) for the Job and Standard Specification No. 6-68-0021 for General requirements.

Project specific civil-structural requirements as mentioned in the Engineering Design Basis (EDB) shall supersede the any such requirements given in this standard specification.

1.2 All codes referred in this document pertain to BIS (Bureau of Indian Standards) publications and bear prefix IS.

1.3 Whenever any reference to BIS code is made, the same shall be taken as the latest revision (with all amendments issued there to) on the notified date of submission of tender.

1.4 Apart from the BIS codes mentioned in particular in the various clauses of this document, all other relevant codes related to the specific job under consideration and/ or referred to in the above-mentioned codes, shall be followed wherever applicable. Reference to some of the codes in the various clauses of this document does not limit or restrict the scope of applicability of other relevant codes.

1.5 In case of any variation/ contradiction between the provisions of BIS codes and the requirements given hereunder, the provisions given in this document shall have precedence over all others. In absence of relevant BIS codes, reference to corresponding British or American codes may be made (in that order of preference).

All material and construction shall strictly conform to the enclosed standards, specifications and 'specific requirements. Only if relevant information is not available in these documents, reference to relevant BIS code shall be made.

2.0 REFERENCED CODES, STANDARDS & PUBLICATIONS

For list of applicable codes, standards & publications, reference to Engineering Design Basis (EDB) shall be made.

3.0 MATERIAL REQUIREMENTS

3.1 General

The minimum requirements of various materials to be used in Civil and Structural works are as below:

3.2 Water

a) Water used in construction for all Civil & Structural works shall be clean and free from injurious amounts of oil, acids, alkalies, organic matters and/ or other harmful substances which may be deleterious to concrete, masonry or steel. The pH value of water sample shall not be less than 6. Potable water will be considered satisfactory. All requirements of IS 456 have to be met.

b) Tests on water samples shall be carried out in accordance with IS 3025 and these shall fulfil all the guidelines and requirements given in IS 456.

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c) 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.

d) 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.

e) 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.

3.3 Aggregate (for Concrete)

3.3.1 General

Coarse and Fine aggregates for Civil and Structural Works shall conform in all respects to IS 383 (Specification for Coarse and Fine Aggregates from Natural Sources for Concrete). Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or a combination thereof. These shall be chemically inert, hard, strong, dense, durable, clean and free from veins, adherent coatings, injurious amounts of alkalies, 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.

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.

Aggregates which may chemically react with alkalies of cement or might cause corrosion of the reinforcement shall not be used.

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

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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.

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.

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

Aggregates not in conformity with the specifications shall be rejected and the Contractor shall immediately remove them from the site of work.

3.3.2 Coarse Aggregates

a) Coarse aggregates are the aggregates, which are retained on 4.75 mm IS 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.

b) Coarse aggregates may be obtained from

(1) Uncrushed gravel or stone which results from natural disintegration of rock

(2) Crushed gravel or stone which results from crushing of gravel or hard stone.

(3) Partially crushed gravel or stone which results from blending of (1) and (2) above.
(4) 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.

3.3.3 Fine Aggregates

a) Fine aggregates are the aggregates which pass through 4.75 mm IS sieve but not more than ten percent (10%) pass through 150 micron IS 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.

b) Fine aggregates shall consist of

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.

Crushed Sand –

i) Crushed Stone Sand: Fine aggregate produced by crushing hard stone
ii) Crushed Gravel Sand: Fine aggregate produced by crushing natural gravel

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Mixed Sand: Fine aggregate produced by blending natural sand and crushed stone sand or crushed gravel sand in suitable proportions.

c) 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

3.3.4 Sampling and Testing

The Contractor shall carry out all tests including mix designs of concrete, at the start of work as well as during any stage of construction as per the requirement. Tests 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). The method of sampling shall be in accordance with the requirements given in IS 2430.

3.3.5 Storage of Aggregates

a) Storage of all types of aggregates at the site of work shall be as specified in IS 4082. Aggregates shall in no case be stored near excavated earth or directly over ground surface.

b) 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.

c) Aggregates delivered at the site in wet condition or becoming wet due to rain or any other means, shall not be used for at least 24 hours. For the use of such aggregates the contractor 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.

3.4 Sand (for Masonry & Filling)

3.4.1 Sand for Masonry Mortars

a) 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.

b) 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.

c) 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 or manufactured 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.

3.4.2 Grading of Sand

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

IS Sieve Designation (IS 460 Part-1)	Percentage Passing (by mass)	Reference to method (IS 2386 Part-1)
4.75 mm	100	

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IS Sieve Designation (IS 460 Part-1)	Percentage Passing (by mass)	Reference to method (IS 2386 Part-1)
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	

b) In case of 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 screening which are by themselves unsuitable. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

3.4.3 Sampling and Testing

a) 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. All tests shall be carried out in accordance with the relevant parts of IS 2386.

b) 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.

3.4.4 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. 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.

3.5 Cement

Cement shall be as specified in the Engineering Design Basis.

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

3.6 Steel

3.6.1 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,

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construction specifications such as dimensions, shape, weight, tolerances, testing etc, for all materials covered under this section, shall conform to respective BIS codes.

3.6.2 Reinforcement Bars

Reinforcement shall be TMT (Thermo-mechanically treated) bars of minimum Grade Fe500D (unless specified otherwise in the EDB/ Job Specifications), conforming to IS 1786 and bearing standard mark of the Bureau of Indian Standards.

Corrosion protection to reinforcement bars, if any shall be as specified in the EDB/ Job Specification.

3.6.3 Structural Steel

Structural Steel shall be of minimum Grade E250A/BR/B0 (unless specified otherwise in the EDB/ Job Specifications) conforming to IS 2062 and bearing standard mark of the Bureau of Indian Standards, excluding bars and rods of diameter/ thickness less than 6 mm and structural (angle) below ISA 50x50x6.

Hollow Sections shall be of minimum Grade YSt 310 (unless specified otherwise in the EDB/ Job Specifications) conforming to IS 4923 (for SHS/RHS) and IS 1161 (for CHS) and bearing standard mark of the Bureau of Indian Standards.

3.6.4 Miscellaneous Steel Materials

Miscellaneous steel materials shall conform to the following BIS codes:

a) Specification for Expanded Metal Steel Sheets for General Purposes	IS 412
b) Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement	IS 432
c) Hexagon Head Bolts, Screws and Nuts of Product Grade 'C' - Part 1: Hexagon Head Bolts	IS 1363
d) Cold formed light gauge structural steel sections.	IS 811
e) Technical supply conditions for threaded steel fasteners.	IS 1367
f) Plain washers	IS 2016
g) Steel wire ropes for general engineering purposes	IS 2266
h) Thimbles for wire ropes.	IS 2315
i) Bulldog grips	IS 2361
j) Mild Steel Tubes, tubular and other wrought steel fillings	IS 1239
k) Drop forged sockets for wire ropes for general engineering purposes	IS 2485
l) Steel chequered plates.	IS 3502
m) High Strength Structural Nuts	IS 6623
n) Washers for High Strength Structural Bolts & Nuts	IS 6649

3.6.5 Connection Bolts

Connection bolts shall be High Strength Hot-dip Galvanised Structural bolts of minimum Property Class 8.8, material and installation shall comply to requirements of IS 3757 and IS 4000 respectively. The acceptable methods of tightening the bolts in order of preference are listed below:

a) "Automatic Torque Control" where tightening is by a torque control impact wrench with automatic cut-off, calibrated to shut off at the desired bolts tension.

b) "Stall Torque Control" where tightening is by a standard impact wrench, calibrated by regulation of air pressure to "stall" at the desired bolt tension.

c) "Turn-of Nut" where tightening is by a standard impact wrench, by turning the nut ½ to ¾ turn beyond the "snug" position. The snug position is that position where the wrench begins to impact.

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d) "Manual Torque Control" where tightening is by hand wrench equipped with a torque indicator and calibrated for the desired bolt tension.

All the bolts in a joint shall be tightened to a minimum tension value as per Table 3 of IS 4000.

Properties of Bolt Class 4.6 wherever specified shall conform to IS 1367. Black hexagonal nuts and washers wherever specified shall be as per IS 1363.

3.6.6 Anchor Bolts

Material for Anchor Bolts such as bars, washers, nuts, pipe sleeves and plates etc. shall be as per relevant BIS codes mentioned in the EDB.

3.7 Brick

3.7.1 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

3.7.2 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/mm^2). 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.

3.7.3 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).

3.7.4 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.

3.7.5 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.

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3.7.6 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.

3.7.7 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.

3.7.8 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/mm^2.

All external brick masonry walls shall be of minimum 230 mm thickness (except for fire walls).

3.8 Stone

3.8.1 General

All Stones used for masonry works shall conform to the requirements of following BIS codes:

a)	Method of identification of natural building stones	IS 1123
b)	Recommendations for dimensions and workmanship of natural building stones for masonry work	IS 1127
c)	Recommendations for dressing of natural building stones	IS 1129

3.8.2 Quality of Stones

a) Stones shall be hard, dense, strong, sound, durable, clean and uniform in colour. These shall also be free from veins, adherent coatings, injurious amounts of alkalies, vegetable matters and other deleterious substances such as iron pyrites, coal, lignite, mica, sea shells etc. As far as possible, 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%.

b) 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 ¾th thickness of the wall. Height of the stone shall not be more than 300 mm.

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3.9 Admixtures

3.9.1 General Requirements

a) All concrete admixtures shall comply with the following Indian standards:

i. Specification for integral cement water proofing compounds IS 2645

ii. Specification for other admixtures for concrete IS 9103

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.

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.

b) 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 admixtures 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.

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

d) Admixtures which do not meet the requirements stipulated in this document shall not be used.

3.9.2 Corrosion Inhibiting Admixtures

Bipolar Concrete Penetrating Corrosion Inhibiting Admixture (CPCIA) shall be added to the concrete matrix for protection of embedded steel in concrete against corrosion.

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The CPCIA shall be concrete penetrating type which upon addition into the concrete matrix inhibits the corrosion process. It need not be in direct contact with the steel. Its vapour penetrates through fissures, honeycomb structure of concrete, pure water solution added in concrete and seals steel reinforcement at both anodic & cathodic sites, for inhibition. This is due to the bipolar mechanism property of the system.

Non-concrete penetrating, nitrite & nitrate corrosion inhibitors shall not be used.

The dosage shall be 1% by weight of cement or as recommended by the manufacturer.

In case the product is not as per the Suppliers List, the same shall be got approved by the Owner/ Owner's representative.

3.9.3 Water Proofing Compounds (Crystalline/ Non-crystalline)

Water proofing compounds shall be mixed with cement only.

a) The permeability of the specimen with the admixture shall be less than half of the permeability with a 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.

b) 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. Tests shall be carried out in accordance with IS 4031.

c) Compressive strength of the specimen at 3 days shall not be less than 160 kg/cm^2 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/cm^2 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.

3.10 Water Bars (Water Stops)

a) 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. These shall be preformed 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.

b) Performance requirements of PVC water bars shall meet the requirements of IS 12200. These shall be of an approved make and of ribbed/ serrated/ plain type with a bulb at the centre. The thickness and width of water bars shall in no case be less than 5 mm and 150 mm respectively. However, for concrete sections greater than 300 mm thick, the width of water bars shall not be less than 230 mm.

3.11 Bitumen/ Bituminous Materials

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

i.	Specification of Paving Bitumen	IS 73
ii.	Specification for bitumen mastic for flooring. (Grade IV)	IS 1195
iii.	Specification for Bitumen felts for water proofing and damp proofing	IS 1322
iv.	Specification for Bituminous compounds for water proofing and caulking purposes	IS 1834

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v.	Specification for preformed fillers for expansion joint in concrete pavements and structures	IS 1838
vi.	Specification for bitumen mastic for use in water proofing of roofs	IS 3037
vii	Specification for bitumen primer for use in water proofing and damp proofing	IS 3384
vii	Specification for Bitumen Mastic for Tanking and Damp proofing	IS 5871
ix.	Specification for Glass fibre base coal tar pitch & bitumen felts	IS 7193
x.	Code of practice for damp proofing using bitumen mastic	IS 7198
xi.	Specification for bitumen Mastic, Anti Static and electrically conducting grade	IS 8374

Tests and acceptable criteria shall be as per relevant BIS codes.

3.12 PVC Pipes

PVC Pipes shall conform to the requirements of IS 4985.

3.13 Wood/ Timber

a) 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/mm^2 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.

b) Timber required to be used for form work 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.

c) For proper identification and selection of suitable timber for form work, following codes shall be referred.

i.	Classification of commercial timbers & their zonal distribution	IS 399
ii.	Specification for ballies for general purposes	IS 3337
iii.	Specification for Ply wood for concrete shuttering work	IS 4990

3.14 Concrete Block Masonry

Grade of solid and hollow concrete block masonry shall be as follows:

a) Solid concrete blocks : Grade C (5.0).
b) Hollow concrete blocks : Grade A (5.5) closed cavity.

The nominal dimensions (length, height & width), density, compressive strength of solid & hollow concrete block masonry units shall be in conformance to IS 2185 (Part-1) corresponding to the above-mentioned grades.

Concrete block masonry of following thicknesses shall preferably be used:

a)	100 mm thickness	: Solid concrete block masonry.
b)	200 mm thickness	: Hollow concrete block (closed cavity) masonry.
c)	400 mm thickness (fire walls)	: Hollow concrete block (closed cavity) masonry.

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3.15 Autoclaved Cellular (Aerated) Concrete Blocks (AAC Block Masonry)

AAC Block masonry units shall be in conformance to IS 2185 (Part-3).

3.16 Anti-termite Compounds

Following chemicals as per IS 6313 (Part 2 and 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

3.17 Poly-sulphide Sealants

All Poly-sulphide Sealants shall conform to IS 12118. Test conditions and requirements shall be as given in the above referred BIS code.

4.0 CONSTRUCTION REQUIREMENTS

4.1 Construction

4.1.1 All concrete works shall be carried out as per the provisions of IS 456, IS 3370, IS 2974 and other relevant BIS Codes. Concrete mix proportioning and design mix; sampling and strength test of concrete, production and control of concrete, tolerances and placing of reinforcement and for cover; transporting, placing, compacting and curing etc, inspection and testing of structure (including requirement of non-destructive testing) shall be as specified in IS 456.

4.1.2 Continuous concreting shall be done for structures supporting dynamic equipment as per the provisions of IS 2974.

4.1.3 The damp proof course shall be laid in two layers of equal thickness and each layer given two coats of hot bitumen on top (grade VG-10 conforming to IS 73) at the rate of 1.7 kg/m^2. Dry sharp sand shall be sprinkled evenly over the top layer of bitumen before hardening.

4.1.4 Form work and stripping of form work shall be as per the provisions of IS 456.

4.1.5 Only steel shuttering shall be used for civil construction.

4.1.6 Assembly of reinforcement in RCC structures shall conform to IS 456.

4.1.7 Fabrication of all structural steel works shall be carried out as per the provisions of IS 800/ IS 801/ IS 802/ IS 806 and other relevant BIS codes. Fabrication shall include cleaning, straightening, cutting, bending, holding, bolting, welding, machining, painting, marking, assembling, erecting, inspecting and testing etc. Welding procedure and welder qualification shall be as per IS 800 and/ or referenced BIS codes only.

4.1.8 Erection of all structural steel works including supply of plant & equipment, storing and handling, setting out, field connections, field welding and security during erection shall conform to IS 800/ IS 801/ IS 802/ IS 806.

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4.1.9 All masonry works shall be carried out as per the provisions of IS 1597/ IS 2185/ IS 2212/ IS 4326 and other relevant BIS codes.

4.1.10 Construction of all other items of works shall conform to relevant Indian Standards and sound engineering practices.

4.1.11 The Contractor shall be responsible for the complete safety pertaining to all construction works.

4.2 Tolerances

4.2.1 The limits of dimensional tolerances for Plain and Reinforced Cement Concrete Structures shall be as follows:

a. Deviation from specified dimensions of cross section of columns and beams — -6 mm to +12 mm

b. Deviation from dimensions of footings (refer note below)

i. Dimensions in plan	-12 mm to +50 mm
ii. Eccentricity	0.02 times the width of footing in the direction of deviation but not more than 50 mm
iii. Thickness	±0.05 times the specified thickness

Note: *Tolerances apply to cast-in-situ concrete dimensions only, not to positioning of vertical reinforcing steel or dowels.*

c. Deviation in length (major dimension of single unit)

i. Up to 3.0m	± 6 mm
ii. 3.0m to 4.5m	± 9 mm
iii. 4.5m to 6.0m	±12 mm
iv. additional deviation for every subsequent 6m	± 6 mm

d. Deviation in straightness or bow (deviation from specified line) for a single or continuous member), e.g, beam, column or slab edge:

i. Up to 3.0m	6 mm
ii. 3.0m to 4.5m	9 mm
iii. 4.5m to 6.0m	12 mm
iv. additional deviation for every subsequent 6m	6 mm

e. Deviation in squareness shall be measured taking the longer of two adjacent sides as the base line. The shorter side shall not vary in its distance from a perpendicular so that the difference between the greatest and shortest dimensions exceeds 6mm. For this purpose, any error due to lack of straightness shall be ignored. Squareness shall be checked with respect to the straight lines that are most nearly parallel with the features being checked. When the nominal angle is other than 90 degrees, the included angle between check lines shall be varied accordingly.

f. Deviation in twists shall be within a limit such that any corner shall not be more than the limit given below from the plane containing other three corners:

i. Up to 600mm wide and up to 6m in length : 6 mm
ii. over 600mm wide and for any length : 12 mm

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g. Maximum deviation in flatness from a 1.5 m straight edge placed in any position on a nominally plain surface shall not exceed 6mm.

