APPENDIX-B

ANNEXURE-43A

(In Bank's Letter Head)

Fixed Deposit Confirmation Letter by Bank

Date: _ _/_ _/_ _ _ _

To,

Engineers India Limited,
.....
.....
.....

Dear Sir/ Madam

Sub: Issuance of Cumulative FDR..... amounting to ₹.....valid till.....***{up to Contract period plus defect liability period plus 2 months}*** duly pledged / lien in favour of Engineers India Limited (EIL).

It is hereby certified that Cumulative Fixed Deposit Receipt (FDR) bearing number.....dated..... amounting to ₹..... (Amount in figure and words) has been issued by ..... (Name of the Bank) branch address..... The maturity value is ₹..... on dated.....

This FDR has been issued on the request of M/s .....(Name of the Supplier/ Contractor) under the P.O. No/ Work order No.. .....This FDR can be encashed/ redeemed without any consent/ letter from the Supplier/ Contractor M/s.....(Name of the Supplier/ Contractor) on the demand by Engineers India Limited and the payment will be made to the Account (payable at New Delhi) of Engineers India Limited excluding the interest earned thereon. The Bidder cannot encash/ premature above FDR unless above original FDR is accompanied by the discharge letter/NOC/approval of EIL.

This FDR shall be governed by, and construed in accordance with, the laws of India. .....(Name of the Bank) branch address.....irrevocably agrees that any legal action, suit or proceeding arising out of or relating to this FDRs may be brought in the courts in Delhi.

If the FDR is not withdrawn, till date of maturity, it may be renewed or treated as instructed by the Supplier/ Contractor & EIL for renewal.

This FDR has been issued by authorized signatory of the Bank.

For or on behalf of.....[Name of the Bank & Branch details (Including IFS Code)]

Signature.....

Name:.....
Designation:.....
Contact no. .....
Email Id. .....
Stamp of Bank.....

Note:

(i) This letter in Original forms an integrated part of FDR
(ii) The FDR shall be in the name of the Applicant (Name of Bidder) A/c Engineers India Limited with a lien marked in favor of the beneficiary (i.e. EIL).
(iii) The communication can be send to the following:
Details for confirmations (including Address, Email Id, IFS Code and contact no.)....

FORM OF INSURANCE SURETY BOND

ANNEXURE-43B

FORMAT OF UNCONDITIONAL AND IRREVOCABLE INSURANCE SURETY BOND TOWARDS CONTRACT PERFORMANCE SECURITY

(To be submitted on non-judicial stamp paper of appropriate value to be purchased in the name of the issuing Insurance Company)

Beneficiary: Engineers India Limited

Insurance Surety Bond No. [.....] (hereinafter referred to as the "Surety Bond")

THIS SURETY BOND is executed on this [.....insert day] day of [.....insert month and year] at [.....insert place] by [.....**INSERT NAME OF INSURANCE COMPANY**], a company registered under the Insurance Act, 1938 and licensed by the Insurance Regulatory and Development Authority of India (IRDAI) to carry on the business of general insurance in India, having its head/registered office at [.....insert address], (hereinafter referred to as the "Insurer", which expression shall unless it is repugnant to the subject or context thereof Include successors and assigns)

IN FAVOUR OF:

ENGINEERS INDIA LIMITED, a public limited company incorporated under the Indian Companies Act, 1956, having its registered office at [.....], (hereinafter referred to as the "EIL", which expression shall unless it is repugnant to the subject or context thereof include successors and assigns).

WHEREAS

I. EIL has entered into a Contract vide Purchase Order/Letter of Acceptance / Fax of Acceptance no..... dated..... **(the "Contract")** with ..... **[Insert name of Contractor]** (the **"Contractor"**) having its registered office at ..... (the "Contractor", which expression shall, unless it be repugnant to the context or meaning thereof, include its successors-in-title and permitted assigns), for the project.

II. In terms of the Contract, the Contractor is required to furnish to EIL, an unconditional, irrevocable, on demand Surety Bond for an amount ..... **[insert amount in figures & words]** (the **"Bond Amount"**) which is equal to .....% of the Contract Price, as security for due and punctual performance/discharge of the Contractor's obligations under the Contract.

III. At the request of Contractor, the Insurer has agreed to provide an unconditional, irrevocable and on-demand Surety Bond, for the due and punctual

performance/discharge by the Contractor of its obligations under the Contract during the Contract Validity Period.

NOW THEREFORE THIS BOND WITNESSETH AS FOLLOWS:

1. The Insurer hereby irrevocably and unconditionally guarantees and secures (as primary obligor and not merely as Insurer) to EIL (as beneficiary) the payment in full of all amounts at any time that may be due, owing or payable to EIL from the Contractor for the failure of the Contractor to duly and punctually perform all of its obligations under the Contract (the "Bond Obligation"), without any demur, reservation, protest or recourse, immediately on receipt of a demand from EIL.

   The Insurer further agrees that this Surety Bond does not limit the number of claims that may be made by EIL against the Insurer up to the value of Bond Amount.

   Payment made hereunder shall be made free and clear of and without any deductions so that EIL receives the full Bond Amount due hereunder.

2. The Insurer's liability under this Surety Bond shall not exceed..... (Bond Amount in figures & words) and this Surety Bond shall be valid upto. .....(expiry date). Insurer is liable to pay to EIL the demanded amount only upon receipt of written claim or demand from EIL on or before ..... (not less than 2 months from expiry date).

3. The Insurer shall, pay to EIL sums not exceeding the Bond Amount, within 5 (five) Business Days of receipt of a written demand from EIL stating that the Contractor has failed to meet its performance obligations under the Contract. The Insurer shall not be required to go into the veracity of any breach or failure on the part of the Contractor or status /stage of the contract or validity of demand so made by EIL and shall pay the amount specified in the demand notwithstanding any direction to the contrary given or any dispute whatsoever raised by the Contractor or any other Person. The Insurer's obligations hereunder shall subsist until all such demands are duly met and discharged in accordance with the provisions hereof.

4. The obligations of the Insurer herein are absolute and unconditional, irrespective of the value, genuineness, validity, regularity or enforceability of the Contract or the insolvency, bankruptcy, reorganization, dissolution or liquidation of the Contractor or any sanctions on the Contractor or any change in ownership of the Contractor, or the pendency of any suit or other legal proceedings including arbitration or conciliation pending before any court, tribunal or arbitrator or conciliator(s) relating thereto or any purported assignment by the Contractor or any other circumstance whatsoever which might otherwise constitute a discharge or defence of a Insurer or a surety.

   Further, this Surety Bond is in no way conditional upon any requirement that EIL first attempt to procure the Bond Amount from the Contractor, or any other Person, or resort

to any other means of obtaining payment of the Bond Amount, prior to make any recourse to this Surety Bond.

5. EIL shall be entitled to treat the Insurer as the principal debtor. The obligations of the Insurer under this Surety Bond shall not be affected by any act, omission, matter or thing which would reduce, release or prejudice the Insurer from any of the Bond Amount or prejudice or diminish the Bond Amount in whole or in part, including (whether or not known to it, or EIL):

(a) any time or waiver granted to, the Contractor or any other Person;

(b) any incapacity or lack of powers, of the Contractor or any other Person;

(c) any variation of the Contract

(d) any unenforceability or illegality or invalidity of any obligation of any Person under the Contract or of the Insurer under this Surety Bond or of any Person under any other document or Surety Bond, to the extent that each obligation under this Surety Bond shall remain in full force as a separate, continuing and primary obligation, and its obligations be construed accordingly, as if there were no unenforceability or illegality or invalidity;

(e) the partial or entire release of any Insurer or other Person primarily or secondarily liable or responsible for the performance, payment or observance of any of the Contractor's obligations during the Contract Period; or by any extension, waiver, or amendment whatsoever which may release the Insurer or

(f) any part performance of the Contract by the Contractor or by any failure by EIL to timely pay or perform any of its obligations under the Contract.

6. If, and to the extent that, for any reason the Contractor enters or threatens to enter into any proceedings in bankruptcy or reorganization or otherwise, or if, for any other reason whatsoever, the performance or payment by the Contractor of the Bond Amount becomes or may reasonably be expected to become impossible, then the Bond Amount shall be promptly paid by the Insurer to EIL on demand.

7. The Insurer further represents and warrants to EIL that:

(a) it has the power to execute, deliver and perform the terms and provisions of this Surety Bond and has taken all necessary action to authorize the execution, delivery and performance by it of this Surety Bond;

(b) No actions / omissions of the Insurer shall affect the legality, validity, binding effect or enforceability of this Surety Bond.

(c) the Insurer has duly executed and delivered this Surety Bond, and this Surety Bond constitutes its legal, valid and binding obligation enforceable in accordance with its terms

8. If any one or more of the provisions contained in this Surety Bond are or become invalid or unenforceable in any respect, the validity and enforceability of the remaining provisions shall not in any way be affected or impaired thereby, and the Insurer shall enter into good faith negotiations with EIL to replace the invalid or unenforceable provision.

9. The Insurer further agrees that to fulfill the Contractor's liability during the contract period, if requested by the Contractor in writing, the insurer shall issue Amendment to this Surety Bond, as and when required, incorporating the extended date of validity and/or other amendment.

10. Any notice, request, demand or claim or other communication to be given or made under this Surety Bond shall be in writing addressed to the Insurer and may be transmitted to the insurer either by post or by email address as set opposite its signature hereunder. The Insurer shall pay the amount immediately upon receipt of such written demand from EIL which suffices all requirements for payment to EIL under this Surety Bond.

11. This Surety Bond shall be governed by, and construed in accordance with, the laws of India. The Insurer irrevocably agrees that any legal action, suit or proceeding arising out of or relating to this Surety Bond may be brought in the courts in Delhi.

12. Neither party shall assign or transfer any or all parts of its interest herein to any other person without express written consent of the other party.

13. All related parties have agreed to the terms and conditions of this Insurance Surety Bond which conform with the principle of utmost good faith.

IN WITNESS WHEREOF the **Insurer** has set its hand hereunto on the day, month and year first hereinabove written.
Signed and delivered by its constituted attorney
(Signature of a person authorized to sign on behalf of the Insurer)
insert name of Insurance Company] Insurer by hand

Name:

Designation;

Address:

Email:

INSTRUCTIONS FOR FURNISHING UNCONDITIONAL AND IRREVOCABLE INSURANCE SURETY BOND TOWARDS SECURITY DEPOSIT

1. The Unconditional Insurance Surety Bond shall be from an Indian Insurance Company (Insurer) registered with Insurance Regulatory and Development Authority of India (IRDAI).
2. The Insurance Surety Bond by Indian Bidders will be given on non-judicial stamp paper of appropriate value to be purchased in the name of the issuing insurance Company.
3. Insurance Surety Bond is not applicable for Foreign Bidders.
4. Insurance Surety Bond required to submit in Indian Currency only.
5. Matter to be mentioned in covering letter to be submitted by vendor along with insurance surety bond.

1	Insurance Surety Bond No			
2	Insurance Surety Bond Amount			
3	Date of execution of Insurance Surety Bond			
4	Expiry date of Insurance Surety bond			
5	Expiry date of claim period of Insurance Surety			
6	Bidder Name			
7	Tender No.			
8	Nature of Insurance Surety Bond	Earnest Money Deposit / Security Deposit		
9	Insurer Details	A	Insurer Name:	
		B	Address:	
		C	Email Id:	
		D	Phone No:	

PREAMBLE TO SCHEDULE OF RATES

1 The Schedule of Rates shall be read with all other sections of this Bidding Document.

2 Bidder shall quote after careful analysis of cost involved for the performance of the completed item considering all parts of the Bidding Document.

3 The CONTRACTOR is deemed to have studied the drawings, specifications and details of works to be done within the Time Schedule and should have acquainted himself of the conditions prevailing at site.

4 The quantities shown against the various items are only approximate and may vary to any extent individually subject to conditions given in General Conditions of Contract/ Special Conditions of Contract.

5 All the works shall be measured upon completion and paid for at the rate quoted and accepted in the "Schedule of Rates".

6 In case any activity though specifically not covered in schedule of rates descriptions but the same is covered under scope of work/ scope of supply/ specification/ drawings etc. no extra claim on this account shall be entertained, since Schedule of Rates is to be read in conjunction with all other documents forming part of the Contract.

7 All items of work mentioned in the Schedule of Rates shall be carried out as per the specifications, drawings and instructions of EIL and the rates are deemed to be inclusive of material, equipment, consumable, labour, supervision and tools & tackles wherever required as called for in the detailed specification and conditions of the Contract.

8 Pre-filled SOR with prices is enclosed herewith as FORM SP-0. Bidders shall quote their prices as single percentage increase / decrease (as applicable) in terms of percentage upto 2 decimal places on total estimated value/price in FORM SP-1 subject to Notes specified in Form SP-1. This percentage increase / decrease (as applicable) as quoted by the bidder will apply uniformly to all items of respective FORM SP-0. Bidder shall not change rate/amount indicated in 'Schedule of Rates / Price' (FORM SP-0). Bidder to read provision of this clause in conjunction with Notes specified in Form SP-1.

9 Provisions of Taxes & Duties shall be as mentioned in Special Conditions of Contract (SCC). Bidder to indicate details of Taxes & Duties in Form SP-2.

10 EIL reserves the right to cancel/ delete/ curtail any item or group of work if necessary. Such a step shall not be construed as reason for changing the rates.

STAMP & SIGNATURE OF BIDDER

FORM SP-0

Bidding Document No.	:	JP/C098-000-CD-T-8105/1004
Job No.	:	C098
Tender Title	:	Balance Works forConstruction of Boundary Wall
Client	:	RAM JANMABHOOMI TRUST
Project	:	Construction of boundary wall around the Shri Ram Mandir Complex in Ayodhya

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
1	01EE	01EE	ELECTRICAL WORKS					
2	01EE.1090	01EE.1090	CANOPIES					
3	01EE.1090.10	01EE.1090.10	Supply, fabrication and installation of canopies for miscellaneous outdoor equipment like motors, fire alarm points, telephones, communication hand set stations etc. to render them weatherproof made out of 1.6 mm (16 gauge) sheet steel including supply of hardware and paint, painting, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.	kg	3.000	INR	330.00	990.00
4	01EE.1100	01EE.1100	ANCHOR FASTENERS					
5	01EE.1100.10	01EE.1100.10	Supply, drilling in RCC and fixing of metallic anchor fasteners for supporting of cable trays and miscellaneous electrical switchgear of following sizes, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
6	01EE.1100.10.10	01EE.1100.10.10	3/16" BSW.	nos	3.000	INR	130.00	390.00
7	01EE.1100.10.20	01EE.1100.10.20	5/16" BSW.	nos	3.000	INR	140.00	420.00
8	01EE.1100.10.30	01EE.1100.10.30	1/4" BSW.	nos	3.000	INR	140.00	420.00
9	01EE.1100.10.40	01EE.1100.10.40	3/8" BSW.	nos	3.000	INR	170.00	510.00
10	01EE.2010	01EE.2010	SUPPLY OF MV CABLES					
11	01EE.2010.30	01EE.2010.30	Supply of 1100 V grade, Copper Conductor,XLPE insulated and armoured, cables of following sizes as per EIL standard specification No. 6-51-0051, data sheets, specifications of this tender and directions of Engineer-in-Charge.					
12	01EE.2010.30.20	01EE.2010.30.20	3 C x 2.5 sq. mm	m	780.000	INR	120.00	93,600.00
13	01EE.2010.50	01EE.2010.50	Supply of 1100 V grade, Aluminium Conductor, XLPE insulated and armoured, cables of following sizes as per EIL standard specification No. 6-51-0051, data sheets, specifications of this tender and directions of Engineer-in-Charge.					
14	01EE.2010.50.160	01EE.2010.50.160	4 C x 25 sq. mm	m	650.000	INR	170.00	110,500.00
15	01EE.2040	01EE.2040	LAYING OF CABLES					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
16	01EE.2040.10	01EE.2040.10	Laying of cables of different voltage grade and types of the following overall diameters in ready trays/trenches/ supported on structure/pull through pipes including supply and fixing of stainless steel strip number tags, supply and fixing of GI saddles & saddle bars, trefoil clamps (for single core cables) etc., including transportation from store/yard to site at the place of installation, unpacking, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge					
17	01EE.2040.10.10	01EE.2040.10.10	Cables with OD upto 20 mm.	m	780.000	INR	30.00	23,400.00
18	01EE.2040.10.20	01EE.2040.10.20	Cables with OD above 20 mm but upto 30 mm.	m	650.000	INR	40.00	26,000.00
19	01EE.2040.10.30	01EE.2040.10.30	Cables with OD above 30 mm but upto 40 mm.	m	5.000	INR	50.00	250.00
20	01EE.2040.10.40	01EE.2040.10.40	Cables with OD above 40 mm but upto 50 mm.	m	5.000	INR	60.00	300.00
21	01EE.2040.10.50	01EE.2040.10.50	Cables with OD above 50 mm but upto 60 mm.	m	5.000	INR	70.00	350.00
22	01EE.2050	01EE.2050	END TERMINATIONS					
23	01EE.2050.100	01EE.2050.100	Termination of XLPE insulated armoured power cables (up to 1100 V grade) and connection of leads excluding the supply of cable glands and lugs but including fixing of cable glands, supply and fixing of PVC shrouds for outdoor terminations, cutting and stripping of cable insulation, crimping the lug on to the conductor, clamping of the cable-cores, marking with wire number, ferrules etc., including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
24	01EE.2050.100.10	01EE.2050.100.10	Cables with OD upto 20 mm.	nos	130.000	INR	210.00	27,300.00
25	01EE.2050.100.20	01EE.2050.100.20	Cables with OD above 20 mm but upto 30 mm.	nos	13.000	INR	300.00	3,900.00
26	01EE.2050.100.30	01EE.2050.100.30	Cables with OD above 30 mm but upto 40 mm.	nos	1.000	INR	370.00	370.00
27	01EE.2050.100.40	01EE.2050.100.40	Cables with OD above 40 mm but upto 50 mm.	nos	1.000	INR	530.00	530.00
28	01EE.2050.100.50	01EE.2050.100.50	Cables with OD above 50 mm but upto 60 mm.	nos	1.000	INR	680.00	680.00

