Abbreviations:

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

Structural Standards Committee

Convenor : Mr. Anurag Sinha

Members :
Mr. Virender Goel
Mr. Deepak Agrawal
Mr. VK Panwar
Mr, Amitabh Kishore
Mr. Gyasuddin
Mr. Ravindra Kumar (Const.)
Mr. Charanjit Singh (Proj.)

CONTENTS

1.0 SCOPE 4
2.0 GENERAL 4
3.0 SAFETY PRECAUTIONS 4
4.0 PROCEDURE 5
5.0 CLEANING & STACKING 5
6.0 DISPOSAL 5
7.0 C&D WASTE MANAGEMENT 6
8.0 PAYMENT 6

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.

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.

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

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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विविध मदें

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

Abbreviations:

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

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Convenor: Mr. Anurag Sinha

Members:
Mr. Virender Goel
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Ms. Papia Mandal
Mr. Vikram Kumar Gupta
Mr. Charanjit Singh (Projects)
Mr. Indrajit Neog (Construction)

CONTENTS

1.0 SCOPE 4
2.0 REFERENCES 4
3.0 MATERIALS 4
4.0 GENERAL REQUIREMENTS 4
5.0 PRE-CONSTRUCTIONAL ANTI-TERMITE TREATMENT 4
6.0 ANTI-CORROSIVE LAYER 6
7.0 DRESSING & TRIMMING 7
8.0 BREAKING PILE HEADS 7
9.0 BUILDING-UP PILE HEADS 7
10.0 HARD CORE 8
11.0 SAND FILLING IN PLINTH/FOUNDATIONS 9
12.0 DAMP PROOF COURSE (DPC) 9

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.

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

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.

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

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.

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.

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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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

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

CONTENTS

1.0 SCOPE 4

2.0 REFERENCES 4

3.0 SAMPLING 4

4.0 TESTING REQUIREMENTS 4

5.0 HEALTH, SAFETY & ENVIRONMENT CONSIDERATIONS 5

6.0 PACKAGING 5

ANNEXURE-A (SHORT TERM TESTS) 6

ANNEXURE-B (LONG TERM TESTS) 7

APPENDIX-I (MODIFIED ACCELERATED CORROSION TEST) 9

APPENDIX-II (OPEN CIRCUIT POTENTIAL Ecorr TEST) 10

APPENDIX-III (REDUCTION IN CORROSION CURRENT Icorr TEST……..…..……12

APPENDIX-IV (IMMERSION TEST)……15

APPENDIX-V (TEST FOR EFFECT ON COMPRESSIVE STRENGTH WITH CPCIA)….16

APPENDIX-VI (ELECTROCHEMICAL POLARIZATION TEST) 17

APPENDIX-VII (CORROSION TEST) 18

APPENDIX-VIII (CHLORIDE ION PENETRATION TEST) 19

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.

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

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.

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)			AASHTO T-259 (Refer Appendix-VIII)
	i) Chloride % in concrete at 30mm depth after 90 days.	0.025%, max.	Nil	Chloride ion penetration (Salt ponding test) as per IS 456
	ii) Ability to resist chloride ion penetration			
	a) Concrete grade M-30, Water cement ratio: 0.45	1650 Coulombs, max.	1000 Coulombs, max.	Electrical indication of concrete ability to resist Chloride Ion Penetration (Rapid Chloride Permeability test) as per ASTM C1202
	b) Concrete grade M-40, Water cement ratio: 0.40	1550 Coulombs, max.	1000 Coulombs, max.	

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.

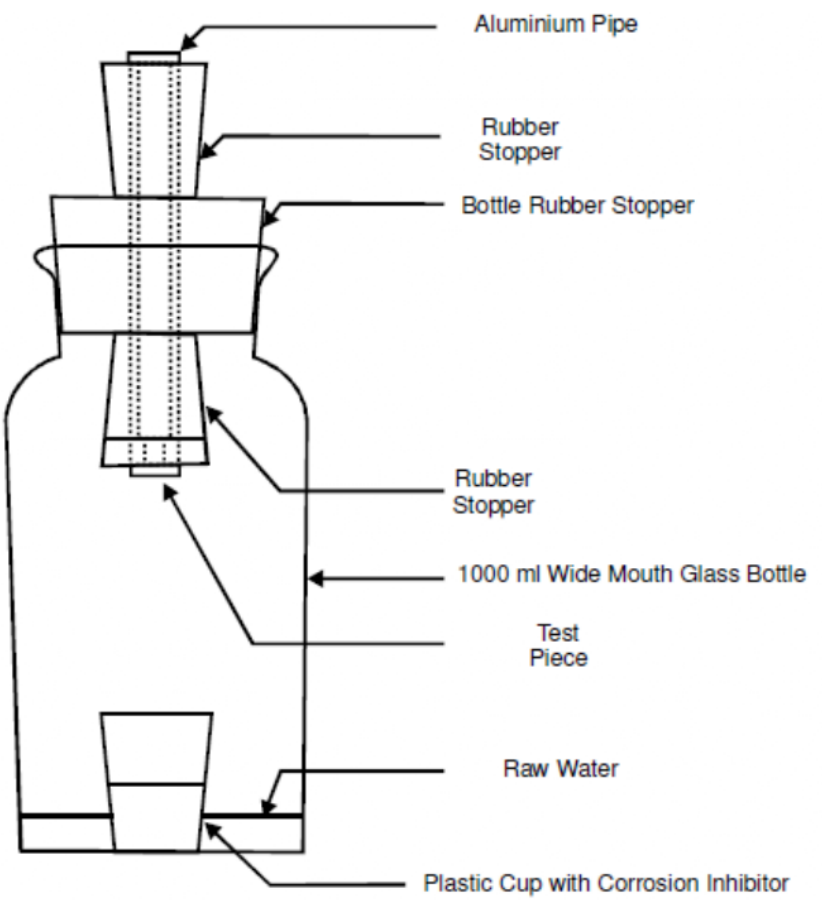
b) Rebars conforming to IS 1786 shall be used for testing purposes