4.2.2 The limits of dimensional tolerances for Steel Structures shall be as follows:

4.2.2.1 For columns and tower-type structures:

a.	Deviation of column axes at foundation top level with respect to true axes	
	i. In longitudinal direction	±5 mm
	ii. In lateral direction	±5 mm
b.	Deviation in the level of bearing surface of columns at foundation top with respect to true level	±5 mm
c.	Out of plumb (verticality) of column axis from true vertical axis, as measured at top	
	i. Up to and including 30m height	lesser of ±H/1000 or ±25mm
	ii. Over 30m height	lesser of ±H/1200 or ±35mm
d.	Deviation in straightness in longitudinal & transverse planes of column at any point along the height	lesser of ±H/1000 or ±10mm
e.	Difference in the erected positions of adjacent pairs of columns along length or across width of building prior to connecting trusses/ beams with respect to true distance	±5 mm
f.	Deviation in any bearing or seating level with respect to true level Up to 600mm wide and up to 6m in length	±5 mm
g.	Deviation in difference in bearing levels of a member on adjacent pair of columns both across & along the building	±5mm

Notes:

1. *Tolerance specified for out-of-plumbness should be read in conjunction with 'Deviation in straightness....' & 'Difference in the erected positions....'.*
2. *'H' is the column height in mm.*
3. *Tolerance limits as given under clause 4.2.2.1 above for steel structures are applicable to concrete columns/ pedestals also.*

4.2.2.2 Trusses

a.	Shift at the centre of span of top chord member with respect to the vertical plane passing through the centre of bottom chord	±1/250 of height of truss in mm at centre of span or ±15 mm, whichever is less
b.	Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss	±1/1500 of span of truss in mm or ±10 mm, whichever is less
c.	Lateral shift in location of truss from its true position	±10 mm
d.	Lateral shift in location of purlin from true position	±5 mm
e.	Deviation in difference of bearing levels of truss from the true level	±1/1200 of span of truss in mm or 20mm, whichever is less

4.2.2.3 Gantry girders and Rails

a.	Shift in the centre line of crane rail with respect to centre line of web of gantry girder	± [web thickness of girder(mm)+2mm] / 2
b.	Shift of alignment of crane rail (in plan) with respect to true axis of crane rail at any point	±5mm

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c.	Deviation in crane track gauge with respect to true gauge	
	i. For track gauge up-to and including 15m	±5 mm
	ii. For track gauge more than 15m	±[5+0.25(S-15)] subject to maximum ±10 mm, where S in metres is true gauge
d.	Difference in level between crane track rails (across the bay) at	
	i. Supports of gantry girders	15 mm
	ii. Mid span of gantry girders	20 mm
e.	Relative shift of crane rail surfaces (at joint) in plan and elevation	2 mm

4.3 Hanger Scaffolding for Pipe Rack

Hanger scaffolding (fixed/ movable) shall be provided in the pipe rack to facilitate mechanical works over the first tier & above. The same shall provide protection from falling material as well as act as a safe working platform. This shall be provided about one meter below the entire pipe rack first tier elevation.

The scaffolding shall be light weight, easy to remove when the work is complete. The deck planks may be perforated sheets suitably folded at the ends and open web ladder type of beams may be used to support them. These beams shall be supported on the hangers provided from the beams of the pipe rack.

The design load under the working condition shall be 120 kg/m^2 and that for the limit state of collapse shall be twice the same. However individual panel shall be designed for the concentrated loads of 120 kg at spacing of 1 m and double that load for the limit state of collapse.

Deflection of individual planks shall be maximum span/100. For the beam, the deflection shall be controlled as per IS 800:2007.

The design shall be supported by the properly testing of the checking for the specified loads.

After completion of work over the pipe rack, the contractor shall remove the hanging scaffolding from the pipe rack and take back the scaffolding material.

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STANDARD SPECIFICATION
CIVIL - STRUCTURAL

एकमुश्त टर्न-की कार्य
(एल.एस.टी.के कार्य)

LUMP-SUM TURN-KEY WORKS
(L. S. T. K. WORKS)

विक्रेता डेटा आवश्यकताएं
VENDOR DATA REQUIREMENTS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	10.02.2025	ISSUED AS STANDARD SPECIFICATION	HKV	RM	AS	MN
A	06.02.2025	ISSUED FOR COMMENTS	HKV	RM	AS	MN

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Abbreviations:

BIS	: Bureau of Indian Standards
DCI	: Document Control Index
EIL	: Engineers India Limited
EPC	: Engineering Procurement & Construction
IS	: Indian Standard
LSTK	: Lump-sum Turn-key
MTO	: Material Take off
PCC	: Plain Cement Concrete
RCC	: Reinforced Cement Concrete
STD	: Standard
TMT	: Thermo-mechanically Treated
VDMS	: Vendor Document Management System

Structural Standards Committee:

Convener: Mr. Anurag Sinha

Members:
Mr. Virender Goel
Mr. Deepak Agrawal
Ms Alpana Srivastava
Dr. Sudip Paul
Mr. Prasenjit Saha (SMMS)
Mr. Charanjit Singh (Project)
Mr. Indrajit Neog (Construction)
Ms Papia Mandal
Mr. Vikram Kumar Gupta

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ANNEXURE-IB : MTO format for individual structure
ANNEXURE-II : Bulk MTO format for entire scope of package
ANNEXURE-III : Detailed MTO format for entire scope of package (Structural, Geotechnical & Architectural)
ANNEXURE-IV : Format for MTO of Rebars
ANNEXURE-V : Format for MTO of Structural Steel

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1.0 GENERAL

1.1 This specification establishes and defines the requirements of various data from contractors for Civil and Structural works under the EPC & LSTK contracts.

1.2 Vendor Document Management System (VDMS) is a web application that lets contactors/ vendors manage their Document Control Index (DCI) through an interface, submit their documents/drawings for review/ record and get the reviewed documents/ drawings.

1.3 A Document Control Index [DCI, i.e. detailed list of documents/ drawings, including specifications, standards, design philosophy (foundation & superstructure), general notes, design calculations, design drawings, Bulk Material Take-off (Bulk MTO), bar bending schedules (for RCC works) and fabrication drawings (for structural steel works)] indicating the document/ drawing category (review or record as applicable) together with the scheduled and actual date of submission of the documents, shall be submitted by the Contractor through the Vendor Document Management System (VDMS) and kept updated at all times in the VDMS for review by Owner/ owner's representative. The DCI shall also indicate the document/ drawing category (review or record as applicable) together with the scheduled and actual date of submission of the documents.

Incomplete, unchecked, unsigned and unstamped design documents/ drawings shall not be reviewed/ accepted and shall be deemed to be considered as void/ withdrawn.

1.4 Annexure IA & IB shall be submitted along with design calculation for all individual structures/ buildings/ foundations as defined in the Vendor Data Requirement document.

1.5 Detailed MTO (Annexure-II) & Bulk MTO (Annexure-III) shall be submitted by the contractor for entire scope of the Package/Tender.

1.6 Bulk MTO (Annexure-III) (showing anticipated, released and balance quantities) shall also be submitted by the Contractor at 30%, 60% & 90% stages of engineering and kept updated at all times in the Vendor Document Management System (VDMS) for review by Owner/ Owner's representative.

ANNEXURES

ANNEXURE-IA	: Load Summary for Structure
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ANNEXURE-V	: Format for MTO of Structural Steel

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ANNEXURE-IA

(LOAD SUMMARY FOR_____)

Job No.:
Package Name:
Structute / Building / Foundation Name:
Type of Structure: Concrete / Steel / Hybrid / Precast / Modular
Project:
Client:
Contractor:
Location:
PO No. & Date:

SL. NO.	TYPE OF LOAD	DIRECTION OF LOAD		
		X (HORZ.)	Y (VERT.)	Z (HORZ.)
A.	Dead Load (DL)	-		-
A1	Self Weight (SW)			
A2	Masonary Load	-		-
A3	Non-modelled elements of structure	-		-
A4	Non-Structural (Equipment, Elect. Panel, AHU equipment etc.)			
B.	Imposed Load (IL)			
B1	Live Load			
C.	Wind Load (WL)		-	
D.	Seismic Base Shear			
D1	Mass Participation (%)			
	Any Other			

Notes:
1. To be submitted along with each design calculations.

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ANNEXURE-IB

Job No.:

Package Name:

Structute / Building / Foundation Name:

Type of Structure: Concrete / Steel / Hybrid / Precast / Modular

Project:

Client:

Contractor:

Location:

PO No. & Date:

SL. NO.	NAME OF STRUCTURE / BUILDING/ FOUNDATION	DOCUMENT/ DRAWING NUMBERS	LENGTH (M)	WIDTH (M)	HEIGHT (M)	PORTAL SPACING (ONLY FOR PIPE RACK)	NO. OF TIERS (ONLY FOR PIPE RACK)	SEISMIC ZONE	BASIC WIND SPEED (m/s)	PILE CAPACITY / SBC (MT/T/Sq.m)	NO. OF PILES (NOS.)	PCC / RCC			TOTAL REBAR (REFER NOTE-2)		STRUCTURAL STEEL (REFER NOTE-3)		GRATING (Sq. M)	HANDRAIL (RM)
												PCC (Cu.M)	RCC SUB-STRUCTURE (Cu.M)	RCC SUPER-STRUCTURE (Cu.M)	SUB-STRUCTURE (MT)	SUPER-STRUCTURE (MT)	UPTO 20 M HEIGHT (MT)	ABOVE 20 M HEIGHT (MT)		

Notes:

1. To be submitted along with each design calculations.
2. Diameter-wise breakup shall be provided for Rebars
3. Section-wise breakup shall be provided for Structural Steel

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ANNEXURE-II

Job No.:

Package Name:

Structute / Building / Foundation Name:

Type of Structure: Concrete / Steel / Hybrid / Precast / Modular

Project:

Client:

Contractor:

Location:

PO No. & Date:

SL. NO.	NAME OF STRUCTURE / BUILDING / FOUNDATION	TYPE OF STRUCTURE (Concrete Steel / Hybrid / Precast / Modular)	DRAWING NUMBERS	LENGTH (M)	WIDTH (M)	HEIGHT (M)	PORTAL SPACING (ONLY FOR PIPE RACK)	NO. OF TIERS (ONLY FOR PIPE RACK)	SEISMIC ZONE	BASIC WIND SPEED (m/s)	PILE CAPACITY / SBC	NO. OF PILES (NOS.)	RCC/PCC			TOTAL REBAR (REFER NOTE-2)		STRUCTURAL STEEL (REFER NOTE-3)		GRATING (Sq. M)	HANDRAIL (RM)
													PCC (Cu.M)	RCC SUB-STRUCTURE (Cu.M)	RCC SUPER STRUCTURE (Cu.M)	SUB-STRUCTURE (MT)	SUPER-STRUCTURE (MT)	UPTO 20M HEIGHT (MT)	ABOVE 20 M HEIGHT (MT)		
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
	TOTAL																				

Notes:

1. To be submitted for the entire scope of each package.
2. Diameter-wise breakup shall be provided for Rebars
3. Section-wise breakup shall be provided for Structural Steel
4. Rows can be added as per requirement.

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ANNEXURE-III

Job No.:
Package Name:
Plot Size:
Project:
Client:
Location:
PO No. & Date:
Time Schedule:

MTO FORMAT (STRUCTURAL, GEOTECHNICAL & ARCHITECTURAL)			
SL. NO.	**DESCRIPTION**	**UNITS**	**Quantity**
1	EARTH WORK IN EXCAVATION (SOIL)	CUM	
2	EARTH WORK IN EXCAVATION (ROCK)	CUM	
3	BACKFILLING	CUM	
4	BACKFILLING WITH BORROW EARTH	CUM	
5	TRANSPORTATION & DISPOSAL OF SURPLUS EARTH / ROCK	CUM	
6	PCC (WITH GRADE)	CUM	
7	RCC IN SUB-STRUCTURE (WITH GRADE)	CUM	
8	RCC IN SUPER-STRUCTURE (WITH GRADE)	CUM	
9	PRECAST RCC (WITH GRADE)	CUM	
10	REINFORCEMENT BARS (WITH GRADE) * REFER NOTE-2	MT	
11	CENTRING AND SHUTTERING IN SUB-STRUCTURE	SQM	
12	CENTRING AND SHUTTERING IN SUPER-STRUCTURE	SQM	
13	STRUCTURAL STEEL (WITH GRADE) * REFER NOTE-3	MT	
13.1	STRUCTURAL STEEL (UPTO 20 M HEIGHT)	MT	
13.2	STRUCTURAL STEEL (ABOVE 20 M HEIGHT)	MT	
14	FLOOR GRATING & CHEQUERED PLATE	MT	
15	HAND RAILING	RM	
16	MASONRY (WITH TYPE & GRADE)	CUM	
17	SAND FILLING	CUM	
18	VERMICULITE IN FIRE PROOFING	SQM	
19	PILING WITH CONCRETE & REINFORCEMENT GRADE		
19.1	TYPE (BCIS/DCIS/PRECAST/STEEL)		
19.2	DIAMETER	mm	
19.3	QUANTITY	Nos.	
19.4	LENGTH	M	
19.5	PILING CONCRETE QUANTITY	CUM	
19.6	PILING REINFORCEMENT QUANTITY	MT	
20	PILE CAPACITY (MT) / SBC (T/SQ.M)	MT/SQ.M	
21	GROUND IMPROVEMENT (SAND-GRAVEL MIX / SAND / CNS MATERIAL / BOULDER SOLING, IF APPLICABLE)	CUM	
22	STONE COLUMNS	Nos.	
22.1	LENGTH OF STONE COLUMNS	M	
22.2	DIAMETER OF STONE COLUMNS	mm	
23	BUILDINGS (BLAST RESISTANT / NON-BLAST RESISTANT)	Nos.	
23.1	TYPE OF CONSTRUCTION (Concrete / Steel / Hybrid / Precast / Modular)		
23.2	SIZE (L, B & H)	M	
23.3	NO. OF FLOORS	Nos.	
23.3	TOTAL FLOOR AREA	SQM	
24	ANY OTHER INFORMATION		

NOTE:

1. Summary to be submitted for the entire scope of each package.
2. Diameter-wise breakup shall be provided for Rebars as per Annexure-IV.
3. Section-wise breakup shall be provided for Structural Steel as per Annexure-V.

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ANNEXURE-IV

Job No.:
Package Name:
Plot Size:
Project:
Client:
Location:
PO No. & Date:
Time Schedule:

FORMAT FOR MTO OF REBARS				
SL. NO.	**NOMINAL SIZE OF REBARS (MM)**	**GRADE OF REBARS**	**WEIGHT (MT)**	**PERCENTAGE (%) (OF GRAND TOTAL)**
1	8			
2	10			
3	12			
4	16			
5	20			
6	25			
7	28			
8	32			
9	36			
10	40			
11	ANY OTHER INFORMATION			
	GRAND TOTAL			**100.00**

NOTE:

1. Summary to be submitted for the entire scope of each package.

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ANNEXURE-V

Job No.:
Package Name:
Plot Size:
Project:
Client:
Location:
PO No. & Date:
Time Schedule:

FORMAT FOR MTO OF STRUCTURAL STEEL				
SL. NO.	SECTION SIZES	GRADE OF STEEL	WEIGHT (MT)	PERCENTAGE (%) (OF GRAND TOTAL)
	GRAND TOTAL			100.00

NOTE:

1. Summary to be submitted for the entire scope of each package.
2. Section sizes shall contain Beams, Channels, Angles, Plates, Flats, including Plate Fabricated Sections (if any).

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सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

इपोक्सी रेजिन प्रणाली द्वारा नई कंक्रीट को पुरानी कंक्रीट से जोडना

BONDING FRESH CONCRETE TO OLD CONCRETE BY EPOXY RESIN BONDING SYSTEM

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	28.02.25	REVISED & REISSUED	RIYA	VIKRAM	AS	MN
4	28.01.20	REAFFIRMED & REISSUED	IQBAL	ALPANA	RS	RKT
3	21.08.14	REAFFIRMED & REISSUED	AJS	AS	PKM	SC
2	30.06.09	REAFFIRMED & REISSUED	AS	SCH	VINAY KUMAR	N.DUARI
1	16.06.99	REISSUED AS STANDARD SPECIFICATION	RPM	RS	SCJ	A. SONI

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Abbreviations:

ASTM : American Society for Testing & Materials

Structural Standards Committee

Convenor: Mr. Anurag Sinha

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

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6.0 PAYMENT 6

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1.0 SCOPE

1.1 This specification defines the material, constructional and other performance requirements for proper bonding of fresh concrete to old, hardened concrete by epoxy resin bonding system which is able to cure under humid conditions and bond to damp surfaces. Any special requirement as shown or noted on the drawings and directed by the Engineer-in-Charge shall govern over the provisions of this specification.

1.2 Actual working shall be carried out in accordance with this specification and recommendation of the manufacturer of the resin system to suit specific requirements for the particular site and other climatic conditions existing there. In case of any conflict, this specification shall govern.

2.0 MATERIALS

2.1 Epoxy resin system used for bonding fresh concrete to old hardened concrete shall consist of two components, viz. epoxy resin and hardener for combining immediately prior to use as per manufacturer's recommendations. Filler material shall be added, if required, as per manufacturer's specification. However, this shall be incorporated in any of the two components. The system shall cure under humid conditions and bond to damp surfaces.

2.2 The bonding material shall be compatible with the concrete to which it is to be applied and shall have the following minimum properties:

Compressive Yield Strength	55 N/mm^2 (7 days)
Tensile Strength	40 N/mm^2 (7 days)
Bond Strength	10 N/mm^2 (14 days)
Flexure Strength	35 N/mm^2 (7 days)
Shear Strength	10 N/mm^2 (7 days)
Pot Life	45 minutes
Full Cure	7 days at 20°C to 35°C
Overlaying Time (open time)	1 hour at 20°C to 35°C

2.3 The resin and hardener shall be mixed in the proportion as specified by the manufacturer. The preparation, mixing and application of the resin system shall strictly be in accordance with the manufacturer's recommendations.

2.4 Certificate of test results of all the materials from BIS/NABL recognised laboratories duly authenticated by the approved manufacturer(s) shall be submitted to Engineer-in-Charge and got approved by him in writing prior to commencement of work. In the event of failure to submit such test results from the manufacturer for any material, the contractor shall carry the tests from an approved laboratory and submit the test results including the name(s) of manufacturer(s) to the Engineer-in-Charge and get approved by him in writing prior to commencement of work. All tests shall be in accordance with ASTM C881M (Type V) in case of non-availability of any specific Indian Standard.

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2.5 Pot life and open time

Pot life is the period during which the resin system after mixing retains sufficient workability for proper use and the resin system must be applied to the prepared concrete surface within this period.

The 'open time' is the maximum period of time allowable between application of resin system and pouring of fresh concrete. Exceeding the 'open time' shall result in considerably reduced adhesion. The adhesive shall be applied to the prepared substrata as soon as the components have been mixed and fresh concrete shall be poured immediately before adhesive begins to gel. The bonding of fresh concrete to old concrete shall not to be done if the temperature is below 10°C.

3.0 SPECIAL REQUIREMENT

3.1 All works covered by this specification shall be carried out by experienced and approved agency having sufficient knowledge in epoxy resin treatment works. Only skilled and experienced operators shall be employed for the purpose.