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
29	01EE.2060	01EE.2060	STRAIGHT THROUGH JOINTS					
30	01EE.2060.10	01EE.2060.10	Supply and Making of heat shrinkable type straight through joints for 1100 volt grade power cables as per EIL standard specification No. 6-51-0051, including cutting, stripping of cable insulation complete with supply of compression / crimping type ferrules, plastic mould and epoxy resin compound etc., including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
31	01EE.2060.10.10	01EE.2060.10.10	Cables with OD upto 20 mm.	nos	1.000	INR	2,090.00	2,090.00
32	01EE.2060.10.20	01EE.2060.10.20	Cables with OD above 20 mm but upto 30 mm.	nos	1.000	INR	3,830.00	3,830.00
33	01EE.2070	01EE.2070	G.I. & PVC PIPES					
34	01EE.2070.10	01EE.2070.10	Supply and laying of following sizes of G.I. Pipes (medium) in required length fixed on steel, concrete or similar structure, laid in trenches, ready to be buried in concrete including cutting, threading, bending and similar works, supply of clamps, small iron structures, spacers and installation of seats, plugs, bushings etc., small civil works, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
35	01EE.2070.10.20	01EE.2070.10.20	50 mm NB.	m	42.000	INR	970.00	40,740.00
36	01EE.2080	01EE.2080	STRUCTURAL STEEL					
37	01EE.2080.20	01EE.2080.20	Supply, fabrication and installation of MS base frames, supports for switchgear, and brackets for miscellaneous electrical equipments, cable and cable tray supports out of rolled MS sections, pipes, plates etc. including shot blasting, welding, bolting, riveting, supply of necessary anchor bolts and grouting etc., supply of paint and applying of anti-rust primer coat and finished coats of approved synthetic enamel paint as per Table-10 of specification 6-79-0020 suitable for highly corrosive environment, including breaking walls, floors etc. for structures as required including supply of all GI hardware materials, all labour and materials complete as per approved drawings, specifications of this tender and directions of Engineer-in-Charge. (Any item weighing up to 1 kg. or less shall neither be measured nor paid).	kg	31.000	INR	140.00	4,340.00
38	01EE.2100	01EE.2100	CABLE GLANDS					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
39	01EE.2100.30	01EE.2100.30	Supply of nickel plated brass double compression cable glands suitable for outdoor installations (WP) of following overall diameter (excluding termination and connections of cables), including drilling of suitable holes in equipments for fixing purposes etc., including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
40	01EE.2100.30.10	01EE.2100.30.10	Cables with OD upto 20 mm.	nos	65.000	INR	310.00	20,150.00
41	01EE.2100.30.20	01EE.2100.30.20	Cables with OD above 20 mm but upto 30 mm.	nos	3.000	INR	520.00	1,560.00
42	01EE.2100.30.30	01EE.2100.30.30	Cables with OD above 30 mm but upto 40 mm.	nos	1.000	INR	870.00	870.00
43	01EE.2100.30.40	01EE.2100.30.40	Cables with OD above 40 mm but upto 50 mm.	nos	1.000	INR	1,380.00	1,380.00
44	01EE.2110	01EE.2110	MARKERS					
45	01EE.2110.10	01EE.2110.10	Supply and installation of cable markers as per std. 7-51-0301, for underground cable runs with 14 SWG enamelled steel plate with white lettering on jade green background inclusive of providing and fixing supports, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.	nos	26.000	INR	1,640.00	42,640.00
46	01EE.2110.20	01EE.2110.20	Supply and installation of earth pit markers for directly buried GI pipe electrodes as per std. 7-51-0101 with 14 SWG enamelled steel plate engraved with white letters BURIED, EARTH ELECTRODE on JADE green background complete with support and foundation, including all labour and materials, as per approved drawings, specifications of this tender and direction of Engineer-in-Charge.	nos	13.000	INR	1,640.00	21,320.00
47	01EE.2120	01EE.2120	CABLE LUGS					
48	01EE.2120.10	01EE.2120.10	Supply of crimping type long barrel tinned copper lugs with circular/sector shaped barrel for following conductor sizes, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
49	01EE.2120.10.10	01EE.2120.10.10	All sizes upto 10 sq. mm	nos	390.000	INR	30.00	11,700.00
50	01EE.2120.10.20	01EE.2120.10.20	All sizes from 16 to 35 sq. mm	nos	39.000	INR	50.00	1,950.00
51	01EE.3040	01EE.3040	SAFE AREA LIGHTING FIXTURES					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
52	01EE.3040.20	01EE.3040.20	Supply, installation, testing and commissioning of following energy efficient lighting fixtures and connecting to wiring junction box/marshalling box complete with lamps and necessary control gear including supply of all connected materials like flexible conduit, clamps, supports, chains, anchor fastners, bolts, nuts and washers etc. as required, including supply and fixing of cable glands, lugs, including all labour and materials, as per approved drawings, data sheet for lighting fixture schedule, EIL installation standards, specifications of this tender and directions of Engineer-in-Charge.					
53	01EE.3040.20.200	01EE.3040.20.200	Type LED 1 Fixtures.	nos	13.000	INR	6,420.00	83,460.00
54	01EE.3040.20.350	01EE.3040.20.350	Type LED IND-1 Fixtures.	nos	16.000	INR	830.00	13,280.00
55	01EE.3040.20.600	01EE.3040.20.600	Type LED FD-3 Fixtures.	nos	13.000	INR	27,170.00	353,210.00
56	01EE.3040.20.ME04	01EE.3040.20.ME04	Well Glass Light (35W):LED Well Glass Luminaire with pressure diecast aluminum housing with corrosion resistant powder coating,toughened glass / lens for IP protection and impact protection, proper heat sink arrangement for efficient heatdissipation, with clear lens optics, built-in surge protection, with followingparameters:Net system Lumen output: Min. 4200 LumensEfficacy: >=120 lumen/WattCRI>=70CCT of 4000/5700K/6500K as requiredIP-66 min.IK-07 min.The life shall be 50K Hrs. at L70B50, operating temperature of the luminaire shall be 0°C to +45°C and drivershall comply to the minimum electronic paramtere like THD¿ 10%, PF ¿0.90, internal surge protection of 4KV,Current Ripple ¿5%, operating voltage range of 140V - 270V having Class - 1 protection	nos	25.000	INR	4,830.00	120,750.00
57	01EE.3050	01EE.3050	FANS AND EXHAUST FANS					
58	01EE.3050.10	01EE.3050.10	Supply, installation, connection, testing and commissioning of following types of exhaust fans including supply of all necessary supports etc., including fixing of cable glands, lugs with BEE(Bureau of Energy Efficiency) rating of minimum 3 star including all labour and materials and accessories like mounting frame, fixing bolt, wire guard/louvres etc., as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
59	01EE.3050.10.10	01EE.3050.10.10	300 mm dia., 1 phase, 900 rpm, wall mounting type epoxy painted exhaust fan with louvres.	nos	3.000	INR	5,000.00	15,000.00

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
60	01EE.3050.30	01EE.3050.30	Supply, installation, connection, testing and commissioning of 240 V AC, 410 mm sweep wall mounting type, single phase, 3 blade fan with oscillation facility and built in speed regulator including fixing, wiring with BEE (Bureau of Energy Efficiency)rating of minimum 3 star including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.	nos	7.000	INR	2,720.00	19,040.00
61	01EE.3080	01EE.3080	JUNCTION BOXES (OUTDOOR / INDOOR TYPE)					
62	01EE.3080.10	01EE.3080.10	Supply and installation of dust and vermin proof G.I. sheet steel (1.6 mm thick) junction box WP type suitable for outdoor/indoor installation with number of outgoing ways as under, complete with PVC connectors, supply and fixing of cable glands, including supply of required size and number of terminals, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
63	01EE.3080.10.20	01EE.3080.10.20	4 way.	nos	39.000	INR	2,980.00	116,220.00
64	01EE.3100	01EE.3100	WIRING					
65	01EE.3100.10	01EE.3100.10	Circuit wiring in non-hazardous areas using (size given below), copper conductor, PVC insulated, FRLS outer sleeve cables (third core for earthing), from lighting/power panel/distribution junction box, excluding the supply of cable, junction boxes and cable glands but including termination and connection, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
66	01EE.3100.10.10	01EE.3100.10.10	3 C x 2.5 sq. mm	m	65.000	INR	60.00	3,900.00
67	01EE.3100.70	01EE.3100.70	Supply and laying of (surface type) approved make of black enamelled steel conduit of following diameter and associated fittings from lighting/power panel, telephone, fire alarm/plant communication points etc., including supply of G.I. sheet steel junction boxes with acrylic cover, pull wire, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
68	01EE.3100.70.10	01EE.3100.70.10	25 mm diameter.	m	338.000	INR	250.00	84,500.00
69	01EE.4020	01EE.4020	EARTH ELECTRODES					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
70	01EE.4020.10	01EE.4020.10	Supply, installation, testing and commissioning of GI earth electrodes, complete with earth pit as per std. 7-51-0102 and all necessary materials including excavation of earth pit, filling with charcoal and salt, back filling, providing necessary brickwork, connections, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
71	01EE.4020.10.10	01EE.4020.10.10	GI earth electrode as per std. 7-51-0102.	nos	13.000	INR	11,400.00	148,200.00
72	01EE.4030	01EE.4030	EARTH STRIPS					
73	01EE.4030.10	01EE.4030.10	Supply, installation and connection of following GI earthing strip along the cable trenches or cable trays or fixing to walls or structures including welding at joints, providing anti-corrosive paint or bitumen and jute covering for welded portion, clamping and necessary hardware for connecting, etc., including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
74	01EE.4030.10.20	01EE.4030.10.20	50 x 6 mm	m	62.000	INR	390.00	24,180.00
75	01EE.4030.10.40	01EE.4030.10.40	25 x 3 mm	m	260.000	INR	170.00	44,200.00
76	01EE.4030.20	01EE.4030.20	Supply, installation and connection of following GI earthing strip buried individually at a depth of 500 mm including welding at joints, providing anti-corrosive paint or bitumen and jute covering for welded portion, clamping and necessary hardware for connecting, excavation and refilling etc., including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
77	01EE.4030.20.20	01EE.4030.20.20	50 x 6 mm	m	130.000	INR	500.00	65,000.00
78	01EE.4030.20.40	01EE.4030.20.40	25 x 3 mm	m	13.000	INR	280.00	3,640.00
79	01EE.4040	01EE.4040	EARTHING CONNECTION					
80	01EE.4040.10	01EE.4040.10	Connecting individual equipment to the earth strip or earth plate with following sizes of G.I. wire / G.I. wire rope including the supply of G.I. wire /G.I. wire rope, lugs, conductors, connecting to the G.I. strip or earth plate and necessary hardware for connection, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. : 0								
SOR No. : C098-000-16-50-CD-SOR-8105-0-0M			**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title: BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL								
81	01EE.4040.10.10	01EE.4040.10.10	3/8" dia (10 mm) flexible rope.	m	26.000	INR	210.00	5,460.00
82	01EE.4050	01EE.4050	EARTH PLATES					
83	01EE.4050.10	01EE.4050.10	Supply, installation and connection of GI earth plates as per std. 7-51-0103, complete with anchor bolts, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge.					
84	01EE.4050.10.10	01EE.4050.10.10	GI earth plate as per std. 7-51-0103.	nos	7.000	INR	1,590.00	11,130.00
85	01EE.6010	01EE.6010	CIVIL WORKS/M.S. CHEQUERED PLATE					
86	01EE.6010.10	01EE.6010.10	Excavation and backfilling of trenches for cables and earth strip etc. , for a maximum depth of 1.5 m, shoring, shuttering and dewatering (if necessary) including consolidation and disposal of surplus earth up to a distance of 30 m, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge. (Excavated trench dimensions shall be measured).					
87	01EE.6010.10.10	01EE.6010.10.10	Excavation and backfilling of trenches in all types of soil except rock.	m^3	260.000	INR	660.00	171,600.00
88	01EE.6010.30	01EE.6010.30	Supply and spreading of approved fine river sand/stone dust in cable trenches, including all labour and materials, specifications of this tender and directions of Engineer-in-Charge.					
89	01EE.6010.30.10	01EE.6010.30.10	Fine river sand.	m^3	65.000	INR	1,620.00	105,300.00
90	01EE.6010.40	01EE.6010.40	Supply and spreading of approved FLY ASH BRICKS - TYPE-5 of 75 mm thickness in cable trenches for cable protection, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge. (Actual area of laid brick surfaces shall be measured).					
91	01EE.6010.40.10	01EE.6010.40.10	Bricks.	m^2	182.000	INR	450.00	81,900.00
92	01EE.ME06	01EE.ME06	Skilled Manpower-Electrician for electrical installation, testing, termination, fault detection, maintenance works of LT/HT systems etc.. Electricians must possess a valid wireman license and at least 3 years of field experience.	Mandays	45.000	INR	1,352.00	60,840.00
93	01EE.ME07	01EE.ME07	Unskilled Manpower-Helper to assist skilled manpower in material handling, shifting, clearing and general site support activities. Helpers must be physically fit and familiar with basic construction safety practices.	Mandays	45.000	INR	963.00	43,335.00

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
94	01EE.ME08	01EE.ME08	Overtime Charges (OT) -Skilled manpower OT charges per hour beyond standard working hours (as per applicable labour laws) for skilled manpower.	Hour	80.000	INR	195.00	15,600.00
95	01EE.ME09	01EE.ME09	Overtime Charges (OT) - unskilled manpower OT charges per hour beyond standard working hours (as per applicable labour laws) for unskilled manpower.	Hour	40.000	INR	139.00	5,560.00
96	11EE	11EE	ELECTRICAL ENGINEERING					
97	11EE.1	11EE.1	WIRING IN STEEL AND PVC CONDUIT					
98	11EE.1.10	11EE.1.10	Wiring for light point/ fan point/ exhaust fan point/ call bell point with1.5 sq. mm FRLS PVC insulated copper conductor single core cablein surface / recessed medium class PVC conduit, with modular switch, modular plate, suitable Gl box and earthing the point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable etc. as required.					
99	11EE.1.10.3	11EE.1.10.3	Group C	Point	1.000	INR	1,339.00	1,339.00
100	11EE.1.14	11EE.1.14	Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed medium class PVC conduit as required.					
101	11EE.1.14.1	11EE.1.14.1	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire	metre	390.000	INR	213.00	83,070.00
102	11EE.1.14.2	11EE.1.14.2	2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire	metre	208.000	INR	251.00	52,208.00
103	11EE.1.20	11EE.1.20	Supplying and fixing of following sizes of steel conduit along with accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.					
104	11EE.1.20.2	11EE.1.20.2	25 mm	metre	5.000	INR	234.00	1,170.00
105	11EE.1.20.4	11EE.1.20.4	40 mm	metre	5.000	INR	429.00	2,145.00
106	11EE.1.21	11EE.1.21	Supplying and fixing of following sizes of medium class PVC conduit along with accessories in surface/recess including cutting the wall and making good the same in case of recessed conduit as required.					
107	11EE.1.21.2	11EE.1.21.2	25 mm	metre	390.000	INR	132.00	51,480.00
108	11EE.1.21.4	11EE.1.21.4	40 mm	metre	260.000	INR	208.00	54,080.00
109	11EE.1.24	11EE.1.24	Supplying and fixing following modular switch/ socket on the existing modular plate & switch box including connections but excluding modular plate etc. as required.					
110	11EE.1.24.1	11EE.1.24.1	5/6 A switch	each	78.000	INR	94.00	7,332.00