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.

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.

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).

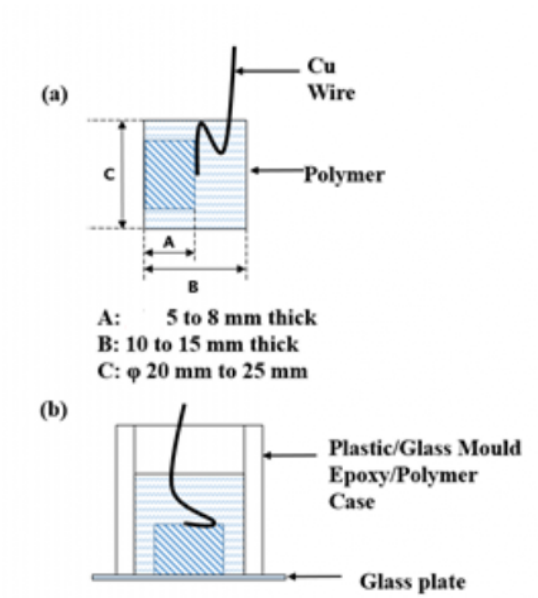


Figure 1.

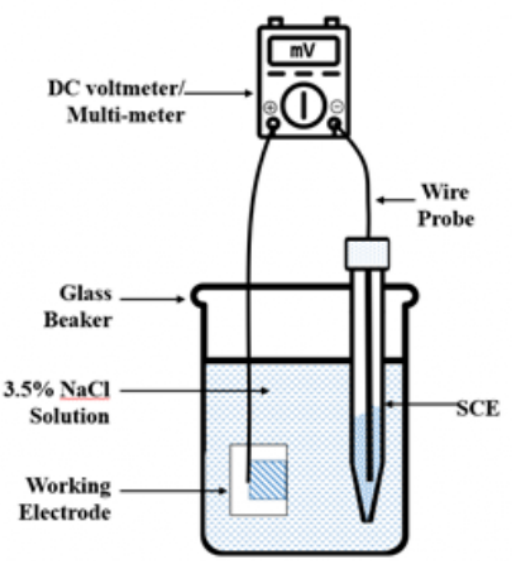


Figure 2.

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.

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.

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.

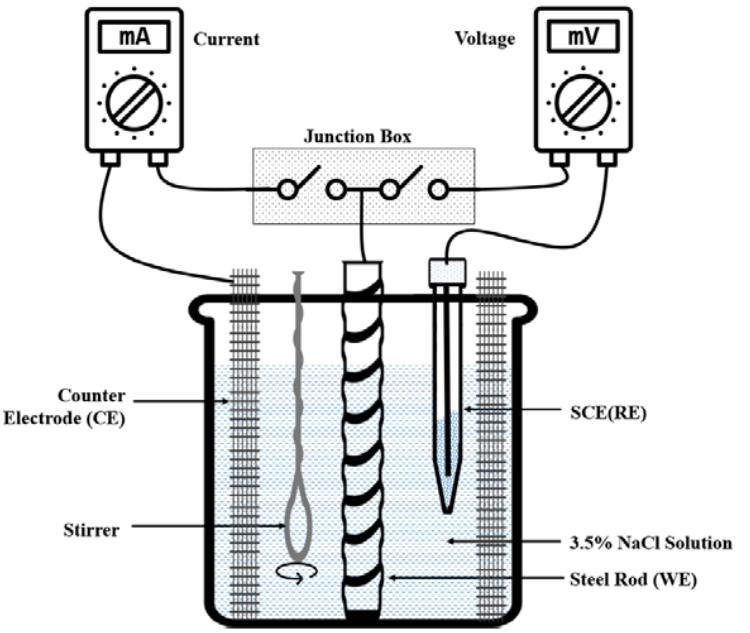
   To avoid jumbled wire connections & simplify the operation during testing a user can conduct this test in a more comfortable and simple way by using a SPDT switch board with a multiple probe connection setup.