4.0 APPLICATION

4.1 Preparation of Concrete Surface

4.1.1 Grease, oil, algae and other foreign substances likely to impair good bonding shall be thoroughly removed from the surface by scrubbing or using detergent and washing with clean water. All loose and spalling concrete pieces shall be removed. The surface to be bonded shall be made thoroughly rough by chiselling, taking off the skin of concrete and sharp edges of aggregate shall be exposed. The surface shall be washed, wetted cleaned and dried with dry compressed air. Exposed reinforcement shall be thoroughly cleaned with sand paper and wire brushes to remove all dust and sticking mortar.

4.2 Mixing

4.2.1 The resin and hardener shall be thoroughly mixed in a mixer. The approved resin system shall be prepared strictly as per manufacturer's recommendations. It shall not contain lumps and shall have uniform colour. Filler material shall be added if so specified by the manufacturer. Hand mixing shall be allowed for small quantity with prior permission of the Engineer-in-Charge.

4.3 Method of Application

4.3.1 The resin system shall be applied by spraying to the prepared surface. Manual application by using stiff nylon bristle brush may also be allowed with prior permission of the Engineer-in-Charge. The manufacturer shall specify the method of application suitable for the specified work.

4.4 Coverage

4.4.1 A minimum of half kilogram per square metre (½ kg/m^2) or resin system shall be applied to prepared concrete surface. However, the covering capacity depends on the nature of surface over which the system is being applied and the contractor shall use additional quantity of the resin system as per the recommendation of the manufacturer.

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4.5 Handling Precaution

4.5.1 Only skilled and experienced workers shall be entrusted with the application of epoxy system. The resin and hardener shall not be allowed to come into direct contact with the skin. Rubber or polythene gloves with cotton gloves underneath must be worn by the workers handling resin products. Parts of skin which have accidently come into contact with resin or hardener shall immediately be washed with lukewarm water and a mild soap. Special cleaning creams or chemical shall be kept readily available and used as recommended by the manufacturer.

4.6 Cleaning and Maintenance of Equipment

4.6.1 Tools and mixing equipment shall be cleaned immediately after use by using scrapers and other solvents (e.g. toluene, xylene or acetone) as recommended by the manufacturer.

5.0 APPROACH, WORKING PLATFORM & SCAFFOLDING

5.1 The contractor shall arrange all approaches, stairways, ladders, working platform etc. for carrying out the entire operation safely. The working area shall be neatly maintained and all facilities required by the Engineer-in-Charge for proper supervision of the work shall be provided by the contractor.

5.2 All precautionary measures required for the safety of the structure during the progress of operation and till the successful completion and handing over shall be the responsibility of contractor. He shall carry out all such measures as directed by Engineer-in-Charge.

6.0 PAYMENT (applicable to item rate tenders only)

6.1 Payment shall be made by weight of resin system actually used in the work.

6.2 The rate quoted shall be inclusive of all labour and materials required for the successful completion of the work including all cleaning operation before and after the work, preparation of the old, hardened concrete surface as specified, mixing, application of epoxy resin and other safety measures including their removal after completion, all plants and tools etc. complete. Rate shall also be inclusive of all tests required to check the specific properties of materials.

6.3 Any test specified and directed to establish the soundness and monolithicity of bonding of fresh concrete to old concrete actually executed shall be paid separately unless such tests fail to meet the requirements of this specification. In case of failure, no such payment shall be made and the contractor shall repair/ rectify or re-do the work as directed by Engineer-in-Charge at no extra cost to the owner.

6.4 Underground work like excavation, backfilling, removal of surplus earth, keeping the pit dry by pumping/ bailing out subsoil water shall be paid separately as per relevant item in the contract.

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STANDARD SPECIFICATIONS FOR ARCHITECTURAL WORKS (GENERAL)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
7	08.02.22	REAFFIRMED AND ISSUED AS STANDARD SPECIFICATION	ANISH MAHALA	ANISH KUNDU	SAMIR DAS	SANJAY MAZUMDAR
6	20.03.17	REAFFIRMED AND ISSUED AS STANDARD SPECIFICATION	PD	JS/ JKB	R. SRIVASTAVA	R.NANDA
5	15.03.12	REVISED AND ISSUED AS STANDARD SPECIFICATION	PD	SD	JKB	D. MALHOTRA
4	21.03.07	RENAMED & ISSUED AS STANDARD SPECIFICATION	SD	JKB	ARVIND KUMAR	V. CHATURVE
3	11.03.99	REAFFIRMED AS STANDARD SPECIFICATION	SD	MLB	SCJ	AS

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Abbreviations:

ASTM	:	American Society for Testing and Materials
BS	:	British Standards
BIS	:	Bureau of Indian Standards

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1.0 GENERAL

This specification establishes and defines various aspects of specifications of Architectural works such as codes, references, manufacturer, conflicts and contradictions, materials, workmanship, packaging, shipping, delivery and storage, testing, submittals and measurement etc. and shall be applicable for all the Architectural specifications.

2.0 DEFINITIONS

2.1 Contractor

The party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of the Project. Contractor includes its approved Manufacturers, Vendors, Suppliers, and subcontractor's. Requirements of this specification shall be enforced at all levels of the Contractor's design, engineering, procurement, construction process.

2.2 Subcontractor

The party which is engaged by the "Contractor" and carries out all or part of the design, engineering, procurement, construction of the system (s).

2.3 Manufacturer/ Supplier/ Vendor

The party which manufactures and/or supplies equipment, materials, technical documents/ drawings and services to perform the duties specified by the "Contractor".

2.4 Shall

Indicates a mandatory requirement.

2.5 Should

Indicates a strong recommendation to comply with the requirements of this document.

3.0 CODES & SPECIFICATIONS

3.1 Codes and standards as indicated in the specifications form a part of specifications. When an edition date is not indicated for a code or standard, the latest edition and addendum or amendment in force at time of contract award shall apply.

3.2 Alternate codes and standards meeting the requirements of the referenced codes and standards may be used with the approval of the competent authority.

3.3 It shall be Contractor's responsibility to be, or to become, knowledgeable of the requirements of any referenced codes and standards.

4.0 MANUFACTURER

4.1 Name of the Manufacturers of products included in the tender documents are the acceptable Manufacturers for the particular product provided the products meet the requirements specified in the tender documents. Products by other Manufacturers which are of equal quality and performance and meet the specified requirements may be considered for approval upon review of information as required and submitted to the competent authority. However the contractor to ensure that the time schedule is adhered to in any case.

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4.2 Product data sheet, specifications, performance data, installation instructions and other recommendations of such approved Manufacturers also form part of the specifications provided that these are not in contradiction with other specified requirements.

4.3 Materials, installation method and other requirements for execution of any item if required by Manufacturer's installation instructions, recommendations and requirements shall also form part of the specifications whether specified or not.

4.4 In case, name of particular Manufacturers are mentioned in specification/ drawing/ item descriptions etc. the purpose is to set example of desired quality of the product. Product of other manufacturers having similar quality (in the opinion of Engineer- in- Charge) may also be considered.

5.0 CONFLICTS & CONTRADICTIONS

5.1 Specifications, Scope of Work, Schedule of rates and drawings for a particular Tender shall be read in conjunction with each other. In case of conflicts/ contradictions amongst them, the clarification shall be obtained from the Engineer-In-Charge whose decision shall be final & binding. Following procedure shall be followed for the necessary clarification.

5.2 Item description shall prevail over specifications for item rate tenders when provisions therein are different from those in specifications. Whenever any requirement is not covered in item description but are covered in specifications, the specifications shall be followed in addition to the requirements of item description .No extra payment shall be made to the Contractor for executing such item as per specification.

5.3 Whenever drawings call for requirements different from or additional to those in item description and specification, the decision of the Engineer-In-Charge shall be obtained in writing. However no extra payment shall be made to the Contractor for executing any work incorporating requirements additional to those in item description and specification but covered in applicable drawings or standards attached to the tender.

5.4 Any conflict between drawing, item description, specification etc. shall be got resolved by the Contractor from the Engineer-In- charge in writing before execution.

6.0 MATERIALS

6.1 All materials shall be of standard quality conforming to the specifications and other requirements of tender document and shall be obtained from the approved Manufacturer.

6.2 The Contractor shall get the samples of materials approved by the Engineer-In-Charge before ordering & procurement. Such approved samples shall be properly marked/ identified as approved sample and shall be kept as record for future reference.

6.3 Contractor shall arrange the samples along with necessary documentation, test certificates etc. so that the compliance with the specifications etc. can be ascertained.

6.4 Contractor shall arrange mock-ups if asked by the Engineer-In- Charge to facilitate approval of the samples.

6.5 Samples shall be approved subjected to compliance with specifications etc. Finishing, colour, texture and other aesthetic aspects shall also be considered for finishing/ interior items.

6.6 Contractor shall get the materials tested from approved test house if and as asked by the Engineers-In-Charge & submit the test certificate at his own cost for which no extra payment shall be made to him.

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6.7 The Engineer-In-Charge shall have the right to reject all or any of the materials intended to be used and such materials shall be immediately removed from the site by the Contractor at his own cost without any claim for compensation etc. due to such rejection.

7.0 WORKMANSHIP

7.1 Workmanship shall be in accordance with relevant codes or in accordance with Manufacturer's recommendations as approved by the Engineer-in-charge if not specified otherwise.

7.2 All work shall be executed to the complete satisfaction of the Engineer-in-charge. Necessary rectification etc. shall be done by the Contractor at no extra cost for works not accepted by the Engineer-in-charge until the work is accepted by him.

7.3 All works shall be done by qualified Contractors who have adequate equipment and skilled workers. All specialized items of work (e.g. Aluminium Doors and Windows, Waterproofing, Underdeck and Overdeck Insulation, roof sheeting/ cladding, False ceiling, False Flooring, Partitioning and Panelling, Expansion joint sealing, Fire Check Doors, Structural Glazing, Aluminium Composite Panels etc.) shall be got executed by the Contractor only through authorised applicators/ sub contractors of approved Manufacturer/ vendor or as approved by the Engineer-In-Charge.

7.4 All precaution and protection shall be taken during & after completion of work to prevent damages to work being done and other works. Any damages done shall be rectified by the Contractor at no extra cost.

7.5 Work area shall be cleaned after completion of each work and shall be kept clean and protected till final acceptance by the competent authority.

8.0 PACKAGING, SHIPPING, DELIVERY & STORAGE

8.1 All material shall be delivered in Manufacturer's original package bearing the name of the Manufacturer, product colour and pattern name, identification number and other related information.

8.2 All materials shall be stored, preserved and protected to safeguard against all adverse environments such as humidity, moisture, rain, dust, dirt, sand, mud, salt air, salt spray and sea water.

8.3 Specific requirement of packaging, shipping, storage and preservation and safety of materials/ items if any as per Manufacturer's recommendation shall also be ensured by Contractor.

8.4 Materials damaged in handling and storage shall not be used. In the event that any material for use deteriorates and become unusable due to inadequate and poor storage they shall be removed from site as instructed by Engineer-in-charge and replaced at the Contractor's expenses.

9.0 SUBMITTALS

If not mentioned otherwise, Contractor shall submit the following.

9.1 Samples

9.1.1 Samples of materials, components, accessories and complete range of finishing/ shades/ colours for verification as well as acceptance of pattern, colour and finish as applicable.

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9.1.2 Samples shall be re-submitted until approved. Approved samples shall be retained as mentioned in clause 6.0

9.2 Test and BIS Certificates

9.2.1 All applicable tests shall be conducted by the Contractor at no extra cost. Test Certificates shall be submitted for review/ approval of the Engineer-in-charge.

9.3 Shop/ fabrication Drawings

9.3.1 Shop or fabrication drawings indicating large scale details, lay-out, connections, anchoring, fastening, bracing, finishes etc. as applicable for review/ approval.

9.3.2 These drawings shall be prepared to achieve the desired design and quality of work expressed in design, drawings and specifications etc..

9.4 Product Information and Manuals

A. Product information (Technical).
B. Manufacturer's recommended installation instructions.

9.5 List of applicators/ Sub contractors

Contractor shall submit list of applicators/ sub contractors of specialized items of works along with there past track report for review/ approval before execution of such items.

9.6 Maintenance manuals

In case of specialized items, contractor shall submit the Operation & maintenance manual including guarantee/warranty card and its validity document.

9.7 Deviations

9.7.1 Deviations if any shall be raised and processed in accordance with conditions mentioned in the tender document.

9.7.2 Deviations shall be submitted before procurement and execution. Procurement, execution and other related works shall be taken up only after the deviation is accepted by the Engineer-In-Charge. Post facto approval of deviation shall not be entertained and Contractor himself shall be responsible for any procurement/ execution of any work or any action which are deviations and for whose, prior approval is not obtained.

9.8 Sample mock-up work

Contractor shall prepare mock-up work of specialized items or systems as specified or asked by the Engineer-In- Charge. Mock-up shall include the complete item or system with all associated items.

10.0 MEASUREMENT

Mode of measurement is generally specified in each Specification. Whenever mode of measurement is not specified, IS: 1200 shall be applicable.

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फ़र्श के परिष्करण के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR FLOOR FINISHING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	GM (E)	Standards Bureau Chairman
					Approved by		
7	01.06.20	REVISED & ISSUED AS STANDARD SPECIFICATION	Anish Mahala	Samir Das	Rajanji Srivastava		Sunil Kumar Saxena
6	03.03.15	REVISED & ISSUED AS STANDARD SPECIFICATION	AM	SD	JKB	PKM (Addn GM)	S CHANDA
5	06.07.10	REVISED & ISSUED AS STANDARD SPECIFICATION	GB	JS	JKB	VK	N. DUARI
4	21.03.07	REVISED & ISSUED AS STANDARD SPECIFICATION	SD	JKB	ARVIND KUMAR		V. CHATURVEDI
3	12.03.99	REAFFIRMED AS STANDARD SPECIFICATION	SD	MLB	SCJ		AS
2	16.03.94	REVISED & ISSUED AS STANDARD SPECIFICATION	JS	JS	AKG		AS

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Abbreviations:

ASTM	:	American Society for Testing and Materials
BS	:	British Standards
IS	:	Indian Standards
PVC	:	Polyvinyl Chloride

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1.0 GENERAL

This specification covers technical specification of various kind of floor finishes/ floorings to be used in building works.

1.1 Standards

Reference shall be made to the following Indian Standards for any further information etc. not covered in this specification.

IS: 2571	Code of practice for laying in situ cement concrete flooring.
IS: 3461	Specification for PVC asbestos floor tiles.
IS: 3462	Specification for unbaked flexible PVC flooring.
IS: 4441	Code of practice for use of resin type chemical resistant mortars.
IS: 4443	Code of practice for use of resin type chemical resistant mortars.
IS: 4457	Acid and/or alkali Resistant tiles.
IS: 4631	Code of practice for laying of epoxy resin floor toppings.
IS: 5318	Code of practice for laying of flexible PVC sheet and tile flooring.
IS: 5491	Code of practice for laying of in-situ granolithic concrete floor topping.
IS: 13630 (Part-1 to 15)	Methods of Testing of ceramic tiles, methods of test, sampling and basis for acceptance
IS 13712	Specification for ceramic tiles; definition, classification characteristic and marking.
IS 15622	Pressed ceramic tile - specification

Note: Wherever, codes other than IS codes are mentioned, equivalent IS codes are also acceptable.

1.2 Base/ sub base for floor finishing

Floor finishing shall be provided over base/ sub base of cement concrete or reinforced cement concrete (RCC) floor slab. In case of ground floor, the floor slab i.e. base/ sub base for floor finish shall be as per standard no. 7-67-0011 or as specified or as mentioned in drawings. For other upper floors, the floor slabs shall be the base/ sub base for floor finish.

1.3 Slope/ levelling of floor finishing

1.3.1 Finished floor shall be in slope towards drainage out-lets. Slope shall be ranging from 1: 48 to 60 or as directed by Engineer-In-Charge in Verandahs, Courtyards, Kitchen, Bath and other wet areas. Slope in Indian type water closet areas shall be 1:30 or as directed by Engineer-In-Charge. Further, necessary drop in flooring in bath, WC, kitchen near floor traps ranging from 6mm to 10mm will also be provided to avoid spread of water.

1.3.2 Necessary margin to accommodate these slopes and drops shall preferably be made in base/ sub base or base course of finishing layer.

1.3.3 Excepting above and if not mentioned specifically otherwise, top of floor finish of all areas/ rooms/ spaces in any particular floor shall be same throughout. If further filling on base floor slab is required for this purpose, the filling shall be done with cement concrete (1 cement: 2

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coarse sand: 4 graded stone aggregate, 20mm nominal size which shall be carried out in accordance with workmanship mentioned in the specification of cement concrete flooring for base course of cement concrete flooring) or cement mortar (1 cement: 3 coarse sand) as directed by Engineer-In-Charge.

1.4 Skirting

Skirting shall be provided with floor finish. If not mentioned otherwise skirting shall be of same finish as that of the flooring.

2.0 CEMENT CONCRETE FLOORING

2.1 General

Cement concrete flooring shall consist of a base course of cement concrete (laid over sub base/ base concrete floor) and a finishing layer.

2.2 Base course

Base course shall be of 40mm thick cement concrete (1 cement: 2 coarse sand: 4 graded stone aggregate, 20mm nominal size).

2.3 Finishing layer

Finishing layer shall be a floating coat of neat cement, including cement slurry (@ 2 kg of cement for area of one square metre).

2.4 Workmanship

2.4.1 The surface of floor slab shall be roughened with steel wire brushes without disturbing the concrete, cleaned, and the laitance shall be removed. Immediately before laying the floor finish, the base shall be wetted and a coat of cement slurry @ 2 kg of cement spread over an area of one square metre so as to get a good bond between the floor slab and base course.

2.4.2 Floor finish of specified thickness shall be laid in the pattern including the border as given in the drawings or as directed by the Engineer-in-Charge. The border panels shall not exceed 450mm in width and the joints in the border shall be in line with panel joints. The panels shall be of uniform size and no dimension of a panel shall exceed 2 metre and the area of a panel shall not be more than 2 square metre. The joints of borders at corners shall be mitred for provision of strips.

2.4.3 Cement concrete floor finish shall be laid in one operation using glass/ aluminium/ PVC/ brass / stainless steel or any other strips (as specified or as per instructions of the Engineer-in-Charge) at the junction of two panels to ensure uniformity in colour of all the panels and straightness at the junction of the panels. The strips shall be fixed with their tops at proper level, giving required slopes.