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
111	11EE.1.24.3	11EE.1.24.3	15/16 A switch	each	7.000	INR	142.00	994.00
112	11EE.1.24.4	11EE.1.24.4	3 pin 5/6 A socket outlet	each	23.000	INR	111.00	2,553.00
113	11EE.1.24.5	11EE.1.24.5	6 pin 15/16 A socket outlet	each	7.000	INR	180.00	1,260.00
114	11EE.1.26	11EE.1.26	Supplying and fixing modular blanking plate on the existing modular plate & switch box excluding modular plate as required.	each	26.000	INR	37.00	962.00
115	11EE.1.27	11EE.1.27	Supplying and fixing following size/ modules, GI box alongwith modular base & cover plate for modular switches in recess etc. as required.					
116	11EE.1.27.1	11EE.1.27.1	1 or 2 Module (75mmX75mm)	each	4.000	INR	272.00	1,088.00
117	11EE.1.27.2	11EE.1.27.2	3 Module (100 mm X 75 mm)	each	26.000	INR	299.00	7,774.00
118	11EE.1.27.3	11EE.1.27.3	4 Module (125mmX75mm)	each	3.000	INR	313.00	939.00
119	11EE.1.27.4	11EE.1.27.4	6 Module (200mmX75mm)	each	8.000	INR	367.00	2,936.00
120	11EE.1.27.5	11EE.1.27.5	8 Module (125mmX125mm)	each	8.000	INR	415.00	3,320.00
121	11EE.1.27.6	11EE.1.27.6	12 Module (200mmX150mm)	each	3.000	INR	499.00	1,497.00
122	11EE.1.3	11EE.1.3	Wiring for light point/fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable etc. as required.					
123	11EE.1.3.3	11EE.1.3.3	Group C	Point	39.000	INR	1,684.00	65,676.00
124	11EE.1.54	11EE.1.54	Wiring for group controlled (looped) light point/fan point/exhaust fan point/ call bell point (without independent switch etc.) with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed steel conduit, and earthing the point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable etc. as required.					
125	11EE.1.54.3	11EE.1.54.3	Group C	Point	3.000	INR	999.00	2,997.00
126	11EE.1.55	11EE.1.55	Wiring for group controlled (looped) light point/fan point/exhaust fan point/ call bell point (without independent switch etc.) with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed PVC conduit, and earthing the point with 1.5 sq. mm FRLS PVC insulated copper conductor single core cable etc. as required.					
127	11EE.1.55.3	11EE.1.55.3	Group C	Point	16.000	INR	783.00	12,528.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
128	11EE.1.7	11EE.1.7	Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed steel conduit as required.					
129	11EE.1.7.1	11EE.1.7.1	2 X 1.5 sq. mm +1 X 1.5 sq. mm earth wire	metre	5.000	INR	299.00	1,495.00
130	11EE.1.7.2	11EE.1.7.2	2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire	metre	5.000	INR	337.00	1,685.00
131	11EE.19	11EE.19	BEE 5 STAR RATED CEILING FAN WITH BRUSH LESS DIRECT CURRENT (BLDC) MOTOR					
132	11EE.19.1	11EE.19.1	Supply, Installation, Testing and Commissioning of 1200 mm sweep, BEE 5 star rated, ceiling fan with Brush Less Direct Current (BLDC) Motor, class of insulation: B, 3 nos. blades, 30 cm long down rod, 2 nos. canopies, shackle kit, safety rope, copper winding, Power Factor not less than 0.9, Service Value (CM/M/W) minimum 6.00,Air delivery minimum 210 Cum/Min , 350 RPM (tolerance as per IS : 374-2019), THD less than 10%, remote or electronic regulator unit for speed control and all remaining accessories including safety pin, nut bolts, washers, temperature rise=75 degree C (max.), insulation resistance more than 2 mega ohm, suitable for 230 V, 50 Hz, single phase AC Supply, earthing etc. complete as required.	each	7.000	INR	2,492.00	17,444.00
133	11EE.2	11EE.2	MCCB, MCB & OB'S					
134	11EE.2.10	11EE.2.10	Supplying and fixing 5 A to 32 A rating, 240/415 V, 10 kA, "C" curve, miniature circuit breaker suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissionin etc. as required.					
135	11EE.2.10.1	11EE.2.10.1	Single pole	each	78.000	INR	234.00	18,252.00
136	11EE.2.10.2	11EE.2.10.2	Single pole and neutral	each	3.000	INR	547.00	1,641.00
137	11EE.2.10.3	11EE.2.10.3	Double pole	each	3.000	INR	599.00	1,797.00
138	11EE.2.10.4	11EE.2.10.4	Triple pole	each	3.000	INR	919.00	2,757.00
139	11EE.2.10.5	11EE.2.10.5	Triple pole and neutral	each	7.000	INR	1,121.00	7,847.00
140	11EE.2.11	11EE.2.11	Supplying and fixing single pole blanking plate in the existing MCB DB complete etc. as required.	each	7.000	INR	12.00	84.00
141	11EE.2.15	11EE.2.15	Supplying and fixing following rating, four pole, (three phase and neutral), 415 volts, residual current circuit breaker (RCCB), having a sensitivity current 30 mA in the existing MCB DB complete with connections, testing and commissioning etc. as required.					
142	11EE.2.15.2	11EE.2.15.2	40 A	each	7.000	INR	2,911.00	20,377.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-16-50-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / ELECTRICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
143	11EE.2.15.3	11EE.2.15.3	63 A	each	1.000	INR	2,622.00	2,622.00
144	11EE.2.16	11EE.2.16	Supplying and fixing DP sheet steel enclosure on surface/ recess along with 25/32 A 240 V "C" curve DP MCB complete with connections, testing and commissioning etc. as required.	each	10.000	INR	1,067.00	10,670.00
145	11EE.2.24	11EE.2.24	Supplying and fixing Cable End Box (Loose Wire Box) suitable for following triple pole and neutral, sheet steel, MCB distribution board, 415 Volts, on surface/ recess, complete with testing and commissioning etc.as required.					
146	11EE.2.24.2	11EE.2.24.2	For 6 way, Double door TPN MCBDB	each	7.000	INR	1,026.00	7,182.00
147	11EE.2.4	11EE.2.4	Supplying and fixing following way, horizontal type three pole and neutral, sheet steel, MCB distribution board, 415 V, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/RCCB/Isolator)					
148	11EE.2.4.2	11EE.2.4.2	6 way (4 + 18), Double door	each	7.000	INR	4,541.00	31,787.00
149	11EE.2.ME05	11EE.2.ME05	Supplying and fixing following rating, four pole, 415 volts, MCB in the existing MCB DB complete with connections, testing and commissioning etc. as required.					
150	11EE.2.ME05.01	11EE.2.ME05.01	40 amps	each	7.000	INR	886.00	6,202.00
							SOR (C098-000-16-50-CD-SOR-8105-0-0M) Total :INR	**2526975.00**
SOR No. :	C098-000-16-51-CD-SOR-8105-0-0M		**Division/Department :** ENGINEERING / INSTRUMENTATION					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
1	01II	01II	INSTRUMENTATION					
2	01II.450	01II.450	MISCELLANEOUS ITEMS AND DEVICES					
3	01II.450.50	01II.450.50	Supply and Installation of CCTV and Access Control System					
4	01II.450.50.03V1	01II.450.50.03V1	Supply and installation of 6 m GI Pole with step ladder alongwith all civil and structural works for installing the pole (as per specification) excluding precast concrete foundation.	nos	1.000	INR	35,000.00	35,000.00
5	01II.450.50.07	01II.450.50.07	Dismantling of CCTV Cameras and Accessories and re-installation at different location including dismantling and relocation of poles	nos	5.000	INR	3,000.00	15,000.00
							SOR (C098-000-16-51-CD-SOR-8105-0-0M) Total :INR	**50000.00**
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
1	01CS	01CS	STRUCTURAL					
2	01CS.10	01CS.10	DEMOLISHING AND DISMANTLING (REFER SPEC NO. 6-68-0012)					
3	01CS.10.1	01CS.10.1	Brickwork - Non FIM Items					
4	01CS.10.1.1	01CS.10.1.1	Demolishing BRICKWORK (taking all necessary safety precautions) for all depths below plinth level including supply of all tools and tackles, necessary scaffolding, propping, underpinning, cleaning and stacking of serviceable material, disposal of unserviceable material to spoil heaps anywhere within the plant boundary, all complete as specified and directed. (Excavation & backfilling shall be paid separately under relevant items).	m^3	5.000	INR	1,710.00	8,550.00
5	01CS.10.1.2	01CS.10.1.2	Demolishing BRICKWORK (taking all necessary safety precautions) for all heights above plinth level including supply of all tools and tackles, necessary scaffolding, propping, underpinning, cleaning and stacking of serviceable material, disposal of unserviceable material to spoil heaps anywhere within the plant boundary, all complete as specified and directed.	m^3	13.000	INR	1,850.00	24,050.00
6	01CS.10.2	01CS.10.2	RCC - Non FIM Items					
7	01CS.10.2.11	01CS.10.2.11	Making cut-outs in RCC slab/ wall upto a thickness of 400mm (taking all necessary safety precautions) by vibration-less spark-free mechanical means like core-cutting, wet cutting by diamond wall saw system at all depths & heights including supply of all tools & tackles, necessary scaffolding etc. cutting of reinforcement bars, disposal of unserviceable material, plastering & finishing the cut surfaces, all complete as specified and directed by the Engineer-in- Charge (Measurement on Plan/ Elevation Area basis).	m^3	0.100	INR	15,000.00	1,500.00
8	01CS.10.2.21	01CS.10.2.21	Demolishing RCC WORK (taking all necessary safety precautions) for all depths below plinth level including supply of all tools & tackles, necessary scaffolding, propping, underpinning etc., cutting, straightening, scraping and cleaning of reinforcement bars, stacking of serviceable materials, disposal of unserviceable material to spoil heaps ANYWHERE OUTSIDE THE PLANT BOUNDARY, all complete as specified and directed. Disposal areas outside plant Boundary to be arranged by the contractor. Royalty as applicable for disposal outside plant limits to be borne by the Contractor. (Excavation & backfilling shall be paid separately under relevant items).	m^3	216.000	INR	3,180.00	686,880.00

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
9	01CS.10.2.22	01CS.10.2.22	Demolishing RCC WORK (taking all necessary safety precautions) for all heights above plinth level including supply of all tools & tackles, necessary scaffolding, propping, underpinning etc., cutting, straightening, scraping and cleaning of reinforcement bars, stacking of serviceable materials, disposal of unserviceable material to spoil heaps ANYWHERE OUTSIDE THE PLANT BOUNDARY, all complete as specified and directed. Disposal areas outside plant Boundary to be arranged by the contractor. Royalty as applicable for disposal outside plant limits to be borne by the Contractor. (Excavation & backfilling shall be paid separately under relevant items).	m^3	39.000	INR	3,450.00	134,550.00
10	01CS.10.3	01CS.10.3	Pockets - Non FIM Items					
11	01CS.10.3.1	01CS.10.3.1	Making POCKETS/HOLES of sizes upto & inclusive of 200 x200x500mm in RCC/PCC works (taking all necessary safety precautions) by chiselling/drilling, including supply of all tools & tackles, necessary scaffolding etc. cutting of reinforcement bars, cleaning the pockets of all debris, disposal of the unserviceable material to spoil heaps anywhere within the plant boundary all complete at all heights & depths as specified and directed.	each	3.000	INR	492.00	1,476.00
12	01CS.10.4	01CS.10.4	PCC _ Non FIM Items					
13	01CS.10.4.2	01CS.10.4.2	Demolishing PLAIN CEMENT CONCRETE work (taking all necessary safety precautions) for all heights above plinth level including supply of all tools & tackles, necessary scaffolding, propping, underpinning etc. disposal of unserviceable material to spoil heaps anywhere within the plant boundary, all complete as specified and directed.	m^3	1.000	INR	2,100.00	2,100.00
14	01CS.10.4.3	01CS.10.4.3	Demolishing PLAIN CEMENT CONCRETE work (taking all necessary safety precautions) for all depths below plinth level including supply of all tools & tackles, necessary scaffolding, propping, underpinning etc. disposal of unserviceable material to spoil heaps ANYWHERE OUTSIDE THE PLANT BOUNDARY, all complete as specified and directed. Disposal areas outside plant Boundary to be arranged by the contractor. Royalty as applicable for disposal outside plant limits to be borne by the Contractor. (Excavation & backfilling shall be paid separately under relevant items).	m^3	78.000	INR	2,280.00	177,840.00
15	01CS.10.6	01CS.10.6	Steelwork - Non FIM Items					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
16	01CS.10.6.1	01CS.10.6.1	Dismantling bolted/rivetted/welded STRUCTURAL STEEL WORK of all descriptions (taking all necessary safety precautions), including supply of all tools and tackles, consumables, necessary scaffolding etc., providing temporary bracings as required, cutting (by flame or saw) gusset plates, bolts, nuts, weldings etc., transporting and stacking of the serviceable materials, cleaning the site of work of all unserviceable materials for disposal to spoil heaps anywhere within the plant boundary, all complete at all depths and heights, as specified and directed.	MT	78.000	INR	11,940.00	931,320.00
17	01CS.2	01CS.2	PLAIN & REINFORCED CEMENT CONCRETE: (REFER SPECIFICATION NO. 6-68-0004)					
18	01CS.2.29	01CS.2.29	Fixing Re-bars in already cast concrete - Non FIM Items					
19	01CS.2.29.1	01CS.2.29.1	Designing, supplying and fixing rebars in already cast concrete, including drilling, cleaning hole with air blow-out & wire-brush and injecting odourless Chemical of approved make, packed in dual foil, with the help of dispenser into a hole of diameter and depth as per manufacture specification, at all levels & locations for high strength deformed steel reinforcement bars of dia. upto 12 mm of Grade Fe500D (conforming to IS:1786), DESIGNED FOR FULL TENSILE ANCHORAGE, including testing (as per manufacturer's recommendations), adjusting and making good any damage done to the structure etc. all complete as specified and directed. SUPPLY OF ALL MATERIAL IN CONTRACTOR'S SCOPE EXCLUDING REINFORCEMENT BARS.	each	3.000	INR	1,030.00	3,090.00
20	01CS.2.29.2	01CS.2.29.2	Designing, supplying and fixing rebars in already cast concrete, including drilling, cleaning hole with air blow-out & wire-brush and injecting odourless Chemical of approved make, packed in dual foil, with the help of dispenser into a hole of diameter and depth as per manufacture specification, at all levels & locations for high strength deformed steel reinforcement bars of dia. 16 mm & 20 mm of Grade Fe500D (conforming to IS:1786), DESIGNED FOR FULL TENSILE ANCHORAGE, including testing (as per manufacturer's recommendations), adjusting and making good any damage done to the structure etc. all complete as specified and directed. SUPPLY OF ALL MATERIAL IN CONTRACTOR'S SCOPE EXCLUDING REINFORCEMENT BARS.	each	3.000	INR	1,110.00	3,330.00
21	01CS.2.30	01CS.2.30	Self Compacting Concrete- Sub Structure- Non FIM items					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
22	01CS.2.30.02	01CS.2.30.02	Providing and laying SELF COMPACTING CEMENT CONCRETEOF M-30 GRADE confirming to specification no. 6-68-0019 with 20 mm and down size graded crushed stone aggregates/ gravel in SUB-STRUCTURE e.g. foundations, raft, beams, slabs, pile caps, retaining walls, dyke walls, jambs, counterforts, buttresses, pedestals, pipe sleepers, columns, suspended floors, staircases, landings, steps, brackets etc., including equipment/ machine foundations & pedestals viz. compressors, ID & FD fans, pumps, generators, crushers, mills, etc., (including single pour concreting as specified on the drawing), applying cement wash on concrete surface (wherever no other surface application is specified), providing pockets, openings, recesses, chamfering, etc., wherever required, curing and rendering if required to give a smooth and even surface etc. (EXCLUDING THE COST OF REINFORCEMENT, SHUTTERING &SPECIFIED ADMIXTURES not covered in 6-68-0004 & 6-68-0019) for all depths below and upto plinth level in any shape, position and thickness etc. all complete as specified, shown and directed. ALL MATERIALS INCLUDING CEMENT SUPPLIED BY THE CONTRACTOR.	cum	104.000	INR	10,000.00	1,040,000.00
23	01CS.2.31	01CS.2.31	Self Compacting Concrete- Super Structure- Non FIM items					
24	01CS.2.31.02	01CS.2.31.02	Providing and laying SELF COMPACTING CEMENT CONCRETEOF M-30 GRADE confirming to specification no. 6-68-0019with 20 mm and down size graded crushed stone aggregates/ gravel in SUPER STRUCTURE in suspended floors, slabs, beams, columns, walls including counterforts, staircases, landings, steps, facias, fins, mouldings, gutters, shelves, window sills, canopies, lintels, girders, ducts, brackets, chajjas with drip moulds, pedestals, posts, struts, equipment/ machine foundations, ramps etc. (including single pour concreting as specified on the drawing), providing cement wash (wherever no other surface application is specified), providing pockets, openings, recesses, chamfering wherever required, curing and rendering if required to give a smooth and even surface etc. EXCLUDING THE COST OF REINFORCEMENT, SHUTTERING & SPECIFIED ADMIXTURES not covered in 6-68-0004 & 6-68-0019) FOR ALL HEIGHTS UPTO & INCLUSIVE OF 20 m ABOVE PLINTH LEVEL in any shape, position, thickness etc. all complete as specified, shown and directed. ALL MATERIALS INCLUDING CEMENT SUPPLIED BY THE CONTRACTOR.	cum	1352.000	INR	10,840.00	14,655,680.00
25	01CS.4	01CS.4	STRUCTURAL STEEL WORKS SPEC NO. 6-68-0006					
26	01CS.4.1	01CS.4.1	General Steel Works - FIM Items					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
27	01CS.4.1.MG22	01CS.4.1.MG22	Transporting from storage yard (or any other location as specified by engineer-in-charge), Storing, Assembling and Erecting in position and testing/ examining, bolted and/ or welded, already Fabricated STRUCTURAL STEEL (of any Grade) at all locations and levels UPTO & INCLUSIVE OF 10 m ABOVE HPP/ FGL, including all built-up sections/ compound sections made out of rolled/ hollow sections and/or plates/ bent plates in all types of structural frameworks, joining the compound/built-up sections by welding/bolting as required, fixing in line and level with temporary staging & bracing and removal of the same after erection, grouting with Ordinary Grout or premix free flow Non shrink Grout as specified etc., all complete. ALREADY FABRICATED STRUCTURAL STEEL SHALL BE PROVIDED TO CONTRACTOR FREE OF COST. SUPPLY OF ALL OTHER MATERIAL IN CONTRACTOR'S SCOPE.	MT	26.000	INR	16,600.00	431,600.00
28	01CS.4.5	01CS.4.5	Grouting					
29	01CS.4.5.1	01CS.4.5.1	Supplying & applying Grouting below the bases of structural steel members with Free-flow Non-shrink Cementitious Grout of approved make.	m^3	1.000	INR	72,800.00	72,800.00
30	01CS.6	01CS.6	MISCELLANEOUS STEEL WORKS SPECIFICATIONS NO. 6-68-0008					
31	01CS.6.15	01CS.6.15	Anchor Bolts - Non FIM Items					
32	01CS.6.15.1	01CS.6.15.1	Supplying, fabricating, fixing and keeping in position at all levels and locations THREADED ANCHOR BOLTS of all diameters and nomenclature including nuts, washers, anchor plates, pipe sleeves etc. in foundations, columns, pedestals, slabs, beams, walls etc. or any other place as directed including handling & transporting, straightening if required, turning from relevant size M.S. rounds to required diameter, threading, welding, providing necessary templates and auxiliary dummy structures, if any, necessary tying and welding with reinforcement, adjustment of shuttering & reinforcement/any other fixture, greasing exposed metal surfaces, covering bolts and packing the sleeves with jute cloth etc. all complete as specified and directed.(SUPPLY OF ALL MATERIALS IN CONTRACTOR'S SCOPE).	MT	0.130	INR	125,390.00	16,300.70
33	01CS.6.18	01CS.6.18	MS Chequered Plates - Non FIM Items					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
34	01CS.6.18.1	01CS.6.18.1	Supplying, fabricating and erecting in position at all levels and locations bolted, screwed and/or welded M.S. CHEQUERED PLATES of any thickness in walkways, platforms, stair treads, any other place as directed etc. including cutting to required size, shape, making holes, notches, openings of required size, nosing, straightening if required, making the edges smooth, removing the burrs, fixing, welding, preparation and submission of fabrication drawings and preparing the surfaces for painting and applying shop primer as per EIL Specification No. 6-79-0020 (or Job Specification, wherever applicable) after fabrication etc. all complete as specified and directed. (SUPPLY OF ALL MATERIALS IN CONTRACTOR'S SCOPE).	MT	0.130	INR	117,700.00	15,301.00
35	01CS.6.19	01CS.6.19	MS Grating Cat. A,B - Non FIM Items					
36	01CS.6.19.5	01CS.6.19.5	Supplying, fabricating and erecting in position at all levels and locations ELECTROFORGED GRATING purchased from approved manufacturer conforming to EIL Standard No. 7-68-0697 in walkways, platforms, stair treads etc. including cutting to required size, shape, making holes, notches, openings of required size, nosing, straightening if required, making the edges smooth, removing the burrs, fabricating clamps, fixing, tack welding, preparation and submission of fabrication drawings and preparing the surfaces for painting and applying pre-erection/ shop primer as per Job Specification after fabrication etc. all complete as specified and directed (SUPPLY OF ALL MATERIALS IN CONTRACTOR'S SCOPE).	MT	4.000	INR	126,900.00	507,600.00
37	01CS.6.25	01CS.6.25	Mechanical Anchor fastners - Non FIM Items					
38	01CS.6.25.1	01CS.6.25.1	"Supplying, handling, transporting to site of work and fixing approved MECHANICAL ANCHOR FASTENERS M.S. bolts of Grade 5.8 or more, GALVANIZED with minimum thickness of 5 microns (approved for use in cracked concrete), of 12mm dia at specified positions on concrete floors, roofs, beams (sides and bottom), walls, columns etc. according to manufacturer's specifications including all accessories like nuts, washers etc. of required size, testing, necessary scaffolding, drilling of the holes in concrete surface with electric drill, cleaning of holes with air blowout & wire-brush, and making good any damage done to the structure etc. all complete for all heights, depths and locations as specified and directed."	each	3.000	INR	471.00	1,413.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
39	01CS.6.25.2	01CS.6.25.2	"Supplying, handling, transporting to site of work and fixing approved MECHANICAL ANCHOR FASTENERS M.S. bolts of Grade 5.8 or more, GALVANIZED with minimum thickness of 5 microns (approved for use in cracked concrete), of 16mm dia at specified positions on concrete floors, roofs, beams (sides and bottom), walls, columns etc. according to manufacturer's specifications including all accessories like nuts, washers etc. of required size, testing, necessary scaffolding, drilling of the holes in concrete surface with electric drill, cleaning of holes with air blowout & wire-brush, and making good any damage done to the structure etc. all complete for all heights, depths and locations as specified and directed."	each	3.000	INR	852.00	2,556.00
40	01CS.6.26	01CS.6.26	Chemical Anchor Fastner					
41	01CS.6.26.1	01CS.6.26.1	"Supplying, handling, transporting to site of work and fixing approved CHEMICAL ANCHOR FASTENERS consisting of M.S. threaded rod of Grade 5.8, GALVANIZED with minimum thickness of 5 microns and chemical (approved for use in cracked concrete), packed in flexible chemical foil or dual foil type, to be used with the help of dispenser, of 12mm dia. at specified positions on concrete floors, roofs, beams (sides and bottom), walls, columns etc. according to manufacturer's specifications including all accessories like nuts, washers etc. of required size, testing, necessary scaffolding, drilling of the holes in concrete surface with electric drill, cleaning of holes with air blowout & wire-brush and making good any damage done to the structure etc. all complete for all heights, depths and locations as specified and directed."	each	3.000	INR	1,794.00	5,382.00
42	01CS.6.26.2	01CS.6.26.2	"Supplying, handling, transporting to site of work and fixing approved CHEMICAL ANCHOR FASTENERS consisting of M.S. threaded rod of Grade 5.8, GALVANIZED with minimum thickness of 5 microns and chemical (approved for use in cracked concrete), packed in flexible chemical foil or dual foil type, to be used with the help of dispenser, of 16mm dia. at specified positions on concrete floors, roofs, beams (sides and bottom), walls, columns etc. according to manufacturer's specifications including all accessories like nuts, washers etc. of required size., testing, necessary scaffolding, drilling of the holes in concrete surface with electric drill, cleaning of holes with air blowout & wire-brush and making good any damage done to the structure etc. all complete for all heights, depths and locations as specified and directed."	each	3.000	INR	2,205.00	6,615.00
43	01CS.MG01	01CS.MG01	Supply of Manpower for Miscellaneous work to be carried out at site with tools, safety gears, PPE (Helmet, Gloves, Face Shield, Apron, etc. as applicable) all complete as per direction of Engineer-in-Charge					
44	01CS.MG01.1	01CS.MG01.1	Skilled Manpower - Carpenter for RCC Works to carry out making of shutters, shuttering/de-shuttering works etc.	Mandays	30.000	INR	1,352.00	40,560.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
45	01CS.MG01.2	01CS.MG01.2	Skilled Manpower - Barbender for RCC Works to carry out cutting, bending, fixing and tying of reinforcement steel	Mandays	30.000	INR	1,352.00	40,560.00
46	01CS.MG01.3	01CS.MG01.3	Skilled Manpower - Welder for welding works including cutting, tack welding, arc welding etc.	Mandays	10.000	INR	1,352.00	13,520.00
47	01CS.MG21	01CS.MG21	CARRIAGE OF MATERIALS BEYOND INITIAL LEAD OF 50 M.					
48	01CS.MG21.01	01CS.MG21.01	Disposal of excavated earth by mechanical transport including loading, unloading and stacking upto lead of 1 km.	cum	1040.000	INR	129.00	134,160.00
49	01CS.MG21.02	01CS.MG21.02	Disposal of excavated earth by mechanical transport including loading, unloading and stacking beyond lead 1 km and up to 2 km.	cum	182.000	INR	147.00	26,754.00
50	01CS.MG21.03	01CS.MG21.03	Disposal of excavated earth by mechanical transport including loading, unloading and stacking beyond lead 2 km and up to 3 km.	cum	13.000	INR	164.00	2,132.00
51	01CS.MG21.04	01CS.MG21.04	Disposal of excavated earth by mechanical transport including loading, unloading and stacking beyond lead 3 km and up to 4 km.	cum	13.000	INR	180.00	2,340.00
52	01CS.MG21.05	01CS.MG21.05	Disposal of excavated earth by mechanical transport including loading, unloading and stacking beyond lead 4 km and up to 5 km.	cum	13.000	INR	196.00	2,548.00
53	01CS.MG21.06	01CS.MG21.06	Disposal of excavated earth by mechanical transport including loading, unloading and stacking beyond lead 5 km and up to 10 km per km.	cum	1586.000	INR	14.00	22,204.00
54	01CS.MG21.07	01CS.MG21.07	Disposal of excavated earth by mechanical transport including loading, unloading and stacking beyond lead 10 km and up to 20 km per km.	cum	1066.000	INR	12.00	12,792.00
55	01CS.MG23	01CS.MG23	Providing and fixing of customized aluminium formwork.					