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.



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.

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.

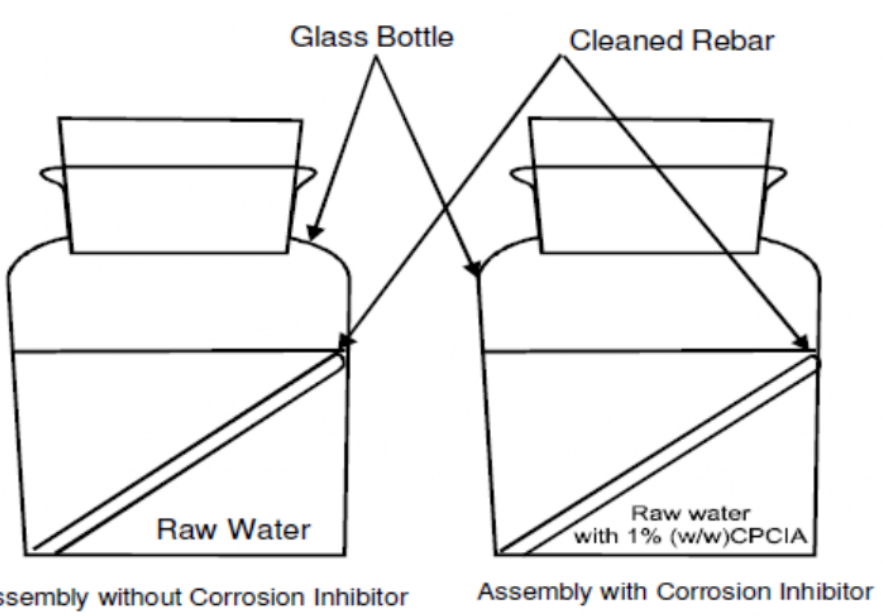
Take six transparent glass/plastic bottles of approx. 150±10 ml with air tight caps. Clean all the bottles with tap water and then fill them with 100 ml of tap water so that the bottles are approx. three fourth filled. In three of the six bottles, add CPCIA 1%, w/w or as recommended by the manufacturer 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



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.

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.

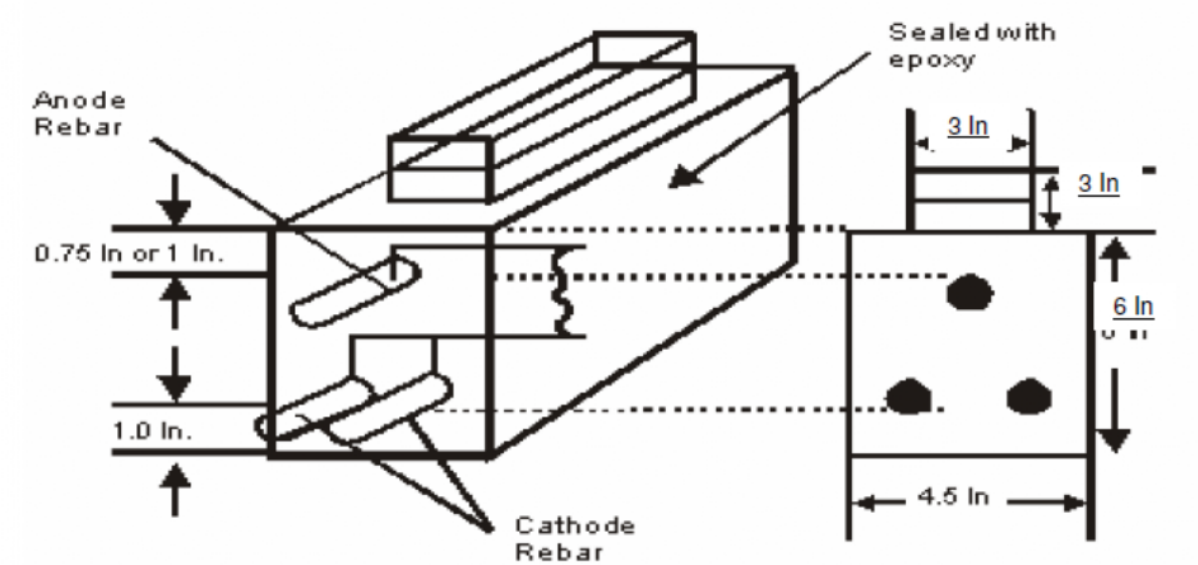
APPENDIX-VII

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.)