If, type of strip is not specified anywhere, minimum 3mm thick PVC strips shall be provided.

2.4.4 Base course of cement concrete shall be placed in the panels and be levelled with the help of straight edge and trowel and beaten with thapy or mason's trowel. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given. Beating shall cease as soon as the surface is found covered with a thin layer of cream of mortar. The evenness of the surface shall be tested with straight edge. Surface of flooring shall be true to required slopes. While laying concrete, care shall be taken to see that the strips are not damaged/disturbed. The tops of strips shall be visible clearly after finishing with cement slurry.

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2.4.5 The finishing layer of the floor finish shall follow immediately after the cessation of beating. The surface shall be left for some time, till moisture disappears from it or surplus water can be mopped up. Use of dry cement or cement and sand mixture stiffening the concrete to absorb excessive moisture shall not be permitted. Excessive trowelling shall be avoided. Fresh cement shall be mixed with water to form thick slurry and spread @ 2 kg of cement over an area of 1 sqm of flooring while the flooring concrete is still green. The cement slurry shall then be properly processed and finished smooth.

2.4.6 The junctions of floor with wall plaster, dado or skirting shall be rounded off.

2.4.7 The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies bag shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

3.0 HEAVY DUTY CEMENT CONCRETE FLOORING

3.1 General

Heavy duty cement concrete flooring shall consist of a base course of cement concrete (laid over sub base/ base concrete floor) and a finishing layer.

3.2 Base Course

Base course shall be of 40mm thick cement concrete (1 cement: 2 coarse sand: 4 graded stone aggregate, 20mm nominal size).

3.3 Finishing layer

Finishing layer shall be of 12mm thick cement hardener consisting of mix 1:2 (1 cement hardener mix: 2 graded stone aggregate 6mm nominal size) by volume laid over the base course.

Hardener/ hardening compound shall be mixed @ 2 litre per 50 kg of cement or as per Manufacturer's specifications.

3.4 Workmanship

3.4.1 Base course shall be laid in accordance with clause nos 2.4.1, 2.4.2, 2.4.3 & 2.4.4

3.4.2 The top surface of base course shall be roughened with brushes while the concrete is still green and the forms/strips shall be kept projecting up 12mm over the concrete surface, to receive finishing layer.

3.4.3 The topping shall be laid on base course within 2 to 4 hours of its laying, true to provide a uniform and even surface. It shall be firmly pressed into the bottom concrete so as to have good bond with it. After the initial set has started, the surface shall be finished smooth and true to slope with steel floats.

3.4.4 The junctions of floor with wall plaster, dado or skirting shall be rounded off.

3.4.4 The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies bag shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

4.0 CEMENT PLASTER SKIRTING

4.1 General

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Cement plaster skirting shall be provided in cases of all types of cement concrete floorings if not mentioned otherwise.

Cement plaster skirting shall be with cement mortar 1:3 (1 cement: 3 coarse sand) finished with floating coat/ slurry of neat cement. The cement to be applied in the form of slurry for smooth finishing shall be at the rate of 2 kg of cement per litre of water applied over an area of 1 sqm.

Average thickness of cement plaster skirting shall not be less than 18mm.

If not mentioned otherwise, height of the skirting shall be 125mm.

4.2 Workmanship

4.2.1 The surface on which the skirting is to be applied shall be prepared for laying skirting. The joints shall be raked out to a depth of at least 15mm in masonry walls. In case of concrete walls, the surfaces shall be roughened by hacking. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

4.2.2 Skirting shall be laid immediately after the surface is prepared. It shall be laid along with the border or adjacent panels of floor. The joints in skirting shall be kept true and straight in continuation of the line of joints in borders or adjacent panels. The skirting shall be finished smooth with top truly horizontal and joints truly vertical except where otherwise indicated.

4.2.3 The finishing of surface shall be done simultaneously with the borders or the adjacent panels of floor. Where skirting is flush with plaster, a groove 10mm wide and upto 5mm deep shall be provided in plaster at the junction of skirting with plaster.

4.2.4 Curing shall be commenced on the next day of plastering when the plaster has hardened sufficiently and shall be continued for a minimum period of 7 days.

5.0 CERAMIC & VITRIFIED TILE FLOORING

5.1 Ceramic Tile

5.1.1 Ceramic Tiles shall conform to IS 15622 and shall be of 1st quality, flat, true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance.

5.1.2 Classification and Characteristics of pressed ceramic tiles shall be as per IS 13712.

5.1.3 The tiles shall be tested as per IS 13630.

5.1.4 The tiles shall conform to table10 of IS 15622 with water absorption 3 to 6% (Group BII).

5.1.5 The top surface of the tiles shall be glazed. Glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only upto 50 per cent of the surface area of the edges.

5.1.6 The tiles shall be non-slip type for flooring application in wet areas and of colour and pattern as specified in drawings, Item descriptions, job specification, design basis or approved by Engineer-in-Charge.

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5.1.7 If not mentioned elsewhere i.e. drawings, Item descriptions, job specification, design basis etc. sizes of the tiles shall be:

Flooring : 300mm x 300mm
Dado : 300mm x 450mm
Thickness : As specified by the Manufacturer.

5.2 Vitrified Tiles

5.2.1 Specification of vitrified tiles shall be similar to 5.1 excepting following specifications which vitrified tiles shall conform.

5.2.2 The tiles shall conform to Table 12 of IS 15622 (Tiles with water absorption less than 0.08 per cent, Group BIa).

5.2.3 Sizes of the tiles shall be as per drawings/ Item descriptions/ job specification/ design basis etc. as directed by Engineer-In-Charge. Thickness shall be as specified by the Manufacturer.

5.2.4 If not mentioned elsewhere i.e. drawings, Item descriptions, job specification, design basis etc. 600mm x 600mm glazed tiles finished with digital printing shall be used.

5.3 Workmanship

The finished surface shall not sound hollow when tapped with a wooden mallet.

The tiles shall be laid in pattern as per drawing.

5.3.1 Base concrete or the RCC slab or plastered wall surface on which the tiles are to be laid shall be cleaned, wetted and mopped.

5.3.2 The tiles shall be laid over a coating of polymer modified, thin set, quick set tile adhesive conforming to IS 15477. The adhesive shall be thoroughly mixed with water and a paste of zero slump shall be prepared so that it can be used within 1.5 to 2 hours. It shall be spread over an area not more than one sqm at one time. Average thickness of adhesive shall be 3mm. The adhesive so spreaded shall be combed using suitable trowel. Tiles shall be pressed firmly in to the position with slight twisting action checking it simultaneously to ensure good contact gently being tapped with wooden mallet till it is properly backed with adjoining tiles. The tiles shall be fixed within 20 minutes of application of adhesive. The surplus adhesive from the joints, surface of the tiles shall be immediately cleaned.

5.3.3 The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

5.3.4 The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. In bath, toilet W.C. kitchen and balcony/ verandah flooring, suitable tile drop or as shown in drawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

5.3.5 For vertical surfaces, the tiles shall be corrected to proper planes with joints truly vertical in required pattern and butt jointed. The fixing shall be done from bottom upward. The top of skirting and dado shall be truly horizontal.

5.3.6 If not mentioned specifically elsewhere such as design basis, item description, drawings, job specifications etc. the joints of tiles shall be cleaned off to a depth of 2-3mm and all dust, loose particles shall be removed and joints shall then be flush pointed with white cement added with pigment to match the colour of tiles.

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5.3.7 If mentioned specifically elsewhere such as design basis, item description, drawings, job specifications etc. tiles shall be laid with 3mm thick PVC spacers at joints. When the laid tiles have set, the spacers shall be removed and the joints shall be filled and finished with approved quality food grade, stain & chemical resistant coloured epoxy grout matching with the colour of tiles.

5.3.8 The tiled floor shall then be kept wet for 7 days. After curing, the tiled surfaces shall be washed and finished clean

6.0 ACID OR ALKALI RESISTANT TILES

6.1 The Acid or Alkali Resistant tiles shall be of vitreous ware and free from deleterious substances. The iron oxide content allowable in the raw material shall not exceed two percent. The tiles shall be vitrified at the temperature of 1100 deg C and above and shall be kept unglazed. The finished, tile, shall appear fine grained in texture, dense and homogenous. The tiles shall be sound, true to slope, flat and free from flows and manufacturing defects affecting their utility.

The tiles shall conform to IS 4457.

The tiles shall be tested for water absorption, compressive strength, acid resistance as per IS 4457. Sampling procedure for acceptance tests and criteria for conformity shall be as per IS 4457.

The tiles shall be 10mm thick (tolerance: + 2 percent). The depth of the grooves on the underside of the tile shall not exceed 3mm.

The tiles shall be of required colour.

6.2 Workmanship

The finished surface shall not sound hollow when tapped with a wooden mallet.

6.2.1 Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped.

6.2.2 The bedding for the tile shall be with acid/alkali resistant cement mortar 1:4 (1acid/alkali resistant cement: 4 coarse sand).

6.2.3 The average thickness of the bedding shall be 10mm for flooring and 12mm for skirting/ Dado while the thickness under any portion of the tiles shall not be less than 10mm.

6.2.4 Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

6.2.5 Over this mortar bedding neat grey acid/alkali resistant cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square metre over an area up to one square metre.

6.2.6 Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

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6.2.7 For vertical surfaces, the tiles shall be corrected to proper planes with joints truly vertical in required pattern and butt jointed. The fixing shall be done from bottom upward. The top of skirting and dado shall be truly horizontal.

6.2.8 The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope.

6.2.9 Tiles which are fixed in the floor adjoining the wall shall enter not less than 10mm under the plaster, skirting or dado.

6.2.10 After tiles have been laid surplus cement slurry shall be cleaned off. The joints shall be cleaned off the cement slurry with wire/coir brush or trowel to a depth of 2mm to 3mm and all dust and loose mortar removed. Joints shall then be flush pointed with acid/alkali resistant cement added with pigment if required to match the colour of tiles.

6.2.11 The tiled floor shall then be kept wet for 7 days. After curing, the tiled surfaces shall be washed and finished clean.

7.0 MARBLE STONE FINISH

7.1 Marble Stone Slabs

The marble slabs shall be of specified size, thickness, type, grade and colour. The marble from which the slabs are made shall be of selected quality, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering and flakes. The sample of marble stone slabs shall be got approved from the Engineer-in-Charge.

Marble stone shall be laid in desired pattern using stones of desired color.

If not mentioned elsewhere i.e. item description, drawings, job specifications etc. marble stone slab shall be second quality Makrana white.

This specification does not cover Marble stone wall cladding and veneering.

Dimensions:

Except for dimensions shown in drawing or cut sizes required to cover the balance areas along peripheries, dimensions of slabs shall be 600mm to 2500mm in length and 600mm to 1000mm in width as per drawing and as directed by Engineer-In-Charge.

Tolerance of + 3% shall be allowed for the thickness. In respect of length and breadth of slabs a tolerance of + 2% shall be allowed.

If not mentioned elsewhere i.e. i.e. item description, drawings, job specifications design basis etc. thickness shall be as below.

1. Thickness of stone slab in flooring and horizontal surfaces: 18mm.
2. Thickness of stone slab in skirting, dado and vertical surfaces: 12mm.

Marble stone in riser, tread of staircases, counter tops shall be of single piece upto 2000mm length. Nosing shall be provided in the treads &counter tops.

Physical properties:

Physical properties of Marble and method of testing shall be as follows:

Physical Property	Requirement	Method of test
Moisture absorption After 24 hours	Maximum 0.4%	IS: 1124

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Immersion in cold water		
Hardness	Minimum 3	Mhos scale
Specific Gravity	Minimum 2.5	IS: 1122

7.2 Workmanship

The slabs shall be washed clean before laying. Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of veins/ streaks or as directed by the Engineer-In-Charge.

The finished surface shall not sound hollow when tapped with a wooden mallet.

7.2.1 Laying

Laying on floor and horizontal surfaces:

Base slab on which the slabs are to be laid shall be cleaned, wetted and mopped.

Marble slabs shall be laid over average 22mm thick cement mortar 1:4 (1 cement : 4 coarse sand) bedding.

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar shall be allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already laid shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the marble slabs.

The slab to be laid shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible.

Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off.

Slabs which are fixed in the floor adjoining the wall shall enter not less than 12mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.

The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge. Joint thickness shall not be more than 1mm.

Laying on vertical surfaces i.e skirting/ dado/ risers:

The joints shall be raked out to a depth of at least 15mm in masonry walls. In case of concrete surfaces, the surface shall be hacked and roughened with wire brushes. The base surface shall be cleaned thoroughly, washed with water and kept wet before laying is commenced.

In case of skirting, the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in drawings or as required by the Engineer-in-Charge. In no case the skirting should project by more than thickness of stone.

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The slabs shall be held in position by suitable temporary measure such as wooden/ bamboo supports, temporary hook etc. as approved by Engineer-In- Charge. The line of the slab shall be at such a distance from the wall that the average width of the gap shall be 12mm and at no place the width shall be less than 10mm, The outer face of the slabs shall be checked for plane and plumb and corrected. The joints shall be as fine as possible and shall be filled with neat cement paste/ grout with white cement and pigment to match the colour of the slabs. The joints shall thus be left to harden and then the rear gap between the slabs and backing surface shall be packed with average 12mm thick cement mortar 1:3 (1 cement : 3 coarse sand). Temporary supports shall be removed after the mortar filling in the gap has acquired sufficient strength.

The joints shall be as fine as possible but not more than 1mm. The top line of the skirting/ dado/ risers shall be truly horizontal and joints truly vertical.

7.2.2 Curing, Polishing and Finishing

The surface shall be kept wet for a minimum period of 7 days. The day after the slabs are laid, all joints shall be cleaned of the grout with a wire brush or trowel. The surface shall thereafter be grounded evenly using the following carborundum stones.

1st grinding — coarse grade stone (No. 60)
Second grinding — medium grade (No. 80)
Final grinding — fine grade (No. 120)

If desired appearance of the finished surface is not achieved, the surface shall be further polished using requisite carborundum stones (including finer grade) as directed by Engineer-In-Charge.

Visible top surfaces of skirting/ dado etc. and edges of nosing shall be polished.

Water shall be used profusely during grinding. After grinding the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped.

Each grinding shall be done one day after the previous grinding has been done.

After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a 'namdah' block (pad of woollen rags).

The following day after the last grinding/ polishing, the surface shall be wiped with a moist rag and dried with a soft cloth and finished clean.

If any stone is disturbed or damaged, it shall be refitted or replaced and properly jointed and polished.

In case of pre-polished stones, any damage or unevenness on the surface shall be rectified.

8.0 KOTA STONE FINISH

8.1 Kota stone slabs

The Kota stone slabs shall be of specified size, thickness, selected quality and shade, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering and flakes. These shall be machine cut to the requisite size and thickness and of the colour indicated in the drawings or as instructed by the Engineer-in-Charge. The sample of stone slabs shall be got approved from the Engineer-in-Charge. Kota stone shall be laid in desired pattern.

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The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified.

All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

Dimensions:

The slabs shall be machine cut to the requisite dimensions.

Except for dimensions shown in drawing or cut sizes required to cover the balance areas along peripheries, dimensions of slabs shall be 600mm to 2500mm in length and 600mm to 1000mm in width as per drawing and as directed by Engineer-In-Charge.

Tolerance of ±2mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of ± 2mm for machine cut slabs shall be allowed.

If not mentioned elsewhere i.e. item description, drawings, job specifications etc. thickness shall be as below.

1. Thickness of stone slab in flooring and horizontal surfaces: 25mm.
2. Thickness of stone slab in skirting, dado and vertical surfaces: 18mm.

Kota stone in riser, tread of staircases, counter tops shall be of single piece up to 2000mm length. Nosing shall be provided in the treads &counter tops.

8.2 Workmanship

The slabs shall be washed clean before laying.

The finished surface shall not sound hollow when tapped with a wooden mallet.

8.2.1 Laying

Laying on floor and horizontal surfaces:

Base slab on which the slabs are to be laid shall be cleaned, wetted and mopped.

Kota stone slabs shall be laid over average 15mm thick cement mortar 1:4 (1 cement: 4 coarse sand) bedding.

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar shall be allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already laid shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the marble slabs.

The slab to be plaid shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible.

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Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off.

Slabs which are fixed in the floor adjoining the wall shall enter not less than 12mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.

The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge.

The edges of the slabs to be jointed shall be buttered with grey cement, with admixture of pigment to match the shade of the slab. The thickness of the joints should be minimum as possible. In any location, it shall not exceed 1mm.

Laying on vertical surfaces i.e skirting/ dado/ risers and vertical surfaces:

The joints shall be raked out to a depth of at least 15mm in masonry walls. In case of concrete surfaces, the surface shall be hacked and roughened with wire brushes. The base surface shall be cleaned thoroughly, washed with water and kept wet before laying is commenced.

In case of skirting, the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in drawings or as required by the Engineer-in-Charge. In no case the skirting should project by more than thickness of stone.

The slabs shall be held in position by suitable temporary measure such as wooden/ bamboo supports, temporary hook etc. as approved by Engineer-In- Charge. The line of the slab shall be at such a distance from the wall that the average width of the gap shall be 12mm and at no place the width shall be less than 10mm, The outer face of the slabs shall be checked for plane and plumb and corrected. The joints shall be as fine as possible and shall be filled with neat cement paste/ grout with white cement and pigment to match the colour of the slabs. The joints shall thus be left to harden and then the rear gap between the slabs and backing surface shall be packed with average 12mm thick cement mortar 1:3 (1 cement : 3 coarse sand). Temporary supports shall be removed after the mortar filling in the gap has acquired sufficient strength.

The edges of the slabs to be jointed shall be buttered with grey cement, with admixture of pigment to match the shade of the slab. The thickness of the joints should be as minimum as possible. In any location, it shall not exceed 1mm. The top line of the skirting/ dado/ risers shall be truly horizontal and joints truly vertical.

8.2.2 Curing, Polishing and Finishing

The surface shall be kept wet for a minimum period of 7 days. The day after the slabs are laid, all joints shall be cleaned of the grout with a wire brush or trowel. The surface shall thereafter be grounded evenly using the following carborundum stones.

First grinding — medium grade (No. 80)
Final grinding — fine grade (No. 120)

If desired appearance of the finished surface is not achieved, the surface shall be further polished using requisite carborundum stones (including finer grade) as directed by Engineer-In-Charge.