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Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
56	01CS.MG23.01	01CS.MG23.01	Providing and fixing of customized aluminium formwork for the monolithic construction on RCC members with repetitive usage made up of aluminium sheets/plates of minimum 4 mm thickness and grade 6061 (Type-6). The form work comprises of (a) wall panel, rocker, kicker and internal soffit corner, external soffit corner, internal corner etc..(b) Beam components i.e. beam side panel, prop head for soffit beam, beams soffit panel, beam soffit panel, beam soffit bulk head and (c) deck components i.e. deck panel, deck prop, prop length, deck mid, soffit length, deck beam bar. The panels shall comprise of inbuilt molding in its panel itself as per the embossing design as specified in architectural drawing & scope of work document attached else-where in the tender document. The panels are held in position by a simple pin and wedge system that passage through holes in the in the outside rib of each panel. The tolerance of finished panel shall not be less than (-1mm) and shall confirm to IS: 14687-1999. Pins and wedges to be made of high grade hot deep galvanized mild steel. This formwork also comprises of M.S. angle iron, "Z" shaped brackets braced diagonally at 0.90 to 1.00 mtr. center to centre on external wall face just the level below on which to lay M.S. square tube panels (Challis) and guard railing supports to form working platform and 40 mm dia G.I telescopic adjustable props to support deck formwork and beam soffit panels including de-shuttering the formwork odd/even level to be shifted/ lifted to next alternate odd/even level before which the pins and shuttering surface to be thoroughly cleaned, pins greasing and shuttering surface oiling properly before fixing all complete including sealing of gap between kicker plates of wall panel and floors (if any) as per design of formwork provided by shuttering supplier and as per the Engineer-in-charge including filling and finishing the holes varied sizes and shapes (left by key/pins of aluminium form work shuttering while de-shuttering) with GP-2 cementeous polymer compound mixed with water in ratio prescribed by manufacturer to form consistent workable dough for pushing in the holes upto full depth of wall using appropriate tools and finishing smooth all complete as per directions of the Engineer-in-charge.	sqm	7280.000	INR	398.00	2,897,440.00
57	11CS	11CS	CIVIL, STRUCTURE AND ARCHITECTURE					
58	11CS.10	11CS.10	STEEL WORK					
59	11CS.10.1	11CS.10.1	Structural steel work in single section, fixed with or without connecting plate,including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.	kg	780.000	INR	93.00	72,540.00
60	11CS.10.2	11CS.10.2	Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.	kg	130.000	INR	106.00	13,780.00

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Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
61	11CS.15	11CS.15	DISMANTLING AND DEMOLISHING					
62	11CS.15.60	11CS.15.60	Disposal of building rubbish / malba / similar unserviceable, dismantled or waste materials by mechanical means, including loading, transporting, unloading to approved municipal dumping ground or as approved by Engineer-in-charge, beyond 50 m initial lead, for all leads including all lifts involved.	cum	52.000	INR	192.00	9,984.00
63	11CS.2	11CS.2	E A R T H W O R K					
64	11CS.2.1	11CS.2.1	Earth work in surface excavation not exceeding 30 cm in depth but exceeding 1.5 m in width as well as 10 sqm on plan including getting out and disposal of excavated earth upto 50 m and lift upto 1.5 m, as directed by Engineer-in- Charge:					
65	11CS.2.1.1	11CS.2.1.1	All kinds of soil	sqm	13.000	INR	103.00	1,339.00
66	11CS.2.16	11CS.2.16	Close timbering in trenches including strutting, shoring and packing cavities (wherever required) complete. (Measurements to be taken of the face area timbered).					
67	11CS.2.16.1	11CS.2.16.1	Depth not exceeding 1.5 m	sqm	3.000	INR	111.00	333.00
68	11CS.2.16.2	11CS.2.16.2	Depth exceeding 1.5 m but not exceeding 3 m	sqm	3.000	INR	123.00	369.00
69	11CS.2.16.3	11CS.2.16.3	Depth exceeding 3 m but not exceeding 4.5 m	sqm	3.000	INR	151.00	453.00
70	11CS.2.20	11CS.2.20	Open timbering in trenches including strutting and shoring complete (measurements to be taken of the face area timbered):					
71	11CS.2.20.1	11CS.2.20.1	Depth not exceeding 1.5 m	sqm	3.000	INR	57.00	171.00
72	11CS.2.20.2	11CS.2.20.2	Depth exceeding 1.5 m but not exceeding 3 m	sqm	3.000	INR	65.00	195.00
73	11CS.2.20.3	11CS.2.20.3	Depth exceeding 3 m but not exceeding 4.5 m	sqm	3.000	INR	77.00	231.00
74	11CS.2.25	11CS.2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and for all lift.	cum	1352.000	INR	156.00	210,912.00
75	11CS.2.25a	11CS.2.25a	Excavating, supplying, stacking and filling of local earth (including royalty) by mechanical transport upto a lead of 5km also including ramming and watering of the earth in layers not exceeding 20 cm in foundation trenches, plinth, sides of foundation etc. complete for all lift.	cum	3.000	INR	493.00	1,479.00
76	11CS.2.26	11CS.2.26	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials.					
77	11CS.2.26.1	11CS.2.26.1	All kinds of soil	cum	3.000	INR	101.00	303.00

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
78	11CS.2.26.2	11CS.2.26.2	Ordinary or hard rock	cum	1.000	INR	181.00	181.00
79	11CS.2.6	11CS.2.6	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and for all lift, as directed by Engineer-in-charge.					
80	11CS.2.6.1	11CS.2.6.1	All kinds of soil	cum	5798.000	INR	141.00	817,518.00
81	11CS.2.7	11CS.2.7	Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-Charge.					
82	11CS.2.7.1	11CS.2.7.1	Ordinary rock	cum	13.000	INR	396.00	5,148.00
83	11CS.3	11CS.3	MORTAR					
84	11CS.3.4	11CS.3.4	Cement mortar 1:4 (1 cement : 4 fine sand).	cum	1.000	INR	2,947.00	2,947.00
85	11CS.3.6	11CS.3.6	Cement mortar 1:6 (1 cement : 6 fine sand).	cum	1.000	INR	2,414.00	2,414.00
86	11CS.4	11CS.4	CONCRETE WORK					
87	11CS.4.1	11CS.4.1	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level :					
88	11CS.4.1.11	11CS.4.1.11	1:5:10 (1 cement : 5 fine sand derived from natural sources: 10 graded stone aggregate 40 mm nominal size derived from natural sources)	cum	151.000	INR	4,918.00	742,618.00
89	11CS.4.1.2	11CS.4.1.2	1:1¿:3 (1 Cement: 1¿ coarse sand (zone-III) derived from natural sources : 3 graded stone aggregate 20 mm nominal size derived from natural sources)	cum	1.000	INR	6,627.00	6,627.00
90	11CS.4.1.3	11CS.4.1.3	1:2:4 (1 cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 20 mm nominal size derived from natural sources)	cum	1.000	INR	6,259.00	6,259.00
91	11CS.4.1.5	11CS.4.1.5	1:3:6 (1 Cement : 3 coarse sand (zone-III) derived from natural sources: 6 graded stone aggregate 20 mm nominal size derived from natural sources)	cum	1.000	INR	5,796.00	5,796.00
92	11CS.4.2	11CS.4.2	Providing and laying cement concrete in retaining walls, return walls, walls (any thickness) including attached pilasters, columns, piers, abutments, pillars, posts, struts, buttresses, string or lacing courses, parapets, coping, bed blocks, anchor blocks, plain window sills, fillets, sunken floor etc., up to floor five level, excluding the cost of centering, shuttering and finishing:					
93	11CS.4.2.8A	11CS.4.2.8A	1:5:10 (1 cement : 5 manufactured sand derived from Recycled concrete aggregate (RCA): 10 graded stone aggregate 40 mm nominal size Recycled aggregate (RA).	cum	1.000	INR	4,918.00	4,918.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
94	11CS.4.20	11CS.4.20	Providing and laying in position ready mixed or site batched design mix cement concrete for plain cement concrete work; using coarse aggregate and fine aggregate derived from natural sources, Portland pozzolana/Ordinary Portland/Portland slag cement, admixtures in recommended proportions as per IS: 9103 to accelerate / retard setting of concrete, to improve durability and workability without impairing strength; including pumping of concrete to site of laying , curing , carriage for all leads; but excluding the cost of centering, shuttering and finishing as per direction of the Engineer- in-charge; for the following grades of concrete.Note: Extra cement up to 10% of the minimum specified cement content in design mix shall be payable separately. In case the cement content in design mix is more than 110% of the minimum specified cement content, the contractor shall have discretion to either re-design the mix or bear the cost of extra cement.					
95	11CS.4.20.1	11CS.4.20.1	All works upto plinth level :					
96	11CS.4.20.1.3	11CS.4.20.1.3	concrete of M20 grade with minimum cement content of 270 kg/cum	cum	192.000	INR	7,319.00	1,405,248.00
97	11CS.4.20.2	11CS.4.20.2	All works above plinth and upto floor V level :					
98	11CS.4.20.2.3	11CS.4.20.2.3	Concrete of M20grade with minimum cement content of 270 kg/cum	cum	1.000	INR	7,602.00	7,602.00
99	11CS.5	11CS.5	REINFORCED CEMENT CONCRETE					
100	11CS.5.22	11CS.5.22	Steel reinforcement for R.C.C. work including straightening, cutting,bending, placing in position and binding all complete upto plinth level.					
101	11CS.5.22.6	11CS.5.22.6	Thermo-Mechanically Treated bars of grade Fe-500D or more.	Kg	65000.000	INR	86.00	5,590,000.00
102	11CS.5.22A	11CS.5.22A	Steel reinforcement for R.C.C. work including straightening, cutting,bending, placing in position and binding all complete above plinth level.					
103	11CS.5.22A.6	11CS.5.22A.6	Thermo-Mechanically Treated bars of grade Fe-500D or more.	Kg	83200.000	INR	86.00	7,155,200.00
104	11CS.5.28	11CS.5.28	Providing and fixing in position 12mm thick bitumen impregnatedfiber board conforming to IS: 1838, including cost of primer, sealing compound Grade-A in expansion joints.	per cm depth per 100m	65.000	INR	521.00	33,865.00