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).

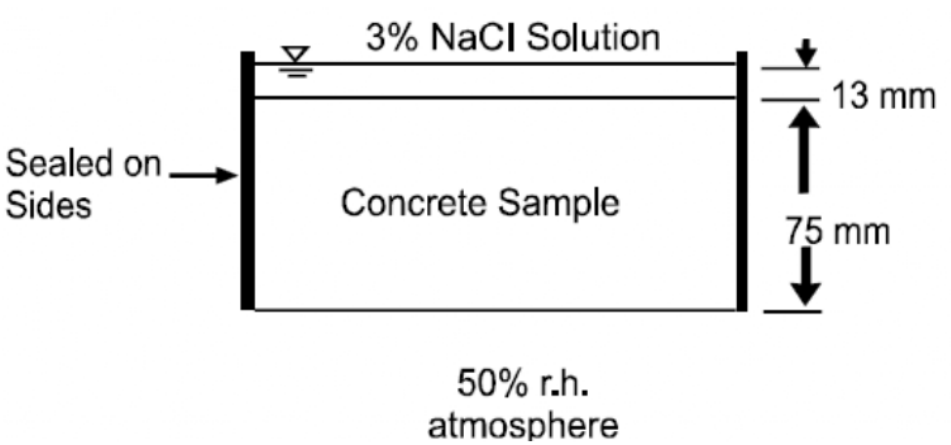


Figure: AASHTO T259 (Salt ponding) test setup

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.

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.

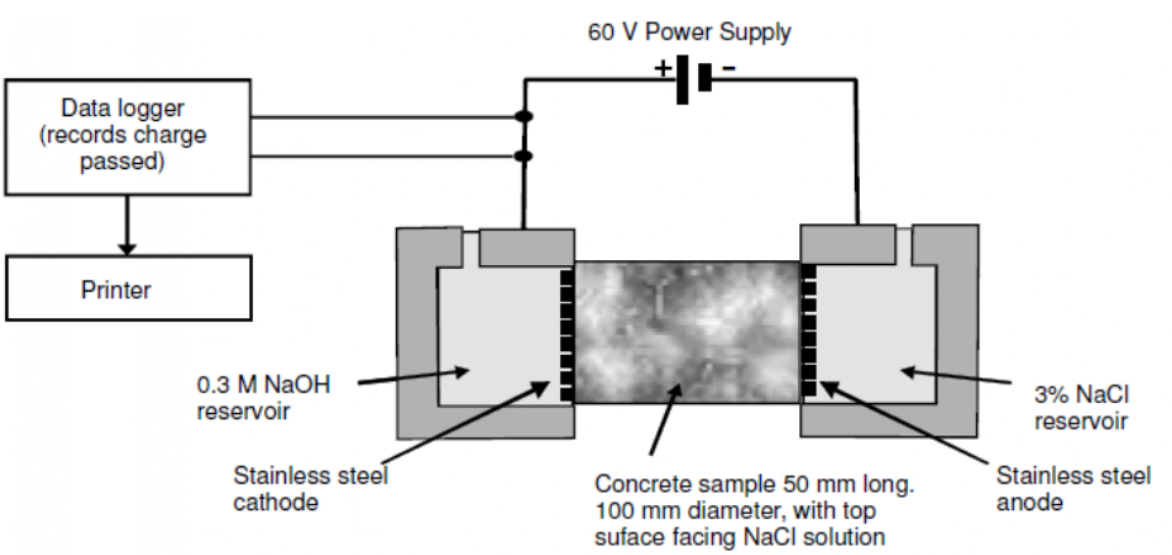


Figure: AASHTO T277 (ASTM C1202) test setup

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
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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**

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

*** For Fireproofing Specifications**

CONTENTS

1.0 GENERAL 4

2.0 REFERENCED CODES, STANDARDS & PUBLICATIONS 4

3.0 MATERIAL REQUIREMENTS 4

3.1 General 4

3.2 Water 4

3.3 Aggregate (for Concrete) 5

3.4 Sand (for Masonry & Filling) 7

3.5 Cement 8

3.6 Steel 8

3.7 Brick 10

3.8 Stone 11

3.9 Admixtures 12

3.10 Water Bars (Water Stops) 13

3.11 Bitumen/Bituminous Materials 13

3.12 PVC Pipes 14

3.13 Wood/ Timber 14

3.14 Concrete Blocks Masonry 15

3.15 Autoclaved Cellular (Aerated) Concrete Blocks (AAC Block Masonry) 15

3.16 Anti-termite Compounds 15

3.17 Poly-sulphide Sealants 15

4.0 CONSTRUCTION REQUIREMENTS 15

4.1 Construction 15

4.2 Tolerances 16

4.3 Hanger Scaffolding for Pipe Rack 18

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.