Visible top surfaces of skirting/ dado etc. and edges of nosing shall be polished.

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Water shall be used profusely during grinding. After grinding the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped.

Each grinding shall be done one day after the previous grinding has been done.

After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a 'namdah' block (pad of woollen rags).

The following day after the last grinding/ polishing, the surface shall be wiped with a moist rag and dried with a soft cloth and finished clean.

If any stone is disturbed or damaged, it shall be refitted or replaced and properly jointed and polished.

In case of pre-polished stones, any damage or unevenness on the surface shall be rectified.

9.0 GRANITE STONE FINISH

The Granite stone shall be of specified size, thickness, type, and colour (such as jet black, cherry red, elite brown, cat eye etc.). They shall be of selected quality, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering and flakes, machine cut and pre-polished/ of flamed finish. The sample of granite stone slabs shall be got approved from the Engineer-in-Charge.

Granite stone shall be laid in desired pattern using stones of desired color.

This specification does not cover Granite stone wall cladding and veneering.

Dimensions:

The slabs shall be machine cut to the requisite dimensions.

Except for dimensions shown in drawing or cut sizes required to cover the balance areas along peripheries, dimensions of slabs shall be 600mm to 2500mm in length and 600mm to 1000mm in width as per drawing and as directed by Engineer-In-Charge.

If not mentioned elsewhere i.e. item description, drawings, job specifications etc 18mm thick Granite slabs shall be provided.

Tolerance of + 1% shall be allowed for the thickness. In respect of length and breadth of slabs a tolerance of + 2% shall be allowed.

Granite stone in riser, tread of staircases, counter tops shall be of single piece upto 2000mm length. Nosing shall be provided in the treads &counter tops.

Finish:

If not mentioned elsewhere i.e item description, drawings, job specifications, design basis etc Granite stone shall be pre-polished finish.

Physical properties:

Physical properties of Granite and method of testing shall be as follows:

Physical Property	Requirement	Method of test
Moisture absorption After 24 hours	Maximum 0.5%	IS: 1124

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Immersion in cold water		
Specific Gravity	Minimum 2.6	IS: 1122

9.2 Workmanship

The slabs shall be washed clean before laying.

The finished surface shall not sound hollow when tapped with a wooden mallet.

9.2.1 Laying

Laying on floor and horizontal surfaces:

Base slab on which the slabs are to be laid shall be cleaned, wetted and mopped.

Granite slabs shall be laid over average 22mm thick cement mortar 1:4 (1 cement: 4 coarse sand) bedding.

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar shall be allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already laid shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the granite slabs.

The slab to be plaid shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible.

Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off.

Slabs which are fixed in the floor adjoining the wall shall enter not less than 12mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.

The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge. Joint thickness shall not be more than 1mm.

Laying on vertical surfaces i.e skirting/ dado/ risers:

The joints shall be raked out to a depth of at least 15mm in masonry walls. In case of concrete surfaces, the surface shall be hacked and roughened with wire brushes. The base surface shall be cleaned thoroughly, washed with water and kept wet before laying is commenced.

In case of skirting, the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in drawings or as required by the Engineer-in-Charge. In no case the skirting should project by more than thickness of stone.

The slabs shall be held in position by suitable temporary measure such as wooden/ bamboo supports, temporary hook etc. as approved by Engineer-In- Charge. The line of the slab shall be at such a distance from the wall that the average width of the gap shall be 12mm and at no place the width shall be less than 10mm, The outer face of the slabs shall be checked for plane

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and plumb and corrected. The joints shall be as fine as possible and shall be filled with neat cement paste/ grout with white cement and pigment to match the colour of the slabs. The joints shall thus be left to harden and then the rear gap between the slabs and backing surface shall be packed with average 12mm thick cement mortar 1:3 (1 cement : 3 coarse sand). Temporary supports shall be removed after the mortar filling in the gap has acquired sufficient strength.

The joints shall be as fine as possible but not more than 1mm The top line of the skirting/ dado/ risers shall be truly horizontal and joints truly vertical.

9.2.2 Curing, Polishing and Finishing

The surface shall be kept wet for a minimum period of 7 days. The day after the slabs are laid, all joints shall be cleaned of the grout with a wire brush or trowel. The surface shall be wiped with a moist rag and dried with a soft cloth and finished clean.

If any stone is disturbed or damaged, it shall be refitted or replaced and properly jointed and polished.

Any damage unevenness of the stone surface shall be rectified.

10.0 PVC FINISH

10.1 PVC Roll/ Tiles

PVC roll/ tiles shall be homogenous, of approved texture, colour, pattern, with polyurethane surface protection and shall be of class-1 category for surface spread of flame when tested in accordance with BS 476, part-7.

PVC rolls shall conform to IS: 3462 and PVC tiles shall conform to IS: 3462.

Antistatic PVC roll/ tiles shall conform to B.S.2050, Table-2.

Thickness of PVC roll/ tiles shall be 2mm.

Size of tiles shall be 600mm x 600mm.

If not mentioned elsewhere i.e item description, drawings, job specifications, design basis etc. PVC floor finish shall be with PVC rolls.

PVC roll/ tiles shall be laid in desired pattern in accordance with drawing or as directed by Engineer-In-Charge.

10.2 Workmanship

The base floor on which PVC finish is to be laid shall be prepared in accordance with PVC tile/roll Manufacturer's recommendation.

The base floor shall be made permanently smooth, firm, free of cracks and dry. If required, suitable leveling compound as recommended and approved by PVC tile/roll manufacturer shall be applied over the base floor.

PVC rolls/tiles shall be brought to the temperature of the area in which it is to be laid and stacked suitably near the site in accordance with manufacturer's recommendation.

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Laying of PVC roll/ tile shall be in accordance with manufacturer's recommendation using adhesive (Fevicol SR-505 or other adhesive as recommended by Manufacturer and approved by Engineer-In-Charge).

In case of rolls, minimum possible number of joints shall be provided.

PVC rolls shall be placed in position from one end onwards slowly without creation on any air pockets between roll and the base floor.

PVC rolls/tiles shall be placed only when the adhesive is set sufficiently for laying. After placing, the rolls/tiles shall be pressed suitably with a wooden roller weighing about 5 kg. The joint between adjacent rolls shall be thin hairline type.

PVC rolls in flooring shall he continued for skirting without any joints.

Joints, seams of the PVC flooring shall be sealed by thermo-welding the joints using PVC welding bar of matching colour.

Any excess adhesive squeezing out of the surface shall he wiped off immediately with a wet cloth. In case of such excess adhesive becoming hard, it shall be removed using suitable removing product.

After a minimum period of 24 hours after laying the rolls/tiles, the finished floor shall be cleaned with a wet cloth soaked in warm soap or detergent solution as per approved manufacturer's specifications.

11.0 ABRASION RESISTANT EPOXY FLOOR COATING SYSTEM

Abrasion resistant epoxy floor coating system shall consist of primer coat, levelling/ self smoothening screed and a top finishing coat. All components of the system shall be compatible to it's under and top layer/coat and shall be of single Manufacturer.

11.1 Material

Primer, screed and top coat shall meet the requirements of the table below :

Requirement	Primer	Screed	Top Coat
Material	Solvent free Epoxy resin.	Shall comprise of resin base, resin hardener and fillers and shall be self-smoothening.	Shall comprise of resin base, resin hardener and aggregate/ fillers , shall be self-smoothening and of approved colour.
Dry film Thickness (Minimum)	200 micron	2000 micron	2000 micron
Material coverage	Material shall be applied in quantity worked out considering minimum coverage mentioned in the data sheet (authenticated by the Manufacturer) for intended surface area for specified thickness.		
Tensile strength (Minimum Value) Material shall meet minimum value corresponding to any test method mentioned below.			
ASTM D 638	-	08 MPa at 7 days	51Mpa at 7 days

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ASTM C 307	-	-	25 MPa at 7 days
EN ISO 527	-	-	07 MPa at 7 days
BS 6319 Part-7	-	08 MPa at 7 days	10 MPa at 7 days
Compressive strength (Minimum Value) Material shall meet minimum value corresponding to any test method mentioned below.			
ASTM D695	-	40 MPa at 7 days	50 MPa at 7 days
ASTM C 579	-	-	40 MPa at 7 days
EN ISO 604	-	-	50 MPa at 7 days
BS 6319 Part-2	-	50 MPa at 7 days	50 MPa at 7 days
Abrasion resistance (Minimum Value)			
ASTM D 4060	-	-	45 Mg thickness loss/ 1000 cycle of CS 17 wheel
Shore D Hardness (Minimum Value)			
ASTM D 2240	-	75	75
Bond strength to concrete (Minimum Value) Material shall meet minimum value corresponding to any test method mentioned below.			
ASTM D 4541	1.5 MPa concrete failure	-	-
ASTMD 412	1.0 MPa concrete failure	-	-

11.2 Workmanship

The work shall be carried out by Applicator recommended by coating Manufacturer and approved by Engineer-In-Charge.

Waiting time between the coats i.e. primer, screed and top coat should be as recommended by Manufacturer.

Surface preparation:

Base concrete slab shall be grinded thoroughly (minimum upto 150-200 microns) to make the surface suitable for epoxy application and achieve desired surface profile.

Base concrete slab on which epoxy coating is to applied shall be cleaned and made free from oil, grease, foreign particles,dust, dirt, debris, loose epoxy coatings, paint, sealers etc. by using wire brushes or mechanical means.

Cutting of construction & control joints in concrete floor including Isolation joints in perimeter of column, Door & floor joint, Machine foundation should be done within 48 to 72 hours after the concrete floor is laid.

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These joints in the concrete floor shall be filled with Poly-Urathane sealant (Having Shore A hardness more than 60 and Movement Accommodation Factor (MAF) more than 10%).

Any damage or pot holes in the concrete floor shall be rectified as directed by Engineer-In-Charge.

Primer coat:

Primer coat shall be applied when the prepared surface is ready for such application.

Primer coat as per specification shall be applied by brush and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

The primer will be left for minimum seven hours or as recommended by manufacturer. to dry before the application of screed.

Screed:

Screed as per specification shall be applied over the primed surface using steel trowel, mixing the ingredients in right proportion and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

Spike Rollers shall be used to remove air entrapment in the screed.

The screed shall be left to get air cured for minimum time as recommended by manufacturer so asto get the floor dry and hard to take care of walking movement. Further it will be cleaned and inspected for pin holes which shall be patched up suitably.

Top coat:

Top coat as per specification and of approved colour shall be applied over the screed using steel trowel, mixing the ingredients in right proportion and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

Spike Rollers shall be used to remove air entrapment.

Any damage or incorrect work/finish shall be suitably rectified.

The finished surface shall be left to dry and cure for minimum 24 hours (for human movement), 72 hours (for light weight movement), 7 days (for heavy movement) or as recommended by manufacturer.

11.3 Submittals by Contractor

Contractor shall submit following:

1. Product Data Sheet authenticated (signed and stamped) by the Manufacturer.
2. Test certificates in support of specified properties/ values.

12.0 ABRASION & IMPACT RESISTANT POLYURETHANE CONCRETE FLOOR COATING SYSTEM

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Abrasion & impact resistant Polyurethane (PU) concrete floor coating system shall consist of primer coat, screed or scratch-coat and a top finishing coat. All components of the system shall be compatible to it's under and top layer/coat and shall be of single Manufacturer.

12.1 Material

Primer, screed or scratchcoat and top coat shall meet the requirements of the table below :

Requirement	Primer	Screed or scratch-coat	Top Coat
Material	Waterborne Epoxy resin or other material compatible to other coats of the system.	Shall comprise of Polyurethane Resin base, resin hardener and fillers	Shall comprise of resin base, resin hardener and aggregate/ fillers , shall be self-smoothening, fast setting and of approved colour
Dry Film Thickness (Minimum)	50 micron	1000 micron	3000 micron
Material coverage	Material shall be applied in quantity worked out considering minimum coverage mentioned in the data sheet (authenticated by the Manufacturer) for intended surface area for specified thickness.		
Tensile strength (Minimum Value) Material shall meet minimum value corresponding to of any test method mentioned below.			
ASTM D 638	-	05 MPa at 28 days	05 MPa at 28 days
ASTM C 307	-	06 MPa at 28 days	06 MPa at 28 days
EN ISO R527	-	09 MPa at 28 days	09 MPa at 28 days
BS 6319 Part-7	-	06 MPa at 28 days	06 MPa at 28 days
Compressive strength (Minimum Value) Material shall meet minimum value corresponding to of any test method mentioned below.			
ASTM D695	-	40 MPa at 28 days	40 MPa at 28 days
ASTM C 579	-	40 MPa at 28 days	40 MPa at 28 days
BS 6319 Part-2	-	45 MPa at 28 days	45 MPa at 28 days
Abrasion resistance (Minimum Value)			
ASTM D 4060	-	-	50Mg thickness loss/ 1000 cycle of CS 17 wheel
Bond strength to concrete (minimum value) Material shall meet minimum value corresponding to of any test method mentioned below.			
ASTM D 4541	1.5 MPa concrete failure	-	-
ASTMD 412	1.0 MPa concrete	-	-

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	failure		
Impact Resistance (minimum Value)			
ASTM D 2794	-	-	8 Joules for 3mm thickness

12.2 Workmanship

The work shall be carried out by Applicator recommended by coating Manufacturer and approved by Engineer-In-Charge.

Waiting time between the coats i.e. primer, screed and top coat shall be as recommended by Manufacturer.

Surface preparation:

Base concrete slab shall be grinded thoroughly (minimum upto 150-200 microns) to make the surface suitable for epoxy application and achieve desired surface profile.

Base concrete slab on which PU coating is to applied shall be cleaned and made free from oil, grease, foreign particles,dust, dirt, debris, loose epoxy coatings, paint, sealers etc. by using wire brushes or mechanical means.

Cutting of construction & control joints in concrete floor including Isolation joints in perimeter of column, Door & floor joint, Machine foundation should be done within 48 to 72 hours after the concrete floor is laid.

These joints in the concrete floor shall be filled with Poly-Urethane sealant (Having Shore A hardness more than 60 and Movement Accommodation Factor (MAF) more than 10%).

Any damage or pot holes in the concrete floor shall be rectified as directed by Engineer-In-Charge.

Primer coat :

Primer coat shall be applied when the prepared surface is ready for such application.

Primer coat as per specification shall be applied by brush and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

The primer will be left for minimum seven hours or as recommended by manufacturer to dry before the application of screed.

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Screed or Scratch coat:

Screed or Scratch-coat shall be applied over the primed surface using notched trowel, mixing the ingredients in right proportion and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

Spike Rollers shall be used to remove air entrapment in the screed.

The screed shall be left to get air cured for 3-4 hours or as recommended by the Manufacturer to get the floor dry and hard to take care of walking movement. Further it will be cleaned and inspected for pin holes which shall be patched up suitably.

Top coat:

Top coat as per specification and of approved colour shall be applied over the screed or scratch coat using notched trowel, mixing the ingredients in right proportion and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

Spike Rollers shall be used to remove air entrapment.

Any damage or incorrect work/finish shall be suitably rectified.

The finished surface shall be left to dry and cure for minimum 24 hours (for human movement), 72 hours (for light weight movement), 7 days (for heavy movement) or as recommended by the Manufacturer.

12.3 Submittals by Contractor

Contractor shall submit following:

1. Product Data Sheet authenticated (signed and stamped) by the Manufacturer.
2. Test certificates in support of specified properties/ values.

13.0 CHEMICAL RESISTANT NOVOLAC EPOXY FLOOR COATING SYSTEM

Chemical resistant Novolac Epoxy floor coating system shall consist of primer coat, levelling screed or scratch coat and chemical resistant top coat. All components of the system shall be compatible to it's under and top layer/coat and shall be of single Manufacturer.

13.1 Material

Primer, screed or scratch coat, coloured coat and final clear coat shall meet the requirements of the table below:

Note:

For chemical resistant top coat, any option (option 1 and option 2) mentioned in the table is acceptable.

Requirement	Primer	Screed or scratch coat	Top coat	
			Option1 – Top coloured coat over clear chemical resistance coat	Option 2 – Coloured chemical Resistance coat

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Material	Solvent free Epoxy resin	Shall comprise of resin base, resin hardener and fillers and shall be self-smoothening	Top coloured coat shall comprise of resin base, resin hardener and aggregate/ fillers , shall be self-smoothening and of approved colour Clear chemical resistance coat shall comprise of resin, hardener and shall be self smoothening and shall be solvent free.	Shall comprise of resin, hardener and shall be self smoothening and shall be solvent free and of approved colour.
Dry Film Thickness (Minimum)	200 micron	2000 micron	Total 1000 micron (500 micron for both clear and coloured coat)	500 micron
Material coverage	Material shall be applied in quantity worked out considering minimum coverage mentioned in the data sheet (authenticated by the Manufacturer) for intended surface area for specified thickness.			
Tensile strength (Minimum Value) Material shall meet minimum value corresponding to of any test method mentioned below.				
ASTM D 638	-	08 MPa at 7 days	14 MPa at 7 days	14 MPa at 7 days
ASTM C 307	-	-	-	-
EN ISO 527	-	-	-	-
BS 6319 Part-7	-	08 MPa at 7 days	-	-
Compressive strength (Minimum Value) Material shall meet minimum value corresponding to of any test method mentioned below.				
ASTM D 695	-	40 MPa at 7 days	60 MPa at 28 days/	-
ASTM C 579	-	-	85 Mpa at 28 days	-
EN ISO 604	-	-	-	-
BS 6319 Part-2	-	50 MPa at 7 days	-	-

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Abrasion resistance				
ASTM D 4060	-	45 Mg thickness loss/ 1000 cycle of CS 17 wheel	-	60 Mg thickness loss/ 1000 cycle of CS 17 wheel
ASTM D 4060	-	-	-	<0.10 Mg/ cycle of 1 Kg CS10 wheel
Shore D Hardness				
ASTM D 2240	-	70	70	70
Bond strength to concrete Material shall meet minimum value corresponding to any test method mentioned below.				
ASTM D 4541	1.5 MPa Concrete failure	-	-	-
ASTMD 412	1.0 MPa concrete failure	-	-	-

13.2 Workmanship

The work shall be carried out by Applicator recommended by coating Manufacturer and approved by Engineer-In-Charge.

Waiting time between the coats i.e. primer, screed or scratch coat, top coloured coat and top clear coat shall as recommended by Manufacturer.