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
105	11CS.5.33	11CS.5.33	Providing and laying in position ready mixed or site batched design mix cement concrete for reinforced cement concrete work; using coarse aggregate and fine aggregate derived from natural sources, Portland Pozzolana/ Ordinary Portland/ Portland Slag cement, admixture in recommended proportions as per IS: 9103 to accelerate/retard settingof concrete, to improve durability and workability without impairing strength; Including pumping of concrete to site of laying, curing, carriage for all leads; but excluding the cost of centering, shuttering, finishing and reinforcement as per the direction of engineer-in-charge, for the following grade of concrete.(Note: Extra cement up to 10% of the minimum specified cement content in design mix shall be paid separately.In case the cement content in design mix is more than 110% of the specified minimum cement content, the contractor shall have discretion to either re-design the mix or bear the cost extra cement.)					
106	11CS.5.33.1	11CS.5.33.1	All works upto plinth level					
107	11CS.5.33.1.2	11CS.5.33.1.2	Concrete of M30 grade with minimum cement content of 350 kg/cum	cum	1300.000	INR	7,671.00	9,972,300.00
108	11CS.5.33.2	11CS.5.33.2	All works above plinth level upto floor V level					
109	11CS.5.33.2.2	11CS.5.33.2.2	Concrete of M30 grade with minimum cement content of 350 kg/cum	cum	104.000	INR	7,954.00	827,216.00
110	11CS.5.33A	11CS.5.33A	Providing and laying in position ready mixed or site batched design mix cement concrete for reinforced cement concrete work; using coarse aggregate and fine aggregate derived from natural sources and using recycled concrete aggregate (RCA) as coarse aggregate and fine aggregate within permissible utilization of 20% each, Portland Pozzolana / Ordinary Portland / Portland Slag Cement, admixtures in recommended proportions as per IS: 9103 to accelerate / retard setting of concrete, to improve durability and workability without impairing strength; including pumping of concrete to site of laying, curing, carriage for all leads; but excluding the cost of centering, shuttering, finishing and reinforcement as per directions of engineer-in-charge; for the following grades of concrete.(Note: Extra cement up to 10% of the minimum specified cement content in design mix shall be payable separately. In case the cement content in design mix is more than 110% of the specified minimum cement content, the contractor shall have discretion to either re-design the mix or bear the cost of extra cement.)					
111	11CS.5.33A.1	11CS.5.33A.1	All works upto plinth level					
112	11CS.5.33A.1.1	11CS.5.33A.1.1	Concrete of M25 grade with minimum cement content of 330 kg/cum	cum	1.000	INR	7,416.00	7,416.00
113	11CS.5.33A.2	11CS.5.33A.2	All works above plinth level upto floor V level					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. : 0								
SOR No. : C098-000-81-41-CD-SOR-8105-0-0M			**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title: BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL								
114	11CS.5.33A.2.1	11CS.5.33A.2.1	Concrete of M25 grade with minimum cement content of 330 kg/cum	cum	1.000	INR	7,698.00	7,698.00
115	11CS.5.35	11CS.5.35	Add for using extra cement in the items of design mix over and abovethe specified cement content therein.	quintal	44.000	INR	583.00	25,652.00
116	11CS.5.9	11CS.5.9	Centering and shuttering including strutting, propping etc. and removalof form for :					
117	11CS.5.9.1	11CS.5.9.1	Foundations, footings, bases of columns, etc. for mass concrete	sqm	858.000	INR	312.00	267,696.00
118	11CS.5.9.2	11CS.5.9.2	Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.	sqm	4160.000	INR	669.00	2,783,040.00
119	11CS.5.9.3	11CS.5.9.3	Suspended floors, roofs, landings, balconies and accessplatform	sqm	546.000	INR	737.00	402,402.00
120	11CS.5.9.5	11CS.5.9.5	Lintels, beams, plinth beams, girders, bressumers and cantilevers	sqm	156.000	INR	585.00	91,260.00
121	11CS.5.9.6	11CS.5.9.6	Columns, Pillars, Piers, Abutments, Posts and Struts	sqm	312.000	INR	764.00	238,368.00
122	11CS.6	11CS.6	MASONRY WORK					
123	11CS.6.1	11CS.6.1	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth in:					
124	11CS.6.1.1	11CS.6.1.1	Cement mortar 1:4 (1 cement : 4 coarse sand)	cum	26.000	INR	5,856.00	152,256.00
125	11CS.6.1.2	11CS.6.1.2	Cement mortar 1:6 (1 cement : 6 coarse sand)	cum	1.000	INR	5,666.00	5,666.00
126	11CS.6.38	11CS.6.38	Providing and laying autoclaved aerated cement blocks masonry with 100 mm thick AAC blocks in super structure above plinth level up to floor V level in cement mortar 1:4 (1 cement : 4 coarse sand). The rate includes providing and placing in position 2 Nos 6 mm dia M.S. bars at every third course of masonry work.	cum	1.000	INR	8,100.00	8,100.00
127	11CS.6.4	11CS.6.4	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure above plinth level up to floor V level in all shapes and sizes in :					
128	11CS.6.4.1	11CS.6.4.1	Cement mortar 1:4 (1 cement : 4 coarse sand)	cum	68.000	INR	7,424.00	504,832.00
129	11CS.6.4.2	11CS.6.4.2	Cement mortar 1:6 (1 cement : 6 coarse sand)	cum	1.000	INR	7,235.00	7,235.00
130	11CS.6.47	11CS.6.47	Providing and laying autoclaved aerated cement blocks masonry with 150mm/230mm/300 mm thick AAC blocks in super structure above plinth level up to floor V level with RCC band at sill level and lintel level with approved block laying polymer modified adhesive mortar all complete as per direction of Engineer-in-Charge. (The payment of RCC band and reinforcement shall be made for seperately).	cum	1.000	INR	6,621.00	6,621.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-41-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / STRUCTURAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
131	11CS.6.7	11CS.6.7	Providing half brick masonry with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in cement mortar 1:3 (1 Cement : 3 coarse sand) in superstructure for closing cavity 5 to 7.5 cm wide in cavity wall complete with 10cm / 11.4 cm wide bitumen felt type 3	metre	1.000	INR	239.00	239.00
							SOR (C098-000-81-41-CD-SOR-8105-0-0M) Total :INR	**53331370.70**
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
1	01GC	01GC	GENERAL CIVIL					
2	01GC.15	01GC.15	MISC. CIVIL AND STRUCTURAL WORKS FOR U/G PIPING AND OTHER CIVIL WORKS					
3	01GC.15.10	01GC.15.10	Providing and laying plain cement concrete of Nominal Mix 1:5:10 with 20mm and down size graded stone aggregates for all depths below and upto plinth level in foundations, manholes, pipe sleepers, culverts, pipe beds, pipe encasements or any other place, including tamping, ramming vibrating, curing all as specified in any shape, position, thickness and finishing the top surface rough or smooth, etc. all complete as per drawings, specifications and direction of Engineer-in-Charge. (Excluding the cost of shuttering)					
4	01GC.15.10.2	01GC.15.10.2	All materials including cement supplied by the Contractor.	m^3	34.000	INR	6,120.00	208,080.00
5	01GC.2	01GC.2	Compound wall/ Chain Link Fencing/ Barbed wire fencing works					
6	01GC.2.2	01GC.2.2	Supplying, fabricating and fixing in position structural steel line posts, straining posts, struts for 'Y' shaped overhang etc. conforming to E250 grade of IS:2062 for barbed wire/ chain link fencing or over brick/stone Masonry/ RCC compound walls/ columns, cutting to required size as per drawings and specifications, welding where necessary, embedding in position, holding to correct level and line, any auxiliary structure for dummy supports, drilling holes and painting as per painting specification attached with tender, cutting brick/rubble/concrete surfaces if necessary, grouting with M20 grade concrete including cost of grout with all labour and material etc. complete as per drawings, specifications and directions of Engineer-in-Charge.(All materials including cement shall be supplied by contractor)					
7	01GC.2.2.1	01GC.2.2.1	For Plant Location Industrial	MT	0.390	INR	110,000.00	42,900.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
8	01GC.2.3	01GC.2.3	Providing and laying plain cement concrete of M20 grade with 20 mm and down size graded stone aggregates on top of compound wall or at any other place as directed for copping etc. including laying in alternate panels, in slope if required, leaving pockets, shuttering the edges including tamping, curing, finishing the top surface rough or smooth etc. complete for all depths and heights as per drawings and specifications and direction of Engineer-in-Charge. (All materials including cement shall be supplied by contractor.)	m^3	1.000	INR	12,590.00	12,590.00
9	01GC.2.MA04	01GC.2.MA04	Supplying and Fixing of High-Security Razor Blade Fencing Panel in MS Mesh consisting of diamond-pattern welded MS mesh integrated with razor blade reinforcement, complete in all respects as per approved drawings and site requirements at all levels and locations. The fencing panel shall be approximately 610 ± 10 mm height, with length as per site condition. The mesh shall have 100 × 200 mm nominal openings fabricated from 3 mm thick MS wire, integrated with 0.60 mm thick razor blade/concertina profile at a density of approximately 324 razor blades per panel. The entire assembly shall be hot-dip galvanized with minimum 60 micron zinc coating thickness for superior corrosion resistance. The rate shall include cost of complete assembly including mesh, razor blades, clips, staging, tools & tackles, transportation, labour, installation, alignment, and all incidental works complete as per approved sample and direction of Engineer-in-Charge.	sqm	458.000	INR	5,213.00	2,387,554.00
10	01GC.2.MA05	01GC.2.MA05	Supply and Fixing of Double C-Channel Mesh Fixing Assembly for High-Security Razor Blade Fencing, fabricated from MS E250 grade steel, comprising 2 Nos. formed MS C-Channels (3 mm thick) welded together and mounted over a 6 mm thick MS base plate suitable for anchoring/grouting. The length of assembly shall be designed to accommodate approximately 610 mm high razor mesh panel and stone coping thickness of approximately 125 mm, with provision for inclined fixing suitable for installation over boundary wall at all levels and locations. Each assembly shall include 4 Nos. M6 rivet nuts for mesh locking, all required fasteners and anchor fasteners, along with concertina wire/razor blade welded along the joint face of the assembly, as per approved drawings. The complete assembly shall include fabrication, cutting, bending, welding, grinding, finishing, and fixing complete in all respects as per approved sample and approved drawings/shop drawings. The entire assembly shall be hot-dip galvanized for corrosion resistance. The rate shall include cost of complete assembly including base plate, double C-channel, rivet nuts, anchor fasteners, all fixtures and fittings, labour, staging, tools & tackles, transportation, erection, and installation complete as per approved sample and direction of Engineer-in-Charge.	Set	270.000	INR	1,026.00	277,020.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
11	01GC.2.MA06	01GC.2.MA06	Supply and Fixing of Single C-Channel Mesh Fixing Assembly for High-Security Razor Blade Fencing, fabricated from MS E250 grade steel, comprising 1 No. formed MS C-Channel (3 mm thick) fixed with suitable mounting arrangement and 6 mm thick MS base plate for anchoring/grouting. The length of assembly shall be designed to accommodate approximately 610 mm high razor mesh panel and stone coping thickness of approximately 125 mm, with provision for inclined fixing suitable for installation over boundary wall at all levels and locations. Each assembly shall include 2 Nos. M6 rivet nuts for mesh locking, all required fasteners and anchor fasteners, along with concertina wire/razor blade welded along the joint face of the assembly, as per approved drawings. The complete assembly shall include fabrication, cutting, bending, welding, grinding, finishing, and fixing complete in all respects as per approved sample and approved drawings/shop drawings. The entire assembly shall be hot-dip galvanized for corrosion resistance. The rate shall include cost of complete assembly including base plate, single C-channel, rivet nuts, anchor fasteners, all fixtures and fittings, labour, staging, tools & tackles, transportation, erection, and installation complete as per approved sample and direction of Engineer-in-Charge.	Set	30.000	INR	723.00	21,690.00
12	01GC.2.MA07	01GC.2.MA07	Supply and Installation of Mesh Clamping Element / Centre Clamp for High-Security Razor Blade Fencing, fabricated from MS E250 grade steel, consisting of specially formed and bent MS clamping bracket of suitable size (approximately 6 mm thick) for securely holding the razor mesh panel in position. The clamp shall be provided with 1 No. M6 rivet nut for mesh locking along with required fasteners and fixing accessories complete as per approved drawings and samples. The complete assembly shall include fabrication, cutting, bending, welding, grinding, finishing, and fixing complete in all respects as per approved sample and approved drawings/shop drawings. The entire assembly shall be hot-dip galvanized for corrosion resistance. The rate shall include cost of complete assembly including clamping element, rivet nuts, fasteners, fixtures, labour, staging, tools & tackles, transportation, erection, and installation complete as per approved sample and direction of Engineer-in-Charge.	Set	300.000	INR	236.00	70,800.00
13	01GC.22	01GC.22	PLUMBING AND BUILDING DRAINAGE					
14	01GC.22.1	01GC.22.1	Supplying and fixing approved quality heavy grade cast iron Floor/Nahani Trap with CP pressed steel grating including cutting floors and making good the same, etc., making inlet and outlet connections, etc. complete for 100mm inlet and 100mm outlet as per drawings, specifications and directions of Engineer-in-Charge.	each	5.000	INR	1,533.00	7,665.00

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Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
15	01GC.22.11	01GC.22.11	Supplying, laying and jointing of above ground approved quality UPVC pipes to be used for ventilating and rain water application inside buildings confirming to IS:13592 (Type-A) and fittings confirming to IS: 14735 with all necessary specials such as bends, Y junction, T junction (both single and double) plugs, coupler, adapter, shoes, vent cowls etc. including solvent welded jointing and testing as per IS: 7634 (Part-3), cutting floors/walls and making good the same after fixing including supply and fixing hooks/ clamps etc. complete as per drawings, specifications and directions of Engineer-in-Charge. For the following Nominal Bore (NB) pipe:					
16	01GC.22.11.1V1	01GC.22.11.1V1	Nominal Dia. 160 mm	m	3.000	INR	1,338.00	4,014.00
17	01GC.22.11.1V5	01GC.22.11.1V5	Nominal Dia. 110 mm	m	3.000	INR	608.00	1,824.00
18	01GC.22.12	01GC.22.12	Supplying, laying and jointing of above ground approved quality UPVC pipes to be used for soil and waste discharge application inside buildings confirming to IS:13592 (Type-B) and fittings confirming to IS: 14735 with all necessary specials such as bends, Y junction, T junction (both single and double) plugs, coupler, adapter, shoes etc. including solvent welded jointing and testing as per IS: 7634 (Part-3), cutting floors/walls and making good the same after fixing including supply and fixing hooks/ clamps etc. complete as per drawings, specifications and directions of Engineer-in-Charge. For the following Nominal Bore (NB) pipe:					
19	01GC.22.12.1	01GC.22.12.1	(All materials including cement supplied by contractor)					
20	01GC.22.12.1.1V2	01GC.22.12.1.1V2	Nominal Dia. 75 mm	m	3.000	INR	635.00	1,905.00
21	01GC.22.12.1.1V4	01GC.22.12.1.1V4	Nominal Dia. 110 mm	m	3.000	INR	941.00	2,823.00
22	01GC.22.13	01GC.22.13	Supplying, laying and jointing of underground approved quality UPVC pipes to be used for soil and waste discharge application inside buildings confirming to IS:13592 (Type-B) and fittings confirming to IS: 14735 with all necessary specials such as bends, Y junction, T junction (both single and double), plugs, coupler, adapter etc. including solvent welded jointing and testing as per IS: 7634 (Part-3), cutting in floors, earth work in excavation, encasing the pipe in 50mm thick PCC M20, backfilling and disposal of surplus earth / debris to demarcated area anywhere within plant complex limit etc. complete as per drawings, specifications and directions of Engineer-in-Complete. For the following Nominal Bore (NB) pipe:					
23	01GC.22.13.1	01GC.22.13.1	(All materials including cement supplied by contractor)					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. : 0								
SOR No. : C098-000-81-45-CD-SOR-8105-0-2M			**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title: BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL								
24	01GC.22.13.1.1 V1	01GC.22.13.1.1V 1	Nominal Dia. 75 mm	m	21.000	INR	762.00	16,002.00
25	01GC.22.13.1.1 V3	01GC.22.13.1.1V 3	Nominal Dia. 160 mm	m	3.000	INR	1,970.00	5,910.00
26	01GC.22.13.1.1 V4	01GC.22.13.1.1V 4	Nominal Dia. 110 mm	m	21.000	INR	1,130.00	23,730.00
27	01GC.22.2	01GC.22.2	Supplying and fixing approved quality heavy grade cast iron Floor/Nahani Trap with CP pressed steel grating including cutting floors and making good the same, etc., making inlet and outlet connections, etc. complete for 100mm inlet and 75mm outlet as per drawings, specifications and directions of Engineer-in-Charge.	each	3.000	INR	1,427.00	4,281.00
28	01GC.22.23	01GC.22.23	Preparation of internal building plumbing and sanitary piping layouts for building as per National Building Code/ Relevant IS codes and getting the same approved by Owner/ PMC.					
29	01GC.22.23.1V111	01GC.22.23.1V111	Building Name Watch Tower	each	3.000	INR	33,000.00	99,000.00
30	01GC.22.MA26	01GC.22.MA26	Supplying, Installing, Testing and Commissioning of Pressure reducing valves of bronze body, food grade rubber diaphragm, with double female ends, pressure adjusting screw head, pressure gauge connections on both sides of the valves etc, complete. The quoted rate shall also include for 2 nos. pressure gauge.					
31	01GC.22.MA26.01	01GC.22.MA26.01	25mm dia	each	1.000	INR	2,293.00	2,293.00
32	01GC.22.MA26.02	01GC.22.MA26.02	40mm dia	each	1.000	INR	3,039.00	3,039.00
33	01GC.22.MA27	01GC.22.MA27	Supplying, installing, testing and commissioning of approved make electrically operated solenoid valve with level controllers to be fixed in the OHT. The cost of valve shall also include necessary level switches, wiring upto control panel at terrace level, control panel, etc., all complete .					
34	01GC.22.MA27.01	01GC.22.MA27.01	25mm dia	each	1.000	INR	5,278.00	5,278.00
35	01GC.22.MA27.02	01GC.22.MA27.02	40 mm dia	each	1.000	INR	7,411.00	7,411.00
36	01GC.26	01GC.26	MISCELLANEOUS ITEMS					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. : 0								
SOR No. : C098-000-81-45-CD-SOR-8105-0-2M			**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title: BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL								
37	01GC.26.1	01GC.26.1	Laying of Random Rubble Masonry in Cement Mortar 1:6 (1 cement: 6 coarse sand) in any shape and thickness for compound wall, toe walls, drains, or at any other places as directed including providing recesses, openings, scaffolding, staging, raking out joints, curing etc. by using stone rubble 150mm to 300mm size available within complex limit, transportation to work site including handling, all leads and lifts within complex limit, using at required locations, dressing of stones, etc. all complete as per drawings, specifications and directions of Engineer-in-Charge.					
38	01GC.26.1.3	01GC.26.1.3	At all depths below and upto and inclusive of plinth level. (All materials including cement supplied by contractor)	m^3	1.000	INR	6,250.00	6,250.00
39	01GC.26.1.4	01GC.26.1.4	At all heights above plinth level. (All materials including cement supplied by contractor)	m^3	1.000	INR	7,240.00	7,240.00
40	01GC.26.6	01GC.26.6	Supplying & laying random rubble pitching 225mm thick in 1:6 cement mortar (1 cement: 6 coarse sand) in one layer for embankments, road side slopes, holding ponds bunds, drains, channels or at any other place as directed including cost of stones, all royalties &taxes, transportation to site with all leads and lifts, dressing, preparation of sub grade for pitching, flush pointing in 1:4 cement mortar (1 cement: 4 sand), curing etc. complete as per drawings, specifications and directions of Engineer-in-Charge.					
41	01GC.26.6.3	01GC.26.6.3	On horizontal surfaces(All materials including cement supplied by contractor)	m^2	26.000	INR	1,450.00	37,700.00
42	01GC.26.6.4	01GC.26.6.4	On sloped surfaces (All materials including cement supplied by contractor)	m^2	26.000	INR	1,600.00	41,600.00
43	01GC.32	01GC.32	Dismantling works					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
44	01GC.32.12	01GC.32.12	Removal of existing U/G RCC piping including excavation in all types of soils except soft rock and hard rock, including supply of any additional material required so as to expose the pipes for removal / dismantling, dewatering of surface / sub-surface water as required to facilitate dismantling of pipes, cutting of pipes in appropriate lengths for transporting purpose, removal of soft material from bottom of trench and compacting, backfilling with available selected earth including re-excavating the deposited soil excavated earlier, breaking clods, laying in thickness not exceeding 15cms, watering rolling and ramming by manual methods / mechanical Compactors to achieve 90% laboratory maximum dry density as per IS:2720 Part VII or 85% relative density as per IS:2720 part XIV as applicable, stacking of serviceable / unserviceable material, transporting and stacking of all piping material to Owner's storage point, disposal of unserviceable material anywhere outside the complex etc. , all complete as per directions of Engineer-in-Charge.(Disposal areas shall be arranged by the contractor at his own cost. The rate quoted shall include all royalties, right-of-way etc. complete.) For the following pipe diameter range.					
45	01GC.32.12.1	01GC.32.12.1	For pipe diameter ranging from 300mm to 600 mm	m	3.000	INR	2,880.00	8,640.00
46	01GC.32.12.2	01GC.32.12.2	For pipe diameter ranging from 600mm to 1000 mm	m	3.000	INR	5,120.00	15,360.00
47	01GC.32.12.3	01GC.32.12.3	For pipe diameter ranging from 1000mm to 1400 mm	m	3.000	INR	7,680.00	23,040.00
48	01GC.32.12.4	01GC.32.12.4	For pipe diameter less than 300mm	m	3.000	INR	960.00	2,880.00
49	01GC.32.8	01GC.32.8	Dismantling of Barbed Wire					
50	01GC.32.8.1	01GC.32.8.1	Dismantling of existing Barbed wire (taking all necessary safety precautions) including supply of all tools & tackles, necessary scaffolding, consumables, cutting of fixing hooks,making rolls, transporting , stacking at designated area/ Oner's store anywhere within plant complex limit etc. all complete for all levels, leads as specified and directed by Engineer-in-Charge .	m	52.000	INR	13.00	676.00
51	01GC.41	01GC.41	Supply, fabrication and Erection of piping(underground)					
52	01GC.41.2	01GC.41.2	Under Ground Sewer System - UPVC Pipe					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
53	01GC.41.2.1	01GC.41.2.1	Supplying, laying and jointing of underground approved quality UPVC pipes to be used for soil and waste discharge or rain water application outside buildings confirming to IS: 15328 and fittings confirming to IS: 14735 with all necessary specials such as bends, Y junction, T junction (both single and double), plugs, coupler, adapter etc. including solvent welded jointing and testing as per IS: 7634 (Part-3), including earthwork in excavation in all types of soil excluding soft rock and hard rock for pipe trenches/ saddle, etc. including dewatering, shoring and strutting if necessary, dressing of sides, leveling, grading and ramming of bottoms, cutting the pipes to required lengths, lowering the pipes to proper grade and alignment, jointing, including connecting the pipes to manholes by using concrete manhole adapters and grouting the pipe body with manhole wall using cement mortar 1:2 (1cement : 2 sand), testing, draining of water and cleaning of pipe after testing, backfilling the trenches with select material from available excavated soil including re excavating the deposited soil excavated earlier breaking clods and laying in layers of 15cm compacted thickness , watering and compacting with mechanical means like vibro rammers etc. to 90% standard proctor density as per IS:2720 Part-VII or 85% relative density as per IS: 2720 Part XIV as applicable, including cutting of roads wherever required and making good the same, disposal of surplus earth/ unserviceable material to demarcated area anywhere within the complex limit etc. complete for all depths as per drawings, specifications and instructions of Engineer-in-Charge. For the following Nominal Bore (NB) pipe: (Depth of excavation for pipe trench shall be upto 3.0m)					
54	01GC.41.2.1.2	01GC.41.2.1.2	(All materials including cement supplied by contractor)					
55	01GC.41.2.1.2.1 V10	01GC.41.2.1.2.1V 10	Nominal Dia. 250 mm	m	26.000	INR	2,900.00	75,400.00
56	01GC.41.2.1.2.1 V3	01GC.41.2.1.2.1V 3	Nominal Dia. 200 mm	m	52.000	INR	2,320.00	120,640.00
57	01GC.5	01GC.5	SITE GRADING & ROCK CUTTING FOR SITE GRADING					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
58	01GC.5.41	01GC.5.41	Earthwork in filling with approved soil for all heights and depths for any lead within the plant boundary for general site grading and any other place as directed to proper level, grade and camber with available excavated soil deposited earlier within plant boundary including, re-excavating the deposited soil excavated earlier including clearing and stripping in filling areas, cutting of trees of girth upto and inclusive of 30 cms (girth measured at a height of 1.0M above ground level) including uprooting of roots,compacting the exposed natural soil to 90% of max. laboratory dry density as per IS:2720 Part-VII etc. breaking clods, spreading in layers not exceeding 30 cms loose thickness, watering, ramming and compacting with power roller to give at least 90% of maximum laboratory dry density as per IS:2720 Part-VII of soil, dressing, leveling, testing, including disposing the unserviceable materials anywhere outside plant boundary limit, (Disposal areas to be arranged by contractor) all complete as per drawings, specifications and directions of the Engineer-in-Charge.	m^3	260.000	INR	197.00	51,220.00
59	01GC.5.48	01GC.5.48	Earthwork in excavation and filling in all types of soil except soft rock and hard rock for general site grading for all heights and depths including clearing and stripping etc. in excavation areas, removing shrubs, grass, bushes, vegetable growth and other objectionable materials, trees upto and inclusive of a girth of 30 cms. (girth measured at a height of one metre above ground level) including uprooting of roots, etc., dewatering, if necessary, sorting out the excavated soil into serviceable and unserviceable materials in excavation areas and including filling in filling areas with serviceable material for general site grading and roads for all heights and depths to proper levels, slopes, grades and camber including clearing and stripping in filling areas as per specifications, compacting exposed natural soil to 90% of max. laboratory dry density as per IS:2720 Part-VII, cutting of trees of girth upto and inclusive of 30 cms, removal of vegetation, breaking clods, spreading in layers not exceeding 30 cms loose thickness, watering, ramming and compacting with power road rollers to give at least 90% of max. laboratory dry density, dressing, leveling, testing, etc. disposal of unserviceable materials outside the plant boundary limit as directed by Engineer-in- Charge. (The leads for the above mentioned operations shall be within the boundary limit of the plant and measurement shall be taken in the cutting area only. Disposal areas shall be arranged by Contractor at his own cost. The rate quoted shall include all royalties, right-of-way etc. complete.)	m^3	1690.000	INR	223.00	376,870.00

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Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
60	01GC.5.51	01GC.5.51	Earthwork in filling with borrow earth for all heights and depths for site grading or at any other place as directed to proper levels, slopes, grades and camber with selected earth obtained from approved borrow areas for all leads from Complex Limit including excavation of earth at borrow areas, clearing and stripping at borrow areas (if necessary),loading, unloading, transportation etc. clearing and stripping at filling areas, cuttig of trees of girth upto and inclusive of 30cm (girth measured at a height of 1.0 M above ground level) including uprooting of vegetation, roots and disposal of the shrubs, bushes, roots etc., consolidating exposed natural soil to 90% of maximum laboratory dry density as per IS:2720 Part-VII, breaking clods, spreading in layers not exceeding 30 cm loose thickness, watering, ramming and compacting with road roller to give at least 90% of max. laboratory dry density as per IS:2720 Part-VII, testingthe degree of consolidation, dressing and leveling, etc. complete, including disposal of all unserviceable materials if any beyond the plant boundary limits for all leads etc., as per drawings, specifications and directions of Engineer-in-Charge. (Borrow/ disposal areas shall be arranged by Contractor at his own cost. The rate quoted shall include all royalties, right-of-way etc. complete).	m^3	130.000	INR	420.00	54,600.00
61	01GC.6	01GC.6	ROADS & FLEXIBLE PAVEMENT (UPTO WBM/WMM LAYER)					
62	01GC.6.17	01GC.6.17	Earthwork in filling with borrow earth for all heights and depths for road embankments, shoulders or any other place as directed to proper levels, slopes, grades and camber with selected earth (having CBR 8%) obtained from approved borrow areas for all leads from Complex Limit including excavation of earth at borrow areas, clearing and stripping at borrow areas (if necessary) loading, unloading, transportation etc., clearing and stripping as per specifications, uprooting of vegetation, roots and disposal of the shrubs, bushes, roots etc., breaking clods, spreading in layers not exceeding 20 cm loose thickness, watering, ramming and compacting with road roller to give at least 97% of laboratory dry density with heavy compaction as per IS:2720 Part-VIII, providing testing apparatus and testing the degree of consolidation, dressing and leveling, etc. complete including disposal of all unserviceable materials if any beyond the boundary limit for all leads etc. as per drawings, specifications and directions of Engineer-in- Charge. (Borrow areas shall be arranged by Contractor at his own cost. The rate quoted shall include all royalties, right-of-way etc. complete)	cum	26.000	INR	420.00	10,920.00

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Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
63	01GC.6.18	01GC.6.18	Supplying and laying of stone aggregate of 53mm and down size for GRANULAR SUB-BASE COURSE (conforming to the Grading II of Table 400-1 and physical properties of Table 400-2 of MORTH Specification of Road & Bridge works) tough, sound, clean and durable including cost of stone aggregate, all royalties, taxes, handling, transportation to site, unloading the same by the side of road with all leads and lifts, spreading and laying to form Granular Sub-base layer in layers not exceeding 100mm compacted thickness to proper grade, camber and level, filling voids with screenings and binding the surface with binding material of plasticity index up to 6% including cost of supply of screening and binding material, consolidating with power driven road roller, watering, with all leads and lifts including preparation of camber below first layer etc. complete as per drawings, specifications (MORTH, EIL) and directions of Engineer-in-Charge.	m^3	354.000	INR	2,710.00	959,340.00
64	01GC.6.19	01GC.6.19	Supplying and Laying of Wet Mix Macadam (WMM) in BASE COURSE (Section 406 of MORTH Specification of Road & Bridge works) using tough, clean, sound & durable stone aggregates including premixing the material (mixing in Plug Mill/ Pan Type Mixer), including transportation to site, laying & spreading in layers not exceeding 125 mm compacted thickness & rolling with vibratory roller 80-100 KN static weight or equivalent capacity to proper grade, camber & level with all leads & liftsetc. complete as per drawing, specifications (MORTH, EIL) & directions of Engineer-in-Charge.	cum	354.000	INR	2,800.00	991,200.00
65	01GC.6.8	01GC.6.8	Supplying and laying of stone aggregate of 90mm down to 45mm size for SUB-BASE COURSE tough, sound, clean and durable including cost of stone aggregate, all royalties, taxes, handling, transportation to site, unloading the same by the side of road with all leads and lifts, spreading and laying to form water bound macadam in one layer of 100mm compacted thickness to proper grade, camber and level, filling voids with screenings and binding the surface with binding material of plasticity index upto 6% including cost of supply of screening and binding material, consolidating with power driven road roller, watering, with all leads and lifts including preparation of camber below first layer etc. complete as per drawings, specifications and directions of Engineer-in-Charge.	m^2	26.000	INR	260.00	6,760.00
66	01GC.8	01GC.8	FLEXIBLE PAVEMENTS WEARING COURSE and miscellaneous road works					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
67	01GC.8.25	01GC.8.25	Providing and laying at or near ground level factory made kerb stone of M-30 grade cement concrete in position to the required line, level and curvature, jointed with cement mortar 1:3 (1 cement: 3 coarse sand), including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5mm), including making drainage opening wherever required complete etc. as per direction of Engineer-in-charge (length of finished kerb edging shall be measured for payment). (Precast C.C. kerb stone shall be approved by Engineer-in-charge).	m^3	39.000	INR	8,940.00	348,660.00
68	01GC.8.26	01GC.8.26	Supplying & Laying 60mm thick interlocking Paver Blocks for footpath, road shoulder etc. including providing 40 mm thick sand filling below Paver Blocks including compaction of sand layer, filling the joints by dry sand, including preparation of compacted base/ sub base etc. all complete as per drawing, standard, specification and directions of Engineer-in-Charge. (All material including cement supplied by contractor, paver blocks shall confirm to category "A" as per IRC SP63. Colour and shape of paver block shall be as per Owner requirement.).	m^2	1690.000	INR	860.00	1,453,400.00
69	01GC.9	01GC.9	RCC PIPE CULVERTS & ELECTRICAL ROAD CROSSINGS ETC.					
70	01GC.9.1	01GC.9.1	Supplying and laying in position RCC pipes with collars conforming to IS:458 for pipe culverts, cable crossings etc. including cutting the pipe if necessary, lowering, laying in position to proper levels, slopes etc. caulking the joints with spun yarn soaked in neat cement slurry and finishing with cement mortar 1:2 (1 cement : 2 sand) curing etc. all complete as per drawings, specifications and directions of Engineer-in-Charge. For following Class and Internal PIPE DIA (MM)					
71	01GC.9.1.1V17	01GC.9.1.1V17	PIPE CLASS NP2 Internal Pipe dia. 100 mm	m	3.000	INR	510.00	1,530.00
72	01GC.9.1.1V4	01GC.9.1.1V4	PIPE CLASS NP3 Internal Pipe dia. 500 mm	m	3.000	INR	2,640.00	7,920.00
73	01GC.9.1.1V5	01GC.9.1.1V5	PIPE CLASS NP3 Internal Pipe dia. 300 mm	m	3.000	INR	1,660.00	4,980.00
74	01GC.9.1.1V7	01GC.9.1.1V7	PIPE CLASS NP3 Internal Pipe dia. 400 mm	m	3.000	INR	1,950.00	5,850.00
75	01GC.9.2	01GC.9.2	Supplying and laying in position PVC pipes conforming to IS:4985 Class - I for cable crossings, including cutting the pipe if necessary, lowering, laying in position to proper levels, slopes ,providing proper jointing as per code requirements or manufacturers recommendations, sealing the open ends of pipes with removable type PVC cap (Sealing cap will be paid separately under relevant items)etc. all complete as per drawings, specifications and directions of Engineer-in-Charge. For following NOMINAL OUTSIDE PIPE DIA (MM)					
76	01GC.9.2.1V2	01GC.9.2.1V2	Pipe Class PVC Nominal outside pipe dia. 160 mm	m	910.000	INR	820.00	746,200.00

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Part No. :	0							
SOR No. :	C098-000-81-45-CD-SOR-8105-0-2M		**Division/Department :** STRUCTURAL / GENERAL CIVIL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
77	01GC.9.2.1V6	01GC.9.2.1V6	Pipe Class PVC Nominal outside pipe dia. 110 mm	m	26.000	INR	500.00	13,000.00
78	01GC.9.3	01GC.9.3	Supplying and fixing in the encasement concrete, cable crossing indicator, made out of 6mm thick MS circular of dia. 150mm welded to 16mm dia. MS Rod of approximately 1.0M length, painted with 2 coats of approved enamel paint over a coat of red oxide primer etc. complete. (All materials in contractor's scope of supply).	each	21.000	INR	711.00	14,931.00
79	01GC.9.5	01GC.9.5	Construction of ERC/IRC as per Std. no.7-65-0006 including supplying and laying in position PVC pipes conforming to IS:4985 Class-I for electrical and instrumentation Road Crossings as per standard drawing no. 7-65-0006 and its addendum, including cutting the pipes if necessary, lowering, laying in position to proper levels, etc. embedded in M-20 grade RCC, providing proper jointing of pipes as per code requirements or manufacturer's recommendations, etc. including earth work in excavation in all types of soil including soft rock but excluding hard rock, backfilling and making good the surface, including cutting of new/ existing roads and making good the same including supply of any road material if required, (Backfilling shall be done in confirmation to sub grade requirement for road/ road crust sections as per standard no. 7-65-0011/ job drawing for road cross section) , including supplying and providing in the encasement concrete, cable crossing indicator made out of 6 mm thick MS circular plate of dia. 150mm welded to 16 mm dia. MS rod of approximately 1.0 m length and painting and lettering with 2 coats of approved enamel paint of approved colour over a coat of red oxide primer etc., supply and fixing of reinforcement as per drawing, including disposal of surplus earth anywhere within plant boundary limit etc. all complete as per drawings, specifications and instructions of Engineer-in-Charge. (All material including cement and reinforcement bar shall be supplied by Contractor)					
80	01GC.9.5.1V10	01GC.9.5.1V10	Number of Layers 1 nos X Number of Rows 1 nos Pipe dia. 110 mm	m	91.000	INR	1,410.00	128,310.00
							SOR (C098-000-81-45-CD-SOR-8105-0-2M) Total :INR	**8720926.00**
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
1	01AR	01AR	ARCHITECTURE					
2	01AR.10	01AR.10	FALSE CEILING, FALSE FLOORING, UNDERDECK INSULATION, PARTITIONING					