Surface preparation:

Base concrete slab shall be grinded thoroughly (minimum upto 150-200 microns) to make the surface suitable for epoxy application and achieve desired surface profile.

Base concrete slab on which epoxy coating is to applied shall be cleaned and made free from oil, grease, foreign particles, dust, dirt, debris, loose epoxy coatings, paint, sealers etc. by using wire brushes or mechanical means.

Cutting of construction & control joints in concrete floor including Isolation joints in perimeter of column, Door & floor joint, Machine foundation should be done within 48 to 72 hours after the concrete floor is laid.

These joints in the concrete floor shall be filled with Poly-Urathane sealant (Having Shore A hardness more than 60 and Movement Accommodation Factor (MAF) more than 10%).

Any damage or pot holes in the concrete floor shall be rectified as directed by Engineer-In-Charge.

Primer coat:

Primer coat shall be applied when the prepared surface is ready for such application.

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Primer coat as per specification shall be applied by brush and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

The primer will be left for minimum seven hours or as recommended by manufacturer. to dry before the application of screed.

Screed:

Screed as per specification shall be applied over the primed surface using steel trowel, mixing the ingredients in right proportion and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

Spike Rollers shall be used to remove air entrapment in the screed.

The screed shall be left to get air cured for 7 hours or as recommended by the Manufacturer to get the floor dry and hard to take care of walking movement. Further it will be cleaned and inspected for pin holes which shall be patched up suitably.

Top coat:

Top coat as per specification and of approved colour shall be applied over the screed using steel trowel, mixing the ingredients in right proportion and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

Chemical resistance top coat should be immediately applied to the prepared surface ensuring a continuous coating of uniform thickness. Stiff nylon brush or short nap roller is recommended for such application.

Chemical resistant, clear coating (option-1) shall be applied over cured top coloured coat using roller, mixing the ingredients in right proportion and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

Spike Rollers shall be used to remove air entrapment.

Any damage or incorrect work/finish shall be suitably rectified.

The finished surface shall be left to dry and cure for minimum 24 hours (for human movement), 72 hours (for light weight movement), 7 days (for heavy movement) or as recommended by the Manufacturer.

13.3 Submittals by Contractor

Contractor shall submit following:

1. Product Data Sheet authenticated (signed and stamped) by the Manufacturer.
2. Test certificates in support of specified properties/ values.

14.0 CHEMICAL RESISTANT NOVOLAC EPOXY WALL COATING SYSTEM

Chemical resistant Novolac epoxy wall coating system shall consist of primer coat and a top coloured coat All components of the system shall be compatible to it's under and top layer/coat and shall be of single Manufacturer.

14.1 Material

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Primer and top coat shall meet the requirements of the table below :

Note :

For chemical resistant top coat, any option (option 1 and option 2) mentioned in the table is acceptable.

Requirement	Primer	Top coat	
		Option 1- Top coloured coat over chemical resistant clear coat	Option 2- Chemical Resistance coloured top coat
Material	Solvent free Epoxy resin	Chemical resistant clear coat shall comprise of resin, hardener and shall be self smoothening. Coloured coat shall comprise of resin base, resin hardener and shall be of approved colour	Shall comprise of resin, hardener and shall be self smoothening of approved colour.
Dry film Thickness (Minimum)	200 micron	Chemical resistant clear coat : 300 micron Coloured coat: 100 micron	400 micron
Material coverage	Material shall be applied in quantity worked out considering minimum coverage mentioned in the data sheet (authenticated by the Manufacturer) for intended surface area for specified thickness.		
Tensile strength (Minimum Value) Material shall meet minimum value corresponding to of any test method mentioned below.			
ASTM D 638	-	10 Mpa at 7 days	30 MPa at 7 days

14.2 Workmanship

The work shall be carried out by Applicator recommended by coating Manufacturer and approved by Engineer-In-Charge.

Waiting time between the coats i.e. primer, screed and top coat shall be as recommended by Manufacturer.

Surface preparation:

Base wall shall be grinded lightly or rubbed with a sand paper thoroughly to make the surface suitable for application and achieve desired surface profile.

Base on which coating is to applied shall be cleaned and made free from oil, grease, foreign particles, dust, dirt, debris, loose epoxy coatings, paint, sealers etc. using wire- brushes or mechanical means.

Putty may be applied to the base wall surface depending upon the exisiting condition of the surface and as directed by Engineer-In-Charge

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Any damage or holes or cracks in the wall shall be rectified as directed by Engineer-In-Charge.

Primer coat:

Primer coat shall be applied when the prepared surface is ready for such application.

Primer coat as per specification shall be applied by brush and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

The primer will be left for minimum seven hours or as recommended by manufacturer to dry before the application of screed.

Top coat:

Top coat as per specification and of approved colour shall be applied over the screed using steel trowel, mixing the ingredients in right proportion and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

Chemical resistance top coat should be immediately applied to the prepared surface ensuring a continuous coating of uniform thickness. Stiff nylon brush or short nap roller is recommended for such application.

Chemical resistant, clear coating (option-1) shall be applied over cured top coloured coat using roller, mixing the ingredients in right proportion and in accordance with recommendations by the coating manufacturer to specified thickness and using specified coverage.

Spike Rollers shall be used to remove air entrapment.

Any damage or incorrect work/finish shall be suitably rectified.

14.3 Submittals by Contractor

Contractor shall submit following:

1. Product Data Sheet authenticated (signed and stamped) by the Manufacturer.
2. Test certificates in support of specified properties/ values.

15.0 MEASUREMENTS

For measurement of floor finishing, skirting, wall finishing etc. mentioned in this specification, actual finished surface shall be measured.

No deduction shall be done for cutting or wastage of materials.

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लकड़ी के काम का मानक विनिर्देश (दरवाजे एवं खिड़कियाँ)

STANDARD SPECIFICATION FOR WOODWORK (DOORS & WINDOWS)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
7	04.03.22	REVISED & ISSUED AS STANDARD SPECIFICATION	PIYALEE DAS	ATUL GUPTA	SAMIR DAS	SANJAY MAZUMDAR
6	27.03.17	REAFFIRMED & ISSUED AS STANDARD SPECIFICATION	PD	JS/ JKB	R.SRIVASTAVA	R. NANDA
5	15.03.12	REVISED & ISSUED AS STANDARD SPECIFICATION	PD	SD	JKB	D. MALHOTRA

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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

Architecture Standards Committee
Convenor: Mr. Samir Das

Members: Mr. Rajesh Gujral
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1.0 GENERAL

This standard specification lays down the requirements of wood or wood based doors and windows.

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:

Sl.no:	Standards	Document Title
1.	IS 204 Part-1	Specification for Tower bolts, Part-1: Ferrous metals.
2.	IS 204 Part-2	Specification for Tower bolts, Part-2: Non- Ferrous metals.
3.	IS 205	Specification for non ferrous metal butt hinges
4.	IS 208	Specification for Door handles
5.	IS 287	Specification for Permissible moisture content for timber used for different purposes
6.	IS 303	Specification for plywood for general purposes.
7.	IS 401	Specification for preservation of timber.
8.	IS 710	Specification for marine plywood.
9.	IS 848	Specification for synthetic resin adhesives for plywood (phenolic and amino plastic)
10.	IS 851 (1978)	Specification for Synthetic Resin Adhesives For Construction Work (Non-Structural) in Wood
11.	IS 1003 Part-1	Specification for Timber paneled and glazed shutters, Part-1: Door shutters
12.	IS 1141	Specification for seasoning of timber.
13.	IS 1328	Specification for veenered decorative plywood.
14.	IS 1341	Specification for steel butt hinges.
15.	IS 1659	Specification for block board.
16.	IS 1708	Methods of testing of small clear specimens of timber
17.	IS 1734 (Part 1)	Specification for method of test for plywood.
18.	IS 2202 Part-1	Specifications for wooden flush door shutters (solid core type), Part 1: Plywood face panels.
19.	IS 2202 Part-2	Specification for wooden flush door shutters (solid core type), Part 2: Particle board and hardboard face panels
20.	IS 2209	Specification for mortise locks- (vertical type)
21.	IS 2338	Code of practice for finishing of wood and wood based materials. (Part I & II)
22.	IS 2835	Specification for flat transparent sheet glass.
23.	IS 3087	Specification for particle boards at wood & other lingno cellulosic material (medium density) for general purposes.
24.	IS 3097	Specification for veneered particle boards.
25.	IS 3564	Specification for hydraulically regulated door closers.
26.	IS 4021	Specification for timber door, window and ventilator frames.

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27.	IS 4835 (1979)	Specification Polyvinyl Acetate Dispersion Based Adhesives for Wood
28.	IS 5437	Specification for figured rolled and wired glass.
29.	IS 5509	Specification for fire retardant plywood.
30.	IS 6315	Specification for floor springs (hydraulically regulated) for heavy doors.
31.	IS 11215	Specification for determining moisture content of timber and timber products.
32.	IS 12823	Specification for plywood for prelaminated particle board.
33.	IS 12896	Specification for Indian timbers for door and window shutters and frames- Classification
34.	IS 14587	Specification for plywood for prelaminated medium density fibre board.

3.0 DOORS, WINDOWS AND VENTILATORS

3.1 Doors and windows shall be complete with frame, shutter/ leaves and hardware with all operational fittings and fixtures as mentioned in the drawings, job specification, item description etc.

3.2 Doors

3.2.1 Door frames shall be as mentioned in the drawings, job specification, item description etc.

If type of door frame is not specifically mentioned in the drawings, Job specs, item description etc, pressed steel door frame as specified in specification no 6-75-0004 shall be used..

Door shutters shall be Block board flush shutter, panelled door shutter, glazed wooden door shutter, flymesh door shutter as mentioned in the drawings, job specification, item description etc.

3.3 Windows

Window frames shall be as mentioned in the drawings, job specification, item description etc.

If type of window frame is not specifically mentioned in the drawings, Job specs, item description etc, powder coated aluminum frame as specified in specification no 6-75-0004 shall be used.

Window shutters shall be panelled/ glazed shutter, flymesh shutter as mentioned in the drawings, job specification, item description etc.

4.0 MATERIAL

4.1 Timber

4.1.1 Teakwood

Teakwood shall be second class Indian Teakwood conforming to IS 12896 of good quality, well seasoned, close grained and free from defects such as cracks, dead knots, sapwood etc. Individual hard and sound knot shall not be more than 40mm in diameter and aggregate area of all the knots shall not exceed one per cent of the piece.

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4.1.2 Deodar wood/ Sal wood

Hard wood shall be first class wood conforming to IS 12896 of good quality, well seasoned and free from defects such as dead knots, cracks, sapwood etc. No individual hard and sound knot shall exceed 25mm in diameter and the aggregate area of all the knots shall not exceed 1% of the area of the piece.

4.1.3 Moisture content in timber

The maximum permissible percentage of moisture content for well seasoned timber shall be checked for every 1 cum or part thereof by electrical moisture meters as per IS: 287. Maximum permissible limit of moisture content of timber for different uses, shall be as per the procedure laid down in IS-11215, and as per table mentioned below:

No	Use	Max. Moisture content percent			
		Zone I	Zone II	Zone III	Zone IV
1.	Beams, Rafters & Posts	12	14	17	20
2.	Doors and windows a. 50 mm and above thickness b. Thinner than 50mm	10 8	12 10	14 12	16 14
3.	Flooring Strips	8	10	10	12
4.	Furniture and cabinet making	10	12	14	15

Tolerance on moisture content: Moisture content of individual samples shall be within +5 percent of maximum permissible moisture content as specified in Table above.

Seasoning of timber shall be done as per IS-1141 and preservative treatment of timber shall be as per IS 401.

4.1.4 Workmanship of wood work

Workmanship for wood and joinery shall be as per IS: 2338.

4.1.5 Painting/polishing of wood work

Painting/polishing of wood work shall be in accordance with specification No. 6-75-0007.

4.2 Plywood board

Plywood board shall be BWP grade or BWR grade as per IS 303.
Marine plywood shall confirm to IS 710.
Fire resistant plywood shall confirm to IS 5509.

Moisture content of the plywood boards when tested in accordance with IS 1734 (Part 1) shall not be less than 5 percent and not more than 15 percent. Testing shall be as per IS 303.

4.3 Particle Board

Particle board shall conform to IS 3087 and shall be flat pressed three layered or graded and of Grade 1, bonded with BWP type, Synthetic resin conforming to IS: 848. Testing shall be as per IS 3087.

4.4 Prelaminated Particle Board.

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Pre-laminated particle board shall conform to IS 12823 and shall be of Grade 1, bonded with BWP type Synthetic resin conforming to IS: 848. Testing shall be as per IS 12823.

4.5 Pre Laminated Medium density fibre Board

Pre-laminated medium density fibre board are available in two grades namely Grade I and II and shall conform to IS: 14587: 1998, laminated on both surfaces by synthetic resin conforming to IS: 848.

4.6 Block Board

Block board is a board having a core made up of strips of wood, not exceeding 30mm in width and shall conform to IS: 1659. Block board shall be of two grades: BWP grade, MR grade. The adhesives used for bonding shall be BWP type/ MR type Synthetic resin conforming to IS: 848.

4.7 Veneers

Veneers shall conform to IS 3097 (Veenered Particle board) and IS 1328 (Veenered decorative plywood).

4.8 Hardware

Reference shall be made to Clause 8.0

4.9 Glazing

Glass sheets for glazing shall be i) 4 mm thick plain glass (wt. 7.2 kg/m2) conforming IS:2835, or ii) 6.0 mm thick toughened glass conforming to IS:5437 as specified.

Glass sheets shall be free from flaws, scratches, cracks, bubbles etc.

If type of glass is not mentioned specifically, toughened glass shall be provided.

5.0 DOOR, WINDOW AND VENTILATOR FRAMES (TIMBER)

Timber for door, window and ventilator frames shall be as per IS 4021, and shall be in accordance with detailed drawings.

If not mentioned specifically, teakwood shall be used.

Timber shall be sawn in the direction of the grains. All members of a frame shall be of the same species of timber and shall be straight without any warp or bow. The wooden members of the frame shall have smooth, well planned surfaces except the surfaces touching the walls, lintels, sill etc. Rebates, rounding or moulding etc. shall be done before the members are jointed into frames.

Joints in the frame work shall be at right angles, pressed in position and shall be glued with adhesive confirming to IS 4835 or adhesive confirming to IS 851 and pinned with 10mm dia hard wood dowels or bamboo pins.

Wood work shall be painted/polished or otherwise treated as specified before fixing in position. All exposed portions shall be coated with wood primer and concealed surface by bituminous paints as per specification No. 6-75-0007.

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Before any surface treatment is applied, the wood work shall be got approved by the Engineer-in-charge. The frames shall be fixed to the masonry by 300mm x 25mm x 6mm MS hold fasts embedded in M-15 grade concrete size of 350mm x 100mm x 100mm in the hole of masonry. In case of concrete, frames shall be fixed by 12mm dia metallic anchor fasteners.

6.0 DOOR SHUTTERS

Door shutters shall be complete with all operational fittings & fixtures like hinges, overhead hydraulic door closers, Tower bolts, Locking device, handles, door stopper etc.

6.1 Block Board Flush Shutter

Block board flush shutter shall conform to IS: 2202. The shutter shall be minimum 35mm thick and shall be made of solid core block board. Width and height of the shutter shall be as shown in the drawings. The moisture content in timbers used in the manufacture of flush door shutters shall not be more than 12 percent when tested according to IS 1708.

Teak wood beading of minimum 12mm thickness fixed to the perimeter of the shutter. The shutter shall be faced on both sides with following finishes as specified and shall be factory made.

If not mentioned specifically, finishing shall be with lamination as described below.

A. 3mm thick commercial type plywood conforming to IS: 303, BS: 476 part-7 finished with two coats of approved quality and shade synthetic enamel paint over approved quality primer.

B. Approved quality 1mm thick teakwood veneering. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS 1328.

C. 1mm thick approved quality lamination of approved shade.

The edges of the shutters shall be painted/ varnished/ French polished as specified over a coat of primer as per specification No. 6-75-0007.

6.2 Panel Door Shutter

Panelled door shutters shall conform to IS 1003. Panel door shutters shall be minimum 35mm thick and shall consist of 100mm x 35mm teakwood stiles & top rail, 200mm x 35mm bottom rail and 150mm x 35mm lock rail and 12mm thick particle board infill panels. The infill panels shall be fixed with adhesive and moulded Teakwood beadings (minimum 12.5mm x 12.5mm size).

The shutter shall be painted with polyurethane paint or shall be varnished/ French polished as specified .

If not mentioned specifically, polyurethane paint shall be done.

6.3 Glazed Wooden Door Shutter

Glazed wooden door shutters shall confirm to IS 1003. Glazed wooden door shutter shall be minimum 38mm thick and shall consist of 100mm x 38mm Teakwood stiles and top rail, 200mm x 38mm bottom rail and 150mm x 38mm thick lock rail. 4mm thick plain glass or 6.0 mm thick toughened glass panels shall be fixed in the stiles & rails with neoperene adhesive and 12.5mm x 12.5mm moulded Teakwood beading. All the wood work shall be painted with

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polyurethane paint or shall be varnished/ French polished as specified.

If not mentioned specifically, toughened glass and polyurethane paint shall be provided.

6.4 Flymesh Door Shutter

Flymesh door shutter shall be minimum 38mm thick and shall consist of 100mm x 38mm Teakwood stiles and top rail, 200mm x 38mm bottom rail and 150mm x 38mm thick lock rail and net of SS/ galvanised MS wire gauge of IS gauge designation 856 & dia 0.56 mm fixed with moulded Teakwood beading. The shutter including wiremesh shall be painted with 2 coats of approved shade synthetic enamel paint or polyurethane paint or French polished.

If not mentioned specifically, SS net and polyurethane paint shall be provided.

7.0 WINDOW/ VENTILATOR SHUTTER/ PANEL

Window/ ventilator shutters / panels shall be glazed type with timber framing. Glass and timber shall be as specified.

If not mentioned specifically, teakwood and toughened glass shall be provided.

If flymesh shutter/ panels are specified, teakwood framing and SS nets (as specified for flymesh door shutter) shall be provided if not mentioned otherwise.

The timber framing shall be painted with synthetic enamel paint or polyurethane paint or shall be varnished/ French polished as specified .

If not mentioned specifically, polyurethane paint shall be done.

8.0 HARDWARE

8.1 Doors, windows and ventilators shall be provided with all required hardware for stability, proper operability. Hardware shall be fixed truly vertical or horizontal as the case may be.

8.2 Hardware used shall be well made, reasonably smooth, and free from all sharp edges and corners, flaws and other defects.

8.3 Hardware shall be of brass body (chromium plated) or powder coated Aluminum alloy or of Stainless Steel (SS-304) as mentioned in the drawings and as mentioned in the following table.

If not mentioned specifically, brass body (chromium plated) hardware shall be provided.

Sl. no:	Hardware	Specification
1	Hinges	Hinges shall be butt type conforming to IS. 205/ IS: 1341. Size of hinges shall be minimum 125mm long.
2	Overhead Hydraulic Door Closer:	Overhead hydraulic door closers shall be of heavy duty type and shall conform to IS: 3564.
3	Floor Mounted Door Closer	Floor mounted door closers shall be of heavy duty type and hydraulically operated and shall conform to IS: 6315
4	Mortice Lock	Mortice locks shall conform to IS: 2209.
5	Door Handles	Door handles shall conform to IS 208.
6	Aldrop	Aldrop shall be 300 mm long and minimum 18mm dia.

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7	Tower Bolt	Tower bolts shall conform to IS: 204.
8	Door Stopper	Door stoppers shall consist of heavy duty rubber shoes spring loaded type with zinc alloy pressure die cast chromium plated holders.
9	Toilet Door Latch	Toilet Door latch shall be with Vacant/occupied indicator.
10	Coat & Hat Hook	Coat & Hat hooks for Toilet doors shall be of chromium plated brass body or stainless steel.

8.4 Hardware of each shutter shall be as mentioned in drawing.

If not mentioned specifically, each door shutter shall be provided with hinges, tower bolts, overhead hydraulic door closer, door stopper, lock and door handles (on both side). Open type window/ ventilator shall be provided with handles, stays and tower bolts.

Lock and hydraulic door closer shall not be provided in toilet cubicles.

9.0 MEASUREMENT

9.1 Wood work in door/window frames shall be measured in Cu.M.
9.2 Door/window shutters shall be measured in Sq.M.
9.3 Hardware and fittings like locks, tower bolts, door closer etc. shall be counted in numbers provided.

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स्टील/अलुमिनियम दरवाजे, खिडकियों एवं रोशनदान का मानक विनिर्देशन

STANDARD SPECIFICATION FOR STEEL/ALUMINIUM DOORS, WINDOWS AND VENTILATORS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Approved by	Standards Bureau Chairman
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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
RCC	:	Reinforced Cement Concrete
VOC	:	Volatile Organic Compounds
ISO	:	International Organization for Standardization
NFPA	:	National Fire Protection Association

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1.0 GENERAL

This standard specification lays down the requirements of steel/ aluminium door, window and ventilator and rolling shutter assemblies for buildings.

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:

Sl.no:	Standards	Document Title
1.	IS 5	Colour for ready mixed paints and enamels.
2.	IS 325	Three phase induction motors
3.	IS 617	Specifications for aluminium and aluminium alloy ingots & castings for general engineering purposes.
4.	IS 733	Specifications for wrought aluminium and aluminium alloy bars, rods & sections for general engineering purposes.
5.	IS 737	Specifications for wrought aluminium and aluminium alloy sheet & strip for general engineering purposes.
6.	IS 1038	Specifications for steel doors, windows and ventilators.
7.	IS 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
8.	IS 1161	Steel Tubes For Structural Purposes - Specification
9.	IS: 1239	Steel tubes, tubulars and other wrought steel fittings — Specification
10.	IS 1285	Specifications for wrought aluminium and aluminium alloy extruded round tube & hollow sections for general engineering purposes.
11.	IS 1361	Specifications for steel windows for Industrial buildings.
12.	IS 1477 Part-2	Code of practice for painting of ferrous metals in buildings
13.	IS 1948	Specifications for Aluminium doors, windows and ventilators.
14.	IS 2062	Standard for hot rolled medium and high tensile structural steel
15.	IS 2074	Specifications for Ready mixed paint, air drying, red oxide zinc chrome, priming specification
16.	IS 2223	Dimensions of flange-mounted AC Induction motors
17.	IS 2253	Designation for types of construction and mounting arrangements of rotating electrical machines
18.	IS 2385	Designation for types of construction and mounting arrangements of rotating electrical machines
19.	IS 2553 Part-1	Safety glass – specification Part 1: General purposes
20.	IS 2835	Flat transparent sheet glass
21.	IS - 2968	Dimensions of slide rails for electrical motors
22.	IS 3548	Code of practice for glazing building

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23.	IS 3564	Specification for hydraulically regulated door closer
24.	IS 3614 Part-1	Specification for fire check doors. Part-1: Plate metal cover and rolling type
25.	IS 3614 Part-2	Specification for metallic and non metallic fire check doors. Part-2: Resistance test & performance criteria
26.	IS 4029	Guide for testing of three phase induction motors
27.	IS 4351	Specifications for steel door frames.
28.	IS 4454-part I	Steel wire for mechanical springs — specification
29.	IS 4691	Degree of protection provided by enclosure for rotating electrical machinery
30.	IS 4722	Rotating electrical machines
31.	IS 4889	Method of determination of efficiency of rotating electrical machines
32.	IS 5437	Figured rolled and wired glass
33.	IS 6248	Specifications for metal rolling shutters and rolling grill
34.	IS 6315	Specification for Floor springs (hydraulically regulated) for heavy doors.
35.	IS 6362	Designation of methods of cooling of rotating electrical machines
36.	IS: 7088	Recommended practice for anodizing aluminum and its alloys.
37.	IS 7452	Specification for hot rolled steel sections for doors, windows and ventilators.
38.	IS 12436 (1998)	Specifications for preformed rigid polyurethane (PUR) and polyisocyanurate (PIR) foams for thermal insulation..

3.0 DOOR,WINDOW AND VENTILATORS

3.1 Door, window and ventilator assemblies shall be complete with frames, shutters and required, hardware ensuring stability, safety and smooth operation.

3.2 Type of Door, window and ventilator assemblies shall be as mentioned in job specifications or construction drawings.

4.0 STEEL DOORS

4.1 Steel door assemblies shall have following components. For further details reference shall be made to EIL Standard Nos.7-75-0070, 7-75-0071 and 7-75-0074

Component	Specification
Door frame	Made of 16 SWG galvanized steel pressed and profiled to required size with 3mm thick MS flat spacers welded towards jamb size, 3mm thick MS pad plate and 18 SWG galvanized steel mortar guard welded at all hinge & lock locations. The vertical members shall be provided with 20mm x 20mm x 3mm welded MS angle threshold which shall be embedded in flooring. The hollow frame shall be filled up with concrete or any other approved suitable material.

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	Continuous "D" profile EPDM gasket shall be provided in the rebate of the frame in case of air-tight doors.
Door Shutter	Made of 18 SWG galvanized steel pressed and profiled to required size and thickness (minimum thickness – 40mm) with 3mm thick MS flat welded continuously along the perimeter of the shutter, profiled vertical stiffeners made of 18 SWG galvanized steel. The shutter shall be filled up with mineral wool (density – 48 Kg/ cum). Other approved filler material is permissible for large doors/shutters. In case of double shutters, suitable profiling/ rebating shall be done at the junction of meeting shutters for proper closure of the shutters.
Vision Panel	Vision panels shall be provided in the shutters as per project drawings. Glass shall be as mentioned in the drawings. Glass pane shall be fixed by means of 18 SWG galvanized steel "Z" angle welded to the shutter along the periphery of the opening and continuous EPDM gasket. If nothing is specified 350mm x 450mm sized vision panel with 5mm thick toughened glass shall be provided.
Louvers	Louvers shall be provided in the shutters if specified or mentioned in the project drawings. Louvers shall be made of 18 SWG galvanized steel "Z" profiled blades welded to the shutter. Louvers shall not be provided in air conditioned and pressurized area.

4.2 Hardware

Following hardware shall be provided in the steel door assemblies

Hardware	Specification
Hydraulic door closer	1 no. heavy duty hydraulic door closer confirming to IS 3564 for each shutter .
Tower/ Flush bolt	1 no. 10mm dia stainless steel Tower/ Flush Bolt (SS 304 grade, 250mm long upto 2100mm high door and 600mm long upto 2500 mm high door) for each shutter on both sides. For large size door (width- above 2000mm to 3000mm, height- above 2500mm to 3000mm), tower/ flush bolt shall be upto 1400mm long and shall be surface mounted or concealed type.
Aldrop	1 no. 16mm dia stainless steel Aldrop (SS 304 grade, 300mm long) for each shutter on both sides. For large size door (width- above 2000mm to 3000mm, height- above 2500mm to 3000mm), Aldrop shall be 400mm long.
Door Handle	1 no. 18mm dia stainless steel door handle (SS 304 grade, 200mm long) for each shutter on both sides. For large size door (width- above 2000mm to 3000mm, height- above 2500mm to 3000mm), door handles shall be 300mm long.
Door Stopper	1 no. spring loaded heavy duty door stopper for each shutter.
Hinges for shutters	100mm long stainless (SS 304 grade) steel heavy duty ball bearing hinge. Number of hinges shall be : 3 (for upto 2100mm high door)

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	4 (for upto 2400mm high door) 5 (for upto 2700mm high door) 6 (for upto 3000mm high door)

4.3 Fabrication & Installation

4.3.1 Doors shall be true to the plumb, size and design and smooth operation shall be ensured.

4.3.2 All metallic components shall be shall be welded or rigidly fixed together by mechanical means. Joints between horizontal and vertical frame members shall be mitred. All welding shall be finished smooth.

4.3.3 The frames shall be fixed to the masonry by means of 200 mm x 25 mm x 6 mm MS hold fast welded to the spacers and grouted with M-20 grade concrete in minimum 250 mm x 100 mm x 100 mm sized hole in the masonry.

4.3.4 In case of concrete, the frames shall be fixed by minimum 100 mm long, 12 mm dia metallic counter sunk type anchor fasteners through the frame and spacers.

4.3.5 Vertical frame member shall be tied together below floor finish by mean of 20mmx20mmx3mm MS Angle welded to both faces of frame.

4.3.6 40mmx150mmx3mm thick MS pad shall be welded to frame at all hinges and lock locations. 18 SWG GI mortar guard shall be provided at the back of hinges and lock.

4.3.7 The metallic surfaces shall be thoroughly cleaned of rust, mill scale, dirt, oil etc. and then finished with painting or powder coating as specified. If not specifically mentioned elsewhere, Finishing of the door assemblies shall be minimum 40 micron powder coating in desired colour. The thickness of powder coating shall be subjected to verification at site (on random basis) as directed by Engineer- in- Charge with appropriate measuring instruments supplied by contractor.

5.0 STEEL WINDOW & VENTILATORS

5.1 Steel window and ventilator assemblies shall have steel frames and shutters (glazed/with wire mesh/ with louvers as specified) with required hardware. For further details reference shall be made to EIL Standard Nos.7-75-0025, 7-75-0027 to 7-75-0032.

5.2 Steel windows and ventilators shall in general conform to IS 1038 and IS 1361.

5.3 Materials/ Assembly components

5.3.1 Frame and shutter shall be made of rolled steel sections conforming to IS: 7452.

5.3.2 Glass for glazed shutters shall be as specified. If nothing is mentioned specifically, minimum 5 mm thick toughened glass shall be provided.

5.3.3 Louvers shall be made of 18 SWG MS steel profiled sheets.

5.3.4 Wire mesh shall be of stainless steel (SS-304 grade) or wire of galvanized steel as specified. If nothing is mentioned specifically, stainless steel wire mesh shall be provided.

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5.4 Hardware

5.4.1 All hardware required for smooth operation, durability and safety such as handles, Peg-stays, hinges, closure of shutters etc. shall be provided.

5.5 Fabrication & Installation

5.5.1 Steel window and ventilator assemblies shall be true to the plumb, size and design and smooth operation shall be ensured.

5.5.2 All metallic components shall be shall be welded together. Joints between horizontal and vertical frame members shall be mitred. All welding shall be finished smooth.

5.5.3 Frames shall be fixed in the opening by means of 100mm x 15mm x 6 mm thick MS lugs @ grouted with M-20 grade concrete or with minimum 100 mm long, 12 mm dia metallic counter sunk type anchor fasteners. when fixing to steel work, mastic shall be applied to the sill of the opening and the unit shall be placed on it with the jambs and head buttered with mastic and the unit shall be fixed with special fixing dips or with nuts and bolts.

5.5.4 Where larger units are to be formed by coupling individual units, the mullions, transoms shall be bedded in mastic to ensure weather tightness. Mastic shall be applied liberally to the channels of the outside frame sections before assembly, and the two units being coupled shall be drawn together tight with clamps, the mastic being squeezed out and cut off neatly when the units shall be screwed together tight.

5.5.5 Where fixed glazing units are placed over openable units, a push fit weather bar shall be provided.

5.5.6 Before glazing, all opening parts shall be checked for their operational smoothness. The frame shall be completely cleaned and bedding putty shall be placed in the rebate before glazing. Glass then shall be cushioned into the bedding and shall be fronted with front putty in a manner so as to enable the painting to be done up to the sight line. The back putty oozing out over the glazing rebate shall be cut off square and smoothed down.

5.5.7 For panels exceeding 600 x 300 mm in size, glass shall be secured by special glazing clips inserted in holes already provided in the steel sections, before applying the front putty.

5.5.8 For glazing of very large areas, rust proof steel beading with mitred corners shall be provided with screws @ 10 cm. from each corner and @ 20 cm. apart from each other. Putty shall be provided to the face of the bead in contact with glass, in addition to back putty.

5.5.9 Side hung shutters shall be connected to the frame by means of friction hinges. The handle for side hung shutters shall be of pressed brass mounted on a steel handle plate welded to the opening shutter frame and shall not be removable easily after glazing. The handle shall have a two point nose which shall engage with a brass striking plate on the fixed frame in a slightly open as well as in a fixed position.

5.5.10 Top hung shutters shall be provided with steel butt hinges welded to the fixed frame after cutting a slot in it. Top hung casements shall be provided with peg stay of 3 holes of pressed brass; 300 mm long which when closed shall be held tightly by the locking bracket fitted to the fixed frame or to the window.

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5.5.11 All the steel surfaces shall be thoroughly cleaned free of rust, mill scale, dirt, oil etc. by sand and shot blasting and then finished with painting by priming with red oxide zinc chromate primer conforming to IS:2074 and minimum two coats of synthetic enamel paint conforming to IS:1477 (Part II). Putty shall also be provided with painting in a manner so as to seal the putty glass junction. Surfaces not meant for painting shall be cleaned of any strains of paint.

6.0 ALUMINIUM DOORS, WINDOWS AND VENTILATORS

6.1 Aluminium door, window and ventilator assemblies (glazed/with wire mesh/ with louvers as specified) shall have frames and shutters made of extruded profiled tubular Aluminium sections with required hardware. Aluminium window shutters shall be side hung or sliding type as mentioned in the design basis, job specifications or construction drawings. For further details reference shall be made to EIL Standard Nos. 7-75-0014, 7-75-0015, 7-75-0016, 7-75-0017 etc.

6.2 Materials/ Assembly components

6.2.1 Aluminium sections shall be extruded profiled tubular sections of approved Manufacturers having aluminium alloy as per IS: 733 and IS: 1285.

6.2.2 Aluminium sections shall be anodised as per IS: 7088 or electrostatically powder coated to as specified. The thickness of anodizing/ powder coating shall be subjected to verification at site (on random basis) as directed by Engineer- in- Charge with appropriate measuring instruments supplied by contractor.

6.2.3 If not mentioned specifically, the finishing of Aluminium sections shall be of powder coating in approved colour.

6.2.4 Thickness of powder coating shall be as specified. If not specified the minimum thickness shall be 50 micron.

6.2.5 Glass used for glazing shall be as specified. If not mentioned specifically minimum 5 mm thick toughened glass conforming to IS: 2835 shall be provided.

6.2.6 Louvers shall be made of 2 mm thick bend and profiled Aluminium sheets framed suitably and shall be fixed to the door/ window/ ventilator frame. The profiles and spacing of louver blades/ sheets shall ensure prevention of water ingress.

6.2.7 Wire mesh shall be of stainless steel (SS-304 grade) or wire of galvanized steel as specified. If nothing is mentioned specifically, stainless steel wire mesh shall be provided.

6.3 Hardware

6.3.1 If not specifically mentioned, following hardware shall be provided in the Aluminium door assemblies.

Hardware	Specification
Hydraulic door closer	1 no. heavy duty hydraulic door closer confirming to IS 3564 for each shutter .
Tower/ Flush bolt	1 no. 10mm dia aluminium or stainless steel (SS-304 grade), 250mm long upto 2100mm high door and 600mm long upto 2500 mm high door) for each shutter on both sides.

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	For large size door (width- above 2000mm to 3000mm, height- above 2500mm to 3000mm), tower/ flush bolt shall be upto 1400mm long and shall be surface mounted or concealed type. Finishing of Aluminium tower/ flush bolts shall be similar to aluminum profiled sections of the door assembly.
Door Handle	1 no. 10mm dia aluminium or stainless steel (SS-304 grade), minimum 250mm long for each shutter on both sides. For large doors, longer door handles shall be provided as mentioned in design basis, job specification or construction drawings. Finishing of Aluminium handles shall be similar to aluminum profiled sections of the door assembly.
Door Stopper	1 no. spring loaded heavy duty door stopper for each shutter.
Double action hydraulic floor spring	1 no for each shutter conforming to IS 6315 with double spring mechanism and pivot.
Lock	Brass body, minimum 4 lever

Note: In case of Aluminum doors, either Double action hydraulic floor spring as per IS 6315 or Hydraulic door closer as per IS 3564 will be applicable.

6.3.2 If not mentioned elsewhere, window/ ventilator assemblies shall be provided with hardware such as hinges, handles, peg-stays, tower/flush bolts, sliding mechanism etc. as required for safety, operation and durability.

6.3.3 If not mentioned elsewhere, visible hardware shall be of Aluminium having finishing similar to aluminum profiled sections of the window/ ventilator assembly.

6.4 Fabrication & Installation

6.4.1 Frames and shutters shall be square and flat, the corner of the frame being fabricated to true right angles. Aluminium sections of frames, shutters etc. shall be mitred and jointed rigidly.Details of construction of frames, shutters etc. shall be as per construction drawings and EIL standards.

6.4.2 In case of composite Door/window/ventilator units, the units shall be coupled as per drawing. Weather bar shall be provided whenever a coupling member is fitted over an external opening shutter.