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Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
3	01AR.10.3	01AR.10.3	Providing and fixing Mineral Fibre Tile false ceiling consisting of A. 600mm x 600mm x 15mm thick Mineral Fibre Acoustical tiles with durable tegular edging having noise reduction coefficient (NRC) value of min. 0.50, light reflectance value of min. 80%,thermal conductivity (K) value of 0.052-0.057 w/m deg.C and fire performance conforming to class-I as per BS-476,back of the tiles being provided with one coat of protective coating. B. Suspension system consisting of hot dipped galvanised steel main runners @ max. 1200mm c/c (0.33mm thk.,"T"shaped, 24mm x 38mm size with single rotary stiching), cross runners (0.25mm thk.,"T" shaped with double rotary stiching, 24mm x 30mm size, 1200mm long and 24mm x 25mm size, 600mm long), perimeter sections (0.45mm thick,22mm x 22mm size) including suspending the system by means of 4mm dia MS wire,6mm thk. MS cleat of 25mm x 25mm size, dash fasteners and level adjustors, providing 30 micron powder coating to exposed metallic members, providing slit openings for fixing supply/return air grill, lighting fixtures, AC ducts etc. all complete.					
4	01AR.10.3.1	01AR.10.3.1	With fine fissured tiles (Acoustical punchers (10mm deep) = 24000sm, No. Of fissures (3 to 4mm deep) = 28800sm)	m²	78.000	INR	2,445.00	190,710.00
5	01AR.11	01AR.11	MISCELLANEOUS ITEMS					
6	01AR.11.22	01AR.11.22	1000 mm high satin finish stainless steel (SS 304 grade) tubular railing					
7	01AR.11.22.1	01AR.11.22.1	Supplying, assembling and installing 1000 mm high satin finish stainless steel (SS 304 grade) tubular railing of approved design in staircases, ramps, around floor cut outs etc. consisting of:1. 50mm dia SS pipe top handrail2. 32 mm dia SS pipe balusters (at every third step for staircase, @ maximum 1200mm c/c for ramp, floor cutouts)3. 3 nos minimum 18mm dia SS pipe intermediate handrails.Including:1. Fixing balusters to floor with 4 nos bolts änd 8mm thick, 100mm dia SS base plate & SS cap/collar.2. Fixing top handrail to the balusters with 12mm dia SS bar connector & 6mm thick SS saddle plate.3. Fixing intermediate handrails to the balusters with 12mm dia SS bar connector.4. All end caps, decorative caps over balustrades,necessary bending, welding, polishing of all welded joints (Length of top handrail shall be measured for payment).	RM	107.000	INR	4,800.00	513,600.00
8	01AR.4	01AR.4	STEEL/AL./GLAZED/FULLY GLASS/PVC DOORS,WINDOWS & VENTILATORS					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
9	01AR.4.12	01AR.4.12	Pressed steel sheet door shutterProviding and fixing pressed steel sheet door shutter made of 18 SWG galvanized pressed steel sheet bent to form hollow box of 40 mm overall thickness; and consisting of/ including:(i) 3 mm thick MS flat all along perimeter(ii) Packing the shutter with mineral wool (48 kg/cum) without gap(iii) Strengthening with 18 SWG GI vertical stiffeners @200 c/c(iv) 3 mm thick MS pad plates welded inside at required locations for fixing of hardware etc.(v) Fixing to door frame by 100 mm long SS 304 grade heavy duty ball bearing hinge @600 c/c maximum(vi) Hardware and vision panel as required.(vii) Grinding and smoothening of welding, cleaning, finishing (synthetic enamel painting/ polyurethane (PU) coating/ electrostatic powder coating), making true alignments and surfaces etc. all complete.Notes:1. Reference shall be made to EIL standard nos. 7-75-0070, 7-75-0071Only the net shutter(s) area shall be measured for payment					
10	01AR.4.12.3	01AR.4.12.3	Single shutter painted with Electrostatic powder coating with following hardware: (i) Over head hydraulic door closer (heavy duty).(ii) SS 304 grade 16 mm dia 250mm long aldrop on both sides of shutter.(iii) Spring loaded heavy duty door stopper(iv) SS 304 grade 19 mm dia.200 mm long handle on both side of shutter.(v) 10 mm dia SS 304 tower bolt (250mm long for 2100mm height & 600mm long for 2500mm height)	m^2	1.000	INR	11,684.00	11,684.00
11	01AR.4.14	01AR.4.14	Aluminium work for doors, windows, ventilators and partitionProviding and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) :					
12	01AR.4.14.12	01AR.4.14.12	Providing and fixing double action hydraulic floor spring of approved brand and manufacture conforming to IS : 6315, having brand logo embossed on the body / plate with double spring mechanism and door weight upto 125 kg, for doors, including cost of cutting floors, embedding in floors as required and making good the same matching to the existing floor finishing and stainless steel cover plate of minimum thickness 1.25 mm with brass pivot and single piece M.S. sheet outer box with slide plate etc. complete as per the direction of Engineer-in-charge.	each	7.000	INR	2,310.00	16,170.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
13	01AR.4.14.31	01AR.4.14.31	Providing and fixing toughened glass panes of 6.0 mm thickness in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber/ neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge. (Cost of aluminium snap beading shall be paid in basic item)	m²	169.000	INR	1,620.00	273,780.00
14	01AR.4.14.MB14	01AR.4.14.MB14	MISCELLANEOUS - STEEL/AL./GLAZED/FULLY GLASS/PVC DOORS, WINDOWS & VENTILATORS					
15	01AR.4.14.MB14.01	01AR.4.14.MB14.01	Providing and fixing single glazing of 6 mm thickness toughened high performance glass with VLT34 , SHGC 0.34 & U value 3.1 wm2k US summer , internal reflection 8 and external reflection 23 in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of Engineer-in-charge . (Cost of aluminium snap beading shall be paid in basic item):	sqm	3.000	INR	2,220.00	6,660.00
16	01AR.4.14.MB14.02	01AR.4.14.MB14.02	Providing & Fixing SS304 Ball bearing Flush Hinge of size 127mm x 3mm with necessary screws for glazed doors all complete per specifications and direction of Enigneer In Charge.	each	3.000	INR	553.00	1,659.00
17	01AR.4.14.MB14.03	01AR.4.14.MB14.03	Providing and fixing stainless steel SS 304 ball bearing butt hinges of size 102 mm x 76 mm x 3 mm with metal / timber stainless steel screws etc. complete	each	18.000	INR	338.00	6,084.00
18	01AR.4.14.MB14.04	01AR.4.14.MB14.04	Providing and fixing stainless steel 304 Grade Mortise lock sets, with 60 mm Euro profile cylinder, necessary accessories, SS. screws etc. all complete.					
19	01AR.4.14.MB14.04.1	01AR.4.14.MB14.04.1	Locks with 55 mm backset	each	7.000	INR	2,995.00	20,965.00
20	01AR.4.14.MB14.05	01AR.4.14.MB14.05	Supplying , providing and fixing Stainless steel SS 304 satin finish surface mounted tower bolt with necessary screws as required all complete as per specifications and direction of Engineer-In-Charge.					
21	01AR.4.14.MB14.05.1	01AR.4.14.MB14.05.1	150 mm long	Set	3.000	INR	338.00	1,014.00
22	01AR.4.14.MB14.05.2	01AR.4.14.MB14.05.2	300 mm long	Set	8.000	INR	628.00	5,024.00
23	01AR.4.14.MB14.06	01AR.4.14.MB14.06	Providing and fixing Stainless steel 304 Grade handle of approved make, type, finish and size, including SS screws, accessories etc. including making holes of required size in shutter etc. all complete as per drawing, specifications and direction of Engineer-in-Charge.					
24	01AR.4.14.MB14.06.1	01AR.4.14.MB14.06.1	Pair of 22mm dia D type Pull Handle of size 300mm (centre to centre), Finish: Satin	Set	3.000	INR	966.00	2,898.00
25	01AR.4.14.MB14.06.2	01AR.4.14.MB14.06.2	Pair of 25mm dia D type Pull Handle of size 450mm (centre to centre), Finish : Satin	Set	7.000	INR	1,449.00	10,143.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
26	01AR.4.14.MB14.07	01AR.4.14.MB14.07	Providing and fixing SS 304 door stopper with necessary screws etc. complete					
27	01AR.4.14.MB14.07.1	01AR.4.14.MB14.07.1	Half dome floor mounted door stoppe	each	7.000	INR	121.00	847.00
28	01AR.4.14.MB14.07.2	01AR.4.14.MB14.07.2	Wall mounted door stopper	each	3.000	INR	396.00	1,188.00
29	01AR.4.14.MB14.08	01AR.4.14.MB14.08	Providing and fixing SS 304 kick plate of size 750 mm x 300 mm 1.2 mm with necessary screws etc. complete	each	3.000	INR	7,674.00	23,022.00
30	01AR.4.15	01AR.4.15	P/F pressed steel door and window framesProviding and fixing pressed steel door and window frames of size (assorted size out of) Overall 125mm x 60mm section, of required profile conforming to IS: 4351, made of 16 SWG pressed steel including/ consisting of:i)3 mm thick MS flat spacers welded to frame @ 500mm c/c and at holdfast locations.ii)Filling the hollow frame section with concrete. iii)MS angle (20mmx20mmx3mm) horizontal tie member below floor finish.iv)MS holdfasts (200mmx25mmx6mm) welded to spacers.v)Fixing to masonry (by grouting the holdfasts with M-15 grade concrete in minimum 250mm x 100mm x 100mm sized hole)/ fixing to RCC (by minimum 100mm long, 12 mm dia metallic counter sunk anchor fasteners) vi)MS pad plates (40mm x 150mm x 3mm) & GI mortar guard welded to frame at hinge and other hardware locations.vii)Metering of joints between horizontal and vertical members, grinding and smoothening of welding, cleaning of frame surface, finishing (synthetic enamel painting/ electrostatic powder coating/ polyurethane (PU) coating), making true alignments and surfaces etc. all complete.Notes:1)Reference shall be made to EIL standard nos. 7-75- 0070, 7-75-00712)Cumulative length of all horizontal and vertical frame members shall be measured for payment.					
31	01AR.4.15.5	01AR.4.15.5	Frames painted with Electrostatic Powder coating.	m	10.000	INR	1,784.00	17,840.00
32	01AR.4.MB91	01AR.4.MB91	Providing and fixing Stainless steel fly proof wire mesh (Grade-304) of aperture 1.4 mm and 0.50 mm dia. in aluminium/steel door, window, ventilator shutters and partitions etc., complete as per the architectural drawings and the directions of Engineer-in-Charge.	sqm	50.000	INR	400.00	20,000.00
33	01AR.4.MB92	01AR.4.MB92	Providing and fixing SS 304 tubular frame of size 25×25×1.6 mm along with SS 304 beading for fixing fly mesh, including cutting, welding, grinding, finishing, and fixing to the opening with stainless steel screws and necessary fasteners, complete as per direction of Engineer-in-Charge.	Kg	140.000	INR	600.00	84,000.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
34	01AR.4.MB93	01AR.4.MB93	Providing and fixing carbon steel galvanized (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm2), counter sunk head, comprising of 10 mm dia polyamide PA 6 grade sleeve, including drilling of hole in frame , concrete/ masonry, etc. as per direction of Engineer-in-charge.					
35	01AR.4.MB93.1	01AR.4.MB93.1	10x120 mm	each	13.000	INR	136.00	1,768.00
36	01AR.4.MB93.2	01AR.4.MB93.2	10x140 mm	each	3.000	INR	148.00	444.00
37	01AR.4.MB94	01AR.4.MB94	Providing 40x5 mm flat Iron hold fast 40 cm long including fixing to frame with 10 mm diameter bolts, nuts and wooden plugs and embedding in cement concrete block 30x10x15cm 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size).	each	13.000	INR	183.00	2,379.00
38	01AR.6	01AR.6	ROOFING TREATMENT					
39	01AR.6.2	01AR.6.2	PCC 1:2:4 over concrete surfacesProviding and laying cement concrete (1 cement : 2 coarse sand : 4 aggregate) over concrete surfaces, laid to slope at all heights including, finishing, curing, tamping etc. all					
40	01AR.6.2.1	01AR.6.2.1	Cement supplied by the Contractor at their cost.	m^3	150.000	INR	8,580.00	1,287,000.00
41	01AR.6.9	01AR.6.9	Polyurethane (PU) waterproof coatingProviding and applying polyether based polyurethane (PU) waterproof coating consisting of 2 components (resin + hardener) in four coats consisting of a primer adhesion coat and three sealing coats applied by brush evenly to perfect level @ min.160 gm/sq.M per coat over R.C.C. slab including sprinkling the last coat of P.U. with a layer of clean sand (300 micron) and laying min. 50mm thk. PCC (1 cement :2 coarse sand :4 aggregate) over the fully cured coating in panels of max. 1.2M x 1.2M with 24 SWG chicken wiremesh finished smooth and sealing joints between panels with Polysulphide sealant as per approved manufacturers spec. and including preparing the base surface (levelling, cleaning, filling up cracks with thin paste of Polyurethane filling compound) providing fillets of 75mm radius with PCC (1 cement : 2 coarse sand : 4 aggregate) at junctions of horizontal and vertical surfaces, continuing the water proofing on vertical face to a minimum ht. of 150mm over finished roof surface, terminating it in continuous groove of 10mm x 20mm and filling with polyurethane sealent putty, continuing the treatment into rain water outlets by , providing 450mm x 450mm khuras at all outlets, levelled down by min. 25mm, finishing all complete.					
42	01AR.6.9.1	01AR.6.9.1	Cement supplied by the Contractor at their cost.	m^2	298.000	INR	1,194.00	355,812.00
43	01AR.8	01AR.8	ROOFING					

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Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
44	01AR.8.12	01AR.8.12	Providing and fixing rain water pipes with M.S. holder clamps including fixing/embedding into masonry/concrete, providing connections like shoes, vents, specials, bends etc. fixing in perfect plumb etc. all complete.					
45	01AR.8.12.5	01AR.8.12.5	110mm dia O.D. Size. exposed PVC rain water pipe jointed with bonding solution of approved quality and make with pressure rating of 4kg/cm2 including clamps, connections etc. all as per approved manufacturer's details.	RM	3.000	INR	280.00	840.00
46	01AR.9	01AR.9	SANITARY FITTINGS & FIXTURES					
47	01AR.9.18	01AR.9.18	round edged mirror of 6mm thick					
48	01AR.9.18.1	01AR.9.18.1	Providing and fixing round edged mirror of 6mm thick float glass with 6mm thick waterproof marine ply backing and rounded/ beveled edging, fixed on wall with wooden cleats and CP brass screws including cutting walls/ tiles, making good the same, finishing etc. all complete.	m^2	3.000	INR	2,185.00	6,555.00
49	01AR.9.MB99	01AR.9.MB99	MISCELLANEOUS - SANITARY FITTINGS & FIXTURES					
50	01AR.9.MB99.01	01AR.9.MB99.01	Providing and fixing approved quality chromium plated liquid soap dispenser of approve make with metallic bottle including fixing to wall with wooden cleats and CP brass screws, cutting walls and making good the same, finishing etc. all complete. Jaquar ¿CAN-CHR-1137N or approved equivalent	nos	3.000	INR	3,219.00	9,657.00
51	01AR.9.MB99.02	01AR.9.MB99.02	Providing and fixing 15mm dia CP Angle stop cock with wall flange of approved make conforming to IS : 781 including making connections, cutting walls and making good the same etc. all complete.Jaquar : OPP-CHR-15053PM or approved equivalent	nos	3.000	INR	1,093.00	3,279.00
52	01AR.9.MB99.03	01AR.9.MB99.03	Providing and fixing approved quality chromium plated brass towel ring of 150mm dia round with round flange including fixing to wall with wooden cleats and CP brass screws, cutting walls and making good the same, finishing etc. all complete.Jaquar ¿CAN-CHR-1121BN or approved equivalent	nos	3.000	INR	994.00	2,982.00
53	01AR.9.MB99.04	01AR.9.MB99.04	Providing & fixing Overhead Shower 120mm dia Round Shape Single Flow (Face Plate Stainless Steel & ABS Body in Chrome finish) with Rubit Cleaning System.Jaquar ¿OHS-CHR-1663 or approved equivalent	nos	3.000	INR	1,444.00	4,332.00
54	01AR.9.MB99.05	01AR.9.MB99.05	Providing & fixing Round Shower arm with 20mm dia. & 300mm Long with Stainless SteelJaquar ¿SHA-CHR-479L300S or approved equivalent	nos	3.000	INR	856.00	2,568.00
55	01AR.9.MB99.06	01AR.9.MB99.06	Providing, fixing, testing and commissioning C.P. brass 2 way bib cock with wall flange for health faucet of following make or approved equivalent 15 mm nominal bore, all complete as per standard design, specifications and direction of Engineer-in-charge.Jaquar ¿FLP-CHR-5041PM or or approved equivalent	nos	3.000	INR	2,114.00	6,342.00

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Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
56	01AR.9.MB99.07	01AR.9.MB99.07	Providing and fixing approved quality chromium plated Health faucet with 8mm Dia, 1 Meter Long Flexible Tube & Wall Hook including fixing to wall with wooden cleats and CP brass screws finishing etc. all complete.Jaquar ¿ALD-CHR-573 or approved equivalent	nos	3.000	INR	1,454.00	4,362.00
57	01AR.9.MB99.08	01AR.9.MB99.08	Providing and fixing in position round/ oval shaped counter Hand Wash Basin with anti-splash rims, conforming to IS:2556 Part IV, to fit in exactly and neatly in the cutout in the marble/ granite stone finished R.C.C counter, rubber plug with C.P. brass chain, 32mm C.P. waste fitting of standard pattern type with 32mm dia G.I. pipe, cutting walls, counter etc. and making good the same, also including providing cut out in marble/ granite slab counter top (and R.C.C underneath) of exact size and shape for wash basin to fit in neatly and perfectly; making all connections, finishing etc. all complete. (Bottle trap , Marble/ Granite counter top shall be paid separately under relevant item of `Floor Finishing')					
58	01AR.9.MB99.08.1	01AR.9.MB99.08.1	Round/ oval shaped counter Wash Basin of following model or equivalent of glazed chinaware in White color.Jaquar ¿ WASH BASIN : FLS-WHT-5701 or approved equivalent	nos	3.000	INR	3,146.00	9,438.00
59	01AR.9.MB99.09	01AR.9.MB99.09	Providing and fixing in position CP Brass Bottle trap 32mm Size with 300mm & 190mm Long Wall Connection Pipes & Wall Flange including making connections, cutting walls and making good the same etc. all complete.(Jaquar - ALD-CHR-769L300X19 or approved equivalent)	nos	3.000	INR	1,785.00	5,355.00
60	01AR.9.MB99.10	01AR.9.MB99.10	"Providing and fixing white glazed Earthen ware double trap, syphonic pattern wall mounted (European type) water closet with Rimless, Blind Installation Wall Hung WC With PP Soft Close Slim Seat Cover, Hinges And Accessories Set,of following model or equivalent, conforming to IS: 2556 Part 16 including white plastic solid seat and cover conforming to IS : 2548, CP brass hinges and rubber buffers, CP brass 40mm dia flush pipe,15 mm dia, ball valve, painting of all exposed metalic surfaces with 2 coats of approved shade and quality synthetic enamel paint (ICI or approved equivalent) over a priming coat of approved quality red oxide zinc chromate, cutting walls, floors and making good of same, making inlet and outlet connections, finishing etc. all complete as per standard design, Specifications and direction of Engineer-in-charge.Jaquar ¿ WATER CLOSET : SLS-WHT-6953BIPPSM or approved equivalant	nos	3.000	INR	10,982.00	32,946.00
61	01AR.9.MB99.11	01AR.9.MB99.11	Providing and Fixing Concealed Flushing Cistern Size 550X95X500mm with dual flush Actuator, flush-stop function, noise less float valve and fast filling action including full frame supporting structure with all component parts of high quality complete including frame for concealed cistern etc. all complete as per the instructions of the engineer-in charge.Jaquar: JCS-WHT-2400FS or approved equivalent	nos	3.000	INR	9,541.00	28,623.00

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Part No. : 0								
SOR No. : C098-000-81-46-CD-SOR-8105-0-1M			**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title: BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL								
62	01AR.9.MB99.12	01AR.9.MB99.12	Providing and Fixing of Flushing plate of with dual knobs chrome Finish in desired shape and size for Concealed Flushing Cistern including all tools, tackles etc., all complete as per the instructions of engineer-in-charge.Jaquar: JCP-CHR-152415 or approved equivalent	nos	3.000	INR	1,279.00	3,837.00
63	01AR.9.MB99.13	01AR.9.MB99.13	Providing and fixing Concealed Body for Single Lever Basin Mixer Wall Mounted, But without Exposed Parts including all tools, tackles etc., all complete as per the instructions of engineer-in-charge.Jaquar ¿ ALD-CHR-233N or approved equivalent	nos	3.000	INR	3,033.00	9,099.00
64	01AR.9.MB99.14	01AR.9.MB99.14	Providing and fixing chrome finish Exposed Part Kit of Single Lever Basin Mixer Wall Mounted Consisting of Operating Lever, Cartridge Sleeve, Wall Flange, Nipple & Spout including all tools, tackles etc., all complete as per the instructions of engineer-in-charge.Jaquar ¿ OPP-CHR-15233NKPM or approved equivalent	nos	3.000	INR	1,941.00	5,823.00
65	01AR.9.MB99.15	01AR.9.MB99.15	Providing and fixing approved quality chromium plated brass Towel rail (Jaquar make or approved equivalent) of 300 mm long including fixing to wall with wooden cleats and CP brass screws, cutting walls and making good the same, finishing etc. all complete.Jaquar- TOWEL RAIL : CAN-CHR-11015 or approved equivalent	nos	3.000	INR	1,323.00	3,969.00
66	01AR.9.MB99.16	01AR.9.MB99.16	Providing and fixing approved quality chromium plated brass Towel Rack (Jaquar make or approved equivalent) of 600 mm long without Lower Hangers including fixing to wall with wooden cleats and CP brass screws, cutting walls and making good the same, finishing etc. all complete.Jaquar- TOWEL RACK : AQN-CHR-7781A or approved equivalent	nos	3.000	INR	4,544.00	13,632.00
67	01AR.9.MB99.17	01AR.9.MB99.17	Providing and Fixing min 100 mm square type SS 304 Floor drain (Matt/gloss finish) in floors of approved make including necessary fixing and jointing with suitable mortar/adhesive neatly finished etc. complete as per instructions of the engineer-in charge.CHILLY : CCT-MTR-127 or approved equivalent	nos	3.000	INR	426.00	1,278.00
68	01AR.MB90	01AR.MB90	STONEWORK					

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
69	01AR.MB90.01	01AR.MB90.01	Supply, fabricating, transporting, hoisting and fixing in position fine grained premium quality Bansipaharpur Pink Sandstone in various elements coloums, pillasters , jali, window surrounds , brackets, chajjas/projections, copings , cornices with required slope and drip course etc for all level & all height. Stone shall be free from cracks, lines, stains, white spots of efflorescence and even in shade for each elements. The stone shall be fine grained and buff-colored. The work shall be carried out as per attached drawings with different process of carving (manual/ by machine), ornamental work, traditional work, CNC cutting, moulding. The carving and molding work shall be of very good quality. The stones shall be fixed in line, level and plumb in all respect with the use of Stainless Steel Cramps & Fasteners (paid separately), cement slurry with matching pigment and Epoxy of approved make as required and as approved by the Architects/Engineer Incharge at site. To and fro transportation charges to CNC establishment included in above rates.	cum	78.000	INR	82,000.00	6,396,000.00
70	01AR.MB90.02	01AR.MB90.02	Providing and fixing copper/SS 304 pins7.5 cm long 6 mm diameter for securing adjacent stones in stone wall lining in cement mortar 1:2 (1 cement : 2 coarse sand), including making the necessary chases.	each	26.000	INR	31.00	806.00
71	01AR.MB90.03	01AR.MB90.03	Providing & Fixing of Stainless Steel 304 Grade Fasteners (Fischer, Hilti or BOSCH or approved equivalent make) with Outer Dia 10 mm x Length Upto 150mm for Sandstone Cladding / Wall Lining Work as per design and drawings including use of epoxy adhesive, if required, complete as per directions of the Engineer-in-Charge	nos	26.000	INR	343.00	8,918.00
72	01AR.MB90.04	01AR.MB90.04	Providing and fixing Stainless Steel 304 Grade cramps of required size and shape for anchoring with stainless steel nuts, bolts and washer (total weight not less than 260 gram) stone wall lining to the backing or securing adjacent stones in stone wall lining in cement mortar 1:2 (1 cement: 2 coarse sand), including making the necessary chases in stone and holes in walls wherever required (Customized at site as per size required, fabricated using Jindal Stainless / SAIL or equivalent raw material).	nos	325.000	INR	466.00	151,450.00
73	01AR.MB90.05	01AR.MB90.05	Providing and applying breathable, non-reactive, antifungal and water repellant Silane/Siloxan chemical (Impregnator) make of Wacker, Remmers, Dow Corning, or equivalent, on the existing sand stone surface with two or more coats to give uniform application of chemical on the surface applicable for all heights, all complete as per manufacturer's specifications and directions of the Engineer-in-charge etc. (with 5 min year Guarantee)	sqm	988.000	INR	288.00	284,544.00
74	11CS	11CS	CIVIL, STRUCTURE AND ARCHITECTURE					
75	11CS.11	11CS.11	FLOORING					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
76	11CS.11.26	11CS.11.26	Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand) :					
77	11CS.11.26.1	11CS.11.26.1	25 mm thick	sqm	60.000	INR	1,548.00	92,880.00
78	11CS.11.27	11CS.11.27	Kota stone slabs 20 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.	sqm	30.000	INR	1,871.00	56,130.00
79	11CS.11.48	11CS.11.48	Grouting the joints of flooring tiles having joints of 3 mm width, using epoxy grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardener and 0.20 kg of resin per kg), including filling / grouting and finishing complete as per direction of Engineer-in-charge.					
80	11CS.11.48.2	11CS.11.48.2	Size of Tile 600x600 mm	sqm	121.000	INR	246.00	29,766.00
81	11CS.11.48.MB99	11CS.11.48.MB99	Size of Tile 300 x 600 mm	sqm	3.000	INR	235.00	705.00
82	11CS.11.50	11CS.11.50	Deduct for not grouting the joints with white cement and matching pigment in the items of fixing of vitrified tiles.	sqm	121.000	INR	11.00	1,331.00
83	11CS.11.MB90	11CS.11.MB90	Providing and laying Vitrified tiles in floor in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS:15622, of approved brand & manufacturer, in all colours and shade, laid on 20 mm thick cement mortar 1:4 (1 cement: 4 coarse sand) jointing with grey cement slurry @3.3 kg/sqm including grouting the joints with white cement and matching pigments etc. The tiles must be cut with the zero chipping diamond cutter only . Laying of tiles will be done with the notch trowel, plier, wedge, clips of required thickness, leveling system and rubber mallet for placing the tiles gently and easily.					
84	11CS.11.MB90.1	11CS.11.MB90.1	Glazed Vitrified tiles Matt/Antiskid finish of size					
85	11CS.11.MB90.1.1	11CS.11.MB90.1.1	Size of Tile 600 x 600 mm	sqm	120.000	INR	1,023.00	122,760.00
86	11CS.13	11CS.13	FINISHING					
87	11CS.13.12	11CS.13.12	18 mm cement plaster in two coats under layer 12 mm thick cement plaster 1:5 (1 cement : 5 coarse sand) and a top layer 6 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished rough with sponge.	sqm	26.000	INR	427.00	11,102.00
88	11CS.13.16	11CS.13.16	6 mm cement plaster of mix :					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
89	11CS.13.16.1	11CS.13.16.1	1:3 (1 cement : 3 fine sand)	sqm	150.000	INR	239.00	35,850.00
90	11CS.13.21	11CS.13.21	Extra for providing and mixing water proofing material in cement plaster work in proportion recommended by the manufacturers. (Unit of measurement is per bag of 50kg cement used in the mix)	each	49.000	INR	18.00	882.00
91	11CS.13.26	11CS.13.26	Providing and applying plaster of paris putty of 2 mm thickness over plastered surface to prepare the surface even and smooth complete.	sqm	161.000	INR	209.00	33,649.00
92	11CS.13.4	11CS.13.4	12 mm cement plaster of mix :					
93	11CS.13.4.1	11CS.13.4.1	1:4 (1 cement: 4 coarse sand)	sqm	393.000	INR	284.00	111,612.00
94	11CS.13.48A	11CS.13.48A	Finishing walls with ready mixed Premium acrylic emulsion paint having VOC less than 50 gm/litre and UV resistance as per IS 15489:2004, Alkali & fungal resistance, dirt resistance exterior paint of required shade (Company Depot Tinted) with silicon additives.					
95	11CS.13.48A.1	11CS.13.48A.1	New work (Two or more coats applied @ 1.43 litre/ 10 sqm. Over and including priming coat of exterior primer applied @ 0.90 litre/10 sqm.	sqm	174.000	INR	144.00	25,056.00
96	11CS.13.5	11CS.13.5	15 mm cement plaster on rough side of single or half brick wall of mix:					
97	11CS.13.5.1	11CS.13.5.1	1:4 (1 cement: 4 coarse sand)	sqm	26.000	INR	327.00	8,502.00
98	11CS.13.62	11CS.13.62	Painting with synthetic enamel paint of approved brand and manufacture of required colour to give an even shade :					
99	11CS.13.62.1	11CS.13.62.1	Two or more coats on new work over an under coat of suitable shade with ordinary paint of approved brand and manufacture	sqm	78.000	INR	180.00	14,040.00
100	11CS.13.83	11CS.13.83	Wall painting with premium acrylic emulsion paint of interior grade, having VOC (Volatile Organic Compound) content less than 50 grams/ litre of approved brand and manufacture, including applying additional coats wherever required to achieve even shade and colour.					
101	11CS.13.83.1	11CS.13.83.1	One coat	sqm	13.000	INR	76.00	988.00
102	11CS.13.83.2	11CS.13.83.2	Two coats	sqm	168.000	INR	113.00	18,984.00
103	11CS.13.MB90	11CS.13.MB90	Providing and fixing 20 gauge/ 12mm x 22g Chicken wire mesh stretched tight at all RCC/ PCC and masonry meeting points in 300mm wide strips (150mm on on each surface) fixed with G.I. "U" type nails before plastering at all levels and heights including scaffolding as required, all complete as per direction of engineer in charge.	sqm	13.000	INR	224.00	2,912.00

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
104	11CS.13.MB91	11CS.13.MB91	Providing and applying smooth sandstone imitation texture coating at all heights made with specially sourced naturally stone sand having high silica and minerals, dispersed in a pure acrylic binding medium, incorporating anti caking, anti-rusting , anti-foaming, anti fungal, and UV resistant to be applied in two coats , primer coat of similar color of suitable grade applied @2.15 ltr/ 10 sqm, second coat of stone imitating texture coat as described above with texture gun using compressed air @3.13 kg/sqm and finally to be sealed with silicon modified pure acrylic top coat @2.5 ltr/sqm in prescribed pattern, texture and position all complete as per drawing and direction of Engineer incharge.	sqm	7176.000	INR	503.00	3,609,528.00
105	11CS.21	11CS.21	ALUMINIUM WORK					
106	11CS.21.1	11CS.21.1	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately):					
107	11CS.21.1.1	11CS.21.1.1	For fixed portion					
108	11CS.21.1.1.2	11CS.21.1.1.2	Powder coated aluminium (minimum thickness of powder coating 50 micron)	kg	3.000	INR	422.00	1,266.00
109	11CS.21.1.1.3	11CS.21.1.1.3	Polyester powder coated aluminium (minimum thickness of polyester powder coating 50 micron)	kg	104.000	INR	429.00	44,616.00
110	11CS.21.1.2	11CS.21.1.2	For shutters of doors, windows & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber / neoprene gasket required (Fittings shall be paid for separately)					
111	11CS.21.1.2.2	11CS.21.1.2.2	Powder coated aluminium (minimum thickness of powder coating 50 micron)	kg	3.000	INR	504.00	1,512.00
112	11CS.21.1.2.3	11CS.21.1.2.3	Polyester powder coated aluminium (minimum thickness of polyester powder coating 50 micron)	kg	143.000	INR	511.00	73,073.00
113	11CS.21.8	11CS.21.8	Filling the gap in between aluminium frame & adjacent RCC/ Brick/ Stone work by providing weather silicon sealant over backer rod of approved quality as per architectural drawings and direction of Engineer-in-charge complete.					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
114	11CS.21.8.1	11CS.21.8.1	Upto 5mm depth and 5 mm width	metre	390.000	INR	77.00	30,030.00
115	11CS.4	11CS.4	CONCRETE WORK					
116	11CS.4.17	11CS.4.17	Making plinth protection 50mm thick of cement concrete 1:3:6 (1 cement: 3 coarse sand (zone - III) derived from natural sources: 6 graded stone aggregate 20 mm nominal size derived from natural sources) over 75mm thick bed of dry brick ballast 40 mm nominal size, well rammed and consolidated and grouted with fine sand, including necessary excavation, levelling & dressing & finishing the top smooth.	sqm	13.000	INR	595.00	7,735.00
117	11CS.8	11CS.8	CLADDING WORK					
118	11CS.8.14	11CS.8.14	Stone work (machine cut edges) for wall lining etc. (veneer work) upto 10 metre height, backing filled with a grout of average 12 mm thick cement mortar 1:3 (1 cement : 3 coarse sand) including pointing in white cement mortar 1:2 (1 white cement : 2 stone dust) with an admixture of pigment matching the stone shade : (To be secured to the backing and the sides by means of cramps and pins which shall be paid for separately) :					
119	11CS.8.14.5	11CS.8.14.5	Gang saw cut stone					
120	11CS.8.14.5.MB90	11CS.8.14.5.MB90	30 mm thick Bansi Pahadpur Pink Sandstone	sqm	510.000	INR	2,248.00	1,146,480.00
121	11CS.8.15	11CS.8.15	Providing and fixing stainless steel cramps of required size and shape for anchoring stone wall lining to the backing or securing adjacent stones in stone wall lining in cement mortar 1:2 (1 cement : 2 coarse sand), including making the necessary chases in stone and holes in walls wherever required.	kg	0.500	INR	568.00	284.00
122	11CS.8.16	11CS.8.16	Providing and fixing copper pins 7.5 cm long 6 mm diameter for securing adjacent stones in stone wall lining in cement mortar 1:2 (1 cement : 2 coarse sand), including making the necessary chases.	each	3.000	INR	35.00	105.00
123	11CS.8.7	11CS.8.7	Providing and fixing cramps of required size & shape in RCC/ CC / Brick masonry backing with cement mortar 1:2 (1 cement :2 coarse sand), including drilling necessary hole in stones and embedding the cramp in the hole (fastener to be paid separately).					
124	11CS.8.7.2	11CS.8.7.2	Stainless steel cramps	kg	26.000	INR	568.00	14,768.00
125	11CS.8.8	11CS.8.8	Providing and fixing expansion hold fasteners on C.C. /R.C.C./Brick masonry surface backing including drilling necessary holes and the cost of bolt etc complete.					
126	11CS.8.8.1	11CS.8.8.1	Wedge expansion type					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-46-CD-SOR-8105-0-1M		**Division/Department :** STRUCTURAL / ARCHITECTURE					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
127	11CS.8.8.1.3	11CS.8.8.1.3	Fastener with threaded dia 12 mm	each	260.000	INR	49.00	12,740.00
							SOR (C098-000-81-46-CD-SOR-8105-0-1M) Total :INR	**15360612.00**
SOR No. :	C098-000-81-47-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / GEOTECHNICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
1	01GG	01GG	GEOTECH					
2	01GG.202	01GG.202	CONSTRUCTION OF BORED CAST-IN-SITU RCC PILES					
3	01GG.202.3	01GG.202.3	BORED CAST-IN-SITU ST. SHAFTED PILES (CEMENT BY CONTRACTOR)					
4	01GG.202.3.1V51	01GG.202.3.1V51	Construction of Bored cast-in-situ RCC straight shafted piles as specified in specific requirements and as per items given below by approved techniques to depths specified using stone chips of 20mm and down size, through all types of soil strata, maintaining borehole sides in position by bentonite slurry by suitable method, tremie concreting, supply of necessary material including plastisizers if required, mobilization of piling rigs and other ancillary equipments/accessories as specified including demobilization etc complete, labour & carry out any ancillary work adjunct to piling work, disposal of surplus materials including earth, muck etc beyond specified lead, shifting plant and equipments from one pile location to another, all complete as per specifications, drawings & direction of Engineer-in-charge (Cost of reinforcement is excluded, cement supplied by contractor at his own cost and duly approved by Engineer-in-Charge). Diameter of pile 300 mm, Length below COL 9 M, Grade of concrete 30	m	8646.000	INR	1,350.00	11,672,100.00
5	01GG.202.3.1V52	01GG.202.3.1V52	Construction of Bored cast-in-situ RCC straight shafted piles as specified in specific requirements and as per items given below by approved techniques to depths specified using stone chips of 20mm and down size, through all types of soil strata, maintaining borehole sides in position by bentonite slurry by suitable method, tremie concreting, supply of necessary material including plastisizers if required, mobilization of piling rigs and other ancillary equipments/accessories as specified including demobilization etc complete, labour & carry out any ancillary work adjunct to piling work, disposal of surplus materials including earth, muck etc beyond specified lead, shifting plant and equipments from one pile location to another, all complete as per specifications, drawings & direction of Engineer-in-charge (Cost of reinforcement is excluded, cement supplied by contractor at his own cost and duly approved by Engineer-in-Charge). Diameter of pile 450 mm, Length below COL 9 M, Grade of concrete 30	m	472.000	INR	2,330.00	1,099,760.00

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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-47-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / GEOTECHNICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
6	01GG.202.3.3V39	01GG.202.3.3V39	Rate per meter length in INCREASE in pile length over specified length (cement Supplied by Contractor at his own cost and duly approved by Engineer-in-Charge) Diameter of pile 300 mm, Length of pile 9 M	m	130.000	INR	1,350.00	175,500.00
7	01GG.202.3.3V40	01GG.202.3.3V40	Rate per meter length in INCREASE in pile length over specified length (cement Supplied by Contractor at his own cost and duly approved by Engineer-in-Charge) Diameter of pile 450 mm, Length of pile 9 M	m	53.000	INR	2,330.00	123,490.00
8	01GG.202.4	01GG.202.4	EMPTY BORING					
9	01GG.202.4.1V4	01GG.202.4.1V4	Boring up to a depth of cut-off level of pile as per the specification & requirement of AFC drawings & carry out any ancillary work adjunct to piling work, disposal of surplus materials including earth, muck etc beyond specified lead, shifting plant and equipments from one pile location to another, all complete as per specifications, drawings & directions of Engineer-In-charge. Diameter of Pile 450 mm	m	53.000	INR	780.00	41,340.00
10	01GG.202.4.1V7	01GG.202.4.1V7	Boring up to a depth of cut-off level of pile as per the specification & requirement of AFC drawings & carry out any ancillary work adjunct to piling work, disposal of surplus materials including earth, muck etc beyond specified lead, shifting plant and equipments from one pile location to another, all complete as per specifications, drawings & directions of Engineer-In-charge. Diameter of Pile 300 mm	m	52.000	INR	660.00	34,320.00
11	01GG.205	01GG.205	STEEL REINFORCEMENT					
12	01GG.205.3	01GG.205.3	Steel reinforcement of HYSD bars confirming to IS:1786 (latest version) (steel supplied by contractor at his own cost and duly approved by Engineer in charge)					
13	01GG.205.3.1	01GG.205.3.1	Placing in position high strength deformed steel bars reinforcement of grade Fe500D conforming to IS:1786, (latest version) for RCC Bored Cast- in -situ piles for full length of pile, straightening, cleaning, decoiling, cutting, bending to required shape & lengths as per details, binding with contractor's own 18 SWG black soft annealed binding wire, supplying and placing with proper cover blocks, supports, chairs, spacers, welding, if required, to form a rigid cage, complete as per instructions of the Engineer-in-Charge (steel supplied by contractor at his own cost and duly approved by Engineer in charge)	t	65.000	INR	84,640.00	5,501,600.00
14	01GG.206	01GG.206	INITIAL PILE LOAD TESTS					
15	01GG.206.1	01GG.206.1	Conducting INITIAL PILE LOAD TESTS by direct loading on piles as per specifications and directions of Engineer-in-Charge.					

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
2	**Bidding Document No.**	JP/C098-000-CD-T-8105/1004

S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-47-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / GEOTECHNICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
16	01GG.206.1.1V67	01GG.206.1.1V67	Conducting INITIAL VERTICAL pile load test by direct loading on piles including finishing pile head, supply & erection of kentledge of suitable magnitude, labour, excavation, back filling, compaction etc. all complete as per specifications and directions of Engineer-in-Charge, analysing the results, making the report and submitting the same in 5 copies (cost of pile is excluded) Diameter of pile 300 mm ,Type of Pile Bored Cast In-situ Safe capacity of pile 12 T	each	2.000	INR	110,000.00	220,000.00
17	01GG.206.1.1V68	01GG.206.1.1V68	Conducting INITIAL VERTICAL pile load test by direct loading on piles including finishing pile head, supply & erection of kentledge of suitable magnitude, labour, excavation, back filling, compaction etc. all complete as per specifications and directions of Engineer-in-Charge, analysing the results, making the report and submitting the same in 5 copies (cost of pile is excluded) Diameter of pile 450 mm ,Type of Pile Bored Cast In-situ Safe capacity of pile 25 T	each	1.000	INR	140,000.00	140,000.00
18	01GG.206.1.3V46	01GG.206.1.3V46	Conducting INITIAL LATERAL pile load test by direct loading on piles including finishing pile head, supply & erection of kentledge of suitable magnitude, labour, excavation, back filling, compaction etc. all complete as per specifications and directions of Engineer-in-Charge, analysing the results, making the report and submitting the same in 5 copies (cost of pile is excluded) Diameter of pile 300 mm, Type of pile Bored Cast In-situ Safe capacity of pile 1 T	each	2.000	INR	50,000.00	100,000.00
19	01GG.206.1.3V47	01GG.206.1.3V47	Conducting INITIAL LATERAL pile load test by direct loading on piles including finishing pile head, supply & erection of kentledge of suitable magnitude, labour, excavation, back filling, compaction etc. all complete as per specifications and directions of Engineer-in-Charge, analysing the results, making the report and submitting the same in 5 copies (cost of pile is excluded) Diameter of pile 450 mm, Type of pile Bored Cast In-situ Safe capacity of pile 2 T	each	1.000	INR	60,000.00	60,000.00
20	01GG.207	01GG.207	ROUTINE PILE LOAD TEST					
21	01GG.207.1	01GG.207.1	Conducting ROUTINE PILE LOAD TESTS by direct loading on piles as per specifications and directions of Engineer-in-Charge.					
22	01GG.207.1.1V64	01GG.207.1.1V64	Conducting ROUTINE VERICAL pile load test by direct loading on piles including finishing pile head, supply & erection of kentledge of suitable magnitude, labour, excavation, back filling, compaction etc. all complete as per specifications and directions of Engineer-in-Charge, analysing the results, making the report and submitting the same in 5 copies (cost of pile is excluded) Diameter of pile 300 mm, Type of pile Bored Cast In-situ Safe pile capacity 12 T	each	5.000	INR	36,000.00	180,000.00

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1	**Name of Work**	Balance Works forConstruction of Boundary Wall
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S.No.	Item Sl. No.	Item Code	Item Description	UOM	Qty.	Curr.	Unit Rate	Total Amount
Part No. :	0							
SOR No. :	C098-000-81-47-CD-SOR-8105-0-0M		**Division/Department :** STRUCTURAL / GEOTECHNICAL					
SOR Title:	BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL							
23	01GG.207.1.1V65	01GG.207.1.1V65	Conducting ROUTINE VERICAL pile load test by direct loading on piles including finishing pile head, supply & erection of kentledge of suitable magnitude, labour, excavation, back filling, compaction etc. all complete as per specifications and directions of Engineer-in-Charge, analysing the results, making the report and submitting the same in 5 copies (cost of pile is excluded) Diameter of pile 450 mm, Type of pile Bored