6.4.3 The Aluminium frames shall be fixed in the openings by means of aluminium lugs fixed to the frame (by counter sunk brass machine screws) and grouted with concrete or by means of anchor fasteners.

6.4.4 Glazing shall be fixed to the extruded sections by means of extruded Aluminium beading. Glass panes shall be provided with EPDM gasket/rubber lining before fixing.

6.4.5 Side hung window shutters shall be fixed to the frame with pivots or hinges.

6.4.6 Gaps at the junction of opening and frame shall be filled up with weather silicon sealant.

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7.0 STEEL, ALUMINIUM ROLLING SHUTTERS

7.1 Rolling shutters shall be of steel or Aluminium as specified and shall conform to IS 6248.

7.2 Rolling shutters shall be push or pull type or operated by mechanical means or by electrical motors as specified. However, rolling shutter beyond 10 square metre in area shall not be push and pull type. If nothing is mentioned specifically, rolling shutters shall be electrical motor operated type.

7.4 Steel Rolling Shutters

7.4.1 Rolling shutter components

Components of steel rolling shutters shall have following specification.

1. Shutter

Shutter shall be built-up of inter locking lath section formed from cold rolled steel strips.

The thickness of the steel strips shall not be less than 0.90 mm for shutters upto 3.5 m width.

The lath sections shall have interlocking curls at both the edges and deep corrugation at the centre with a bridge depth of minimum 12 mm.

Each lath section shall be a continuous single piece without any welded joint.

When interlocked, the lath sections shall have a distance of 75mm rolling centers.

Each alternate lath sections shall be fitted with MS clips securely riveted at either ends to prevent lateral movement of the individual lath sections.

2. Guide channels

Guide channels shall be of mild steel . Width shall be minimum 25mm. Minimum depth (shutter clear width wise) shall be as below :

Upto 3.5 metre wide shutter – 65mm
3.5 metre to 8 metres – 75mm
8 metre and above – 100mm

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

3. Roller and brackets

The suspension shaft of the roller shall be heavy duty steel pipe conforming to IS 1161.

For shutter upto 6 metre width and height not exceeding 5 mitre, steel pipe of minimum 50 mm nominal bore shall be used.The shaft shall be supported on MS brackets.

Size of the brackets shall be minimum 375mm x 375mm x 3.15 for shutters upto clear height of 3.5 metre, minimum 500mm x 500mm x 10mm for clear height above 3.5 metre and upto 6.5 metre.

The suspension shaft shall be fitted with rotatable cast iron pulleys to which the shutter is attached. The pulleys and the pipe shaft shall be connected by means of pretensioned helical

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springs to counter balance the weight of the shutter and to keep the shutter in equilibrium in any partly open position.

When the width of the opening is greater than 3.5 metre, the pullies shall be interconnected with a cage formed out of MS flats and dummy rings to distribute the torque uniformly. Self aligning two row ball bearing with cast iron casing shall be provided at the extreme pully.

4. Spring

The spring shall be built of coiled type manufactured from high tensile spring steel wire or strips of adequate strength conforming to IS 4454-part I

5. Cover

Top cover shall be of mild steel sheets not less than 0.90mm thick and shall be stiffened with MS angle or flat stiffeners.

6. Hardware

Lock plates with sliding bolts, handles and anchoring rods conforming to IS 6248 shall be provided.

7. Grills

If specifically mentioned, rolling grills shall be provided in the shutter. In general, height of grill portion shall not exceed 500mm. In case of grills at multiple locations, cumulative height of the grill portions shall not exceed 1000mm. Grills shall be made of 8 mm dia MS round bars.

8. Finishing

All metallic parts shall be painted with minimum 2 coats of red oxide zinc chromate primer conforming to IS 2075. Visible parts shall be further painted with minimum two coats of synthetic enamel paint conforming to IS 2933.

7.4.2 Sizes and dimensions of various components mentioned in above clause are for normal conditions. For larger sizes and windy locations, the sizes and dimensions shall be suitably modified as directed by the Engineer-In-Chief.

7.4.3 Mechanically operated rolling shutters shall have suitable gear mechanism for smooth operation.

7.4.4 Motor operated rolling shutters shall be provided with necessary and suitable electrical fittings like motors, switch panel, switches, wires, cables etc. all complete and conforming to India standards.

7.4.5 Installation

Rolling shutters shall be installed true to the plane and fixed in the opening ensuring smooth operation as per IS 6248.

7.5 ALUMINIUM ROLLING SHUTTER

7.5.1 Aluminium Rolling Shutters shall be motorized gear operated and either double walled Insulated type or non- insulated type as specified complete with all accessories.

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The Brackets and hood cover shall conform to IS: 6248. The clear opening dimensions shall not exceed 5000 mm x 5000 mm.
The motorised rolling shutters shall be suitable for electrical motor operation (automatic) as well as manual operation with chain-wheel & hand chain. The rolling shutters shall be provided with mechanical reduction / bevel gear box for operation either mechanically or with electrical device.

7.5.2 Rolling shutter components

Components of Aluminium rolling shutters shall have following specification.

1. Shutter curtain

The shutter curtain shall be fabricated using aluminium alloy profiled slats. Aluminium alloy shall have composition of Magnesium 0.4-0.9 %, Silicon 0.3-0.7 %, Manganese 0.3% (maximum) and remaining Aluminium. Aluminium Alloy shall have UTS (Ultimate tensile strength) – 19 Kg/mm2 and Elongation – Min 7%.

The surface of these aluminium alloy shall be micro ribbed with the ends of alternate profiles fitted with end locks to prevent lateral movements of the laths.

The shutter curtains shall have interlocking aluminium alloy slats with integral bottom lock plate.

The non-insulated shutter curtains shall generally be of 80mm x18mm (minimum size) double-walled /skinned slats and the insulated shutter curtains shall be 80mm x 18mm double-walled / skinned slats (minimum size) with thermal PUF (Polyurethane Foam) insulation packing (within the walls).

The PUF packing shall be tight enough so as to fill all irregular voids and at joints. The PUF shall be non-toxic and fire retardant / self-extinguishing. The PUF density shall not be less than 40 kg / cu. meter and its thermal properties & characteristics shall be in accordance with IS-12436

2. Bracket

The bracket shall be made of mild steel conforming to relevant IS having minimum size of 350 mm x 350 mm x 3 mm thick for clear opening dimensions up to 4000 mm x 4000 mm & 350 mm x 350 mm x 4 mm thick for clear opening dimensions beyond 4000 mm x 4000 mm and up to 5000 mm x 5000 mm.

3. Shaft

MS Pipes used for the suspension shaft of the roller shall be heavy duty pipe suitable for mechanical purposes and shall conform to IS: 1239. Minimum diameter shall be 100mm.

4. Side Guides/ Channels

The side guides/ channels shall be joint less (single piece construction) made of aluminium alloy of minimum 3mm thickness. The guide rails shall be provided with PVC / Rubber / Brush seals to ensure silent shutter travel & effective sealing. Size shall be 105mm x 42mm or as required.

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5. Bottom Profile

Aluminium Bottom bar / locking plate shall be minimum 100mm high having a special non-degradable neoprene / rubber profile for providing a complete sealing upon closure.

6. Hood & Side-Motor Cover

The covers shall be made of painted GI sheets not less than 0.8 mm thick. They shall be of rectangular or cylindrical contour depending on the contour of the bracket / end plate. The hood cover shall be stiffened with angle or flat stiffeners at top and bottom edges to retain shape. The hood cover shall be fixed to the bracket plate by means of angle cleats and supported at the top at suitable intervals for preventing sagging. The hood & motor/actuator assembly - covering shall be a water-tight arrangement for ensuring no water seeps through to the internal mechanical & electrical components. Adequate slopes & guide-ways are to be provided to avoid any water accumulation on the hood-covers.

7.5.3 Finishing

All components of rolling shutter except springs and inside of guide channel shall be thoroughly cleaned with a mild non-corrosive chemical to free the substrate of rust, mill-scale, dirt, oil, etc.

Aluminium sections and other visible metallic surfaces shall be electrostatically powder coated (approved colour) to minimum 50 microns. The thickness of powder coating shall be subjected to verification at site (on random basis) as directed by Engineer- in- Charge with appropriate measuring instruments supplied by contractor.

All coated surfaces shall be free from flaking / peeling. Each shutter shall be clearly and legibly marked with the Manufacturer's Name or Trade Mark / Shutter Size / Year of Manufacture.

7.5.4 Electrical Operation of Rolling shutter

The rolling shutters shall be operated by electric motor actuators - operating on 415 Volts, 3-phase or 240 Volts, 1-phase - 50 Hz. AC supply.

All associated electrical components for motor control shall be compatible for working at the above mentioned voltage profile. The motor shall be of side-mounted type installed in alignment with the roller shaft inside the shaft-hood or adjacent to the rolling-shutter box. In either case, the rolling shutter motor & actuator assembly enclosure shall have IP-55 (or better) ingress protection against water & dust. The rolling shutter motor shall be rated for intermittent periodic duty (Duty Type – S3) or intermittent periodic duty with starting (Duty Type – S4). Arrangements shall also be made for emergency manual operation of the rolling shutter with mechanical reduction-gear, wheel & hand-chain override assembly - in the event of failure of the electric equipment or electricity.

For buildings in safe area, all electrical equipment's shall be in weatherproof executive with IP-54 protection for direct drive and IP 44 Protection for indirect drive ingress protection.

For buildings in hazardous are, if specified in Tender/MR, following shall be ensured:

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1. For hazardous area buildings, all electrical equipment's such as motor, actuators, push button control stations, PDB/Local panels etc. shall be flameproof type Exd suitable for applicable Gas Group and Temperature Class.

2. All hazardous area equipment shall have test certificates issued by recognised independent test house (CIMFR/ERTL/BASEEFA/LCEI/UL/FM/KLP or equivalent). All indigenous equipment shall conform to Indian standards and shall be certified by recognised testing agencies. All equipment (indigenous & imported) shall have valid statutory approval (e.g. PESO/DGMS etc.) as applicable for the specified location. All indigenous flameproof equipment shall have valid BIS license and marking as required by statutory authorities.

Make of all hazardous area equipment (for hazardous area building) and weatherproof equipment (for safe area building) shall be approved by owner / Engineer-In-Charge before selection & order placement. The motor shall be heavy duty type & sturdy - suitable for lifting shutters weighing up to 600 kilograms. The motors shall have BIS or equivalent approvals & relevant performance guarantee track records. The motor drive unit for the rolling shutter shall be complete with Drive-Chain / Gear, Plate-Wheel, Bush, Drive-Sprockets, mounting base-plates, integrated safety brakes & limit-switches, etc. Ideally all metallic components of the drive system shall be constructed out of non-corrosive high-grade stainless steel.The motor speed shall be regulated with gear drives such that the speed of the shutter (during up & down movement) for indirect drive shall be up to 0.05 m/s .The motor operating time within the intermittent duty cycle shall be long enough to ensure that the motor does not get heated up excessively, thereby resulting in tripping and / or damaging of motor windings for up to three continuous up & down (full height traverse) operation of the rolling shutter.

The motor shall be automatically protected from thermal overload by internal thermal probes / overload relays. The motor shall be compact and motor operation shall be with minimum of noise & vibration. Ideally, the motor controls (including motor-starter / over-load protections / contactors / etc) shall be placed within the motor-actuator enclosure.

The automation of the shutter shall have local control with a directional push button control station flush-mounted with the wall-surface, with 3 buttons marked UP, DOWN and STOP. The STOP Button must be of Mushroom-head type with lockable arrangement & push to release type. All the push-buttons shall be of latching type (single press & release) – without the need to continuously press the buttons during the traverse time of the shutter. The shutter traversing shall be prohibited if the STOP button is pressed & locked. The push-button unit shall have an enclosure with a minimum degree of IP-44 dust & water protection

7.5.5 Installation

Rolling shutters shall be installed true to the plane and fixed in the opening ensuring smooth operation as per IS 6248.

All fixing / mounting accessories shall be made of stainless steel only.

All necessary control wiring / cabling for the side-motor with the limit switches / controller panel shall be done with 3 / 5 core X 2.5 sq. mm. PVC insulated multi-stranded Copper Conductor armoured and flame retardant Low Smoke (FRLS) cables. All power cabling from PDB to the side motor shall be with 3 core X 4 sq. mm (minimum) Cu conductor, FRLS cable . Only fire rated & PVC insulated cables / wires with multi-stranded copper conductors shall be used for internal wiring of the motor / actuator / push-button. All cabling & wiring shall be concealed type with heavy-duty PVC conduits. Works include termination of the incoming power cable from the owner's Main Power Distribution Board to the motor / actuator /

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controller unit & all outgoing power & control cables from the controller panel to individual electrical components with supply & installation of cable glands & copper lugs of adequate sizes.

7.5.6 Mandatory & commissioning spares

The entire consignment of motorized rolling shutters for the shed / buildings shall be supplied with the following mandatory spares for each rolling shutter.

1. One set of the complete motor / actuator drive unit (of each rating) – duly assembled with limit switches, drive-chain / worm-gear, plate-wheels / bush / sprockets & mounting base-plates.
2. One set of motor controller (PCB / Controlling Unit).

8.0 MEASUREMENT

Doors, windows, ventilators and rolling shutters shall be measured in the following manner.

Pressed steel frames for doors	Length (vertical and horizontal members) in Running metres (RM)
Pressed steel door shutter	Actual shutter area in square metre (SqM)
Steel Windows/ ventilators with MS sections	Actual area of window/ ventilator in square metre (SqM)
Aluminium Doors/windows/ventilators	Aluminium sections by weight (Kg) Glazing - Actual area in square metre (SqM)
Rolling shutters	Actual area of Rolling shutter in square metre (SqM)
Loose hardware	In numbers

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पलस्तर एवं पॉइन्टिंग का मानक विनिर्देशन

STANDARD SPECIFICATION FOR PLASTERING & POINTING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
7	31.05.23	REVISED & ISSUED AS STANDARD SPECIFICATION	SANDEEP SHARMA	GURSHARAN JEET KAUR	SAMIR DAS	SANJAY MAZUMDAR
6	31.05.17	REAFFIRMED & ISSUED AS STANDARD SPECIFICATION	AM	JS/ JKB	R. SRIVASTAVA	R. NANDA
5	05.04.12	REVISED & ISSUED AS STANDARD SPECIFICATION	AM	SM	JKB	D. MALHOTRA
4	21.03.07	REVISED & ISSUED AS STANDARD SPECIFICATION	SD	JKB	ARVIND KUMAR	V.CHATURVEDI
3	10.03.99	REAFFIRMED AS STANDARD SPECIFICATION	SD	MLB	SCJ	AS
2	16.03.94	REVISED & ISSUED STANDARD SPECIFICATION	JS	JS	AKG	AS

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Abbreviations:

ASTM	:	American Standards of Testing of Materials
BS	:	British Standards
EN	:	European Standards
IS	:	Indian Standards
ISO	:	International Organization for Standardization
NBC	:	National Building Code of India

Architecture Standards Committee

Convener : Mr. Samir Das

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Mr. Anish Kundu
Mr. Sandeep Sharma
Ms. Maitrayee Majumdar (Strl)
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1.0 GENERAL

1.1 This specification covers requirements of plastering and pointing in civil work, on building or Architectural or structural elements and as interior or exterior finishing or decorations etc.

1.2 Unless otherwise specifically mentioned in design basis, job specification, drawings, item descriptions etc. all masonry, block work, RCC surfaces shall be plastered.

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, NBC etc. conformity with any of the similar codes is acceptable.

2.2 Reference codes and standards:

Standards	Document Title
IS: 1542	Sand for Plaster - Specification
IS: 1661	Code of Practice for application of cement and cement- lime plaster finishes
IS: 2114	Code of practice for laying in-situ terrazzo floor finish
IS: 2250	Code of Practice for Preparation and Use of Masonry Mortars
IS: 2386 (Part 2)	Methods of test for aggregates for Concrete Part II: Estimation of Deleterious materials and organic impurities
IS: 2402	Code of Practice for External Rendered Finishes
IS: 2542 (Part 1)	Methods of test for Gypsum plaster, Concrete and products, Part I - Plaster and Concrete
IS: 2547 (Part 2)	Specification for Gypsum building plasters, Part II - Premixed lightweight plasters.
IS: 2645	Integral waterproofing compounds for Cement Mortar and Concrete – Specification.
IS: 4031 (Part 1)	Methods of physical tests for hydraulic cement.

3.0 TYPE AND THICKNESS OF PLASTERING

3.1 Plastering shall be of plain cement plastering or plain cement plastering with waterproofing compound or Gypsum plastering or ready-mix plastering as mentioned in design basis, job specification, drawings, item descriptions etc.

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3.2 Unless otherwise specified in design basis, drawings, item descriptions, job specifications etc, the external surfaces shall be plastered with or plain cement plastering with waterproofing compound and internal surfaces shall be plastered with plain cement plastering.

3.3 Unless otherwise specified in design basis, drawings, item descriptions, job specifications etc, thickness of plastering shall be as per following table.

Type of plaster	Surface	Average thickness
Plain cement Plaster	Plumb surface of the internal masonry/ all block work walls & RCC Columns coming in line (flush) with this side of wall.	12 mm
Plain cement Plaster	Rough side of the internal masonry/ all block work walls & RCC Columns coming in line (flush) with this side of wall.	15mm
Plain cement Plaster with waterproofing compound	External surface	18 mm
Plain cement Plaster	Internal RCC surface	06 mm
Gypsum Plaster	Plumb surface of the internal masonry/ all block work walls & RCC Columns coming in line (flush) with this side of wall.	12 mm
Gypsum Plaster	Rough side of the internal masonry/ all block work walls & RCC Columns coming in line (flush) with this side of wall	12 -15 mm
Gypsum Plaster	Internal RCC surface	06 mm
Ready mix plaster	Similar to Plain cement plaster	Similar to plain cement plaster

Note:
However, if the undulation in the surface is beyond proper finishing with specified thickness of plaster, extra thickness of plaster shall be applied as required for proper finish without any extra cost.

4.0 MATERIALS

4.1 Cement

Cement shall conform to `Standard Specification for Civil and Structural Works- Materials' (Structural Specification no. 6-68-0002)

4.2 Sand

Sand for plaster and pointing shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these and shall conform to IS: 1542. Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of silt, day bails or pellets. Sand shall not contain harmful impurities such as iron pyrites, coal particles, lignite, mica shale etc in such form or in quantities as to affect adversely the hardening, strength or durability of the mortar.

Signature Not Verified
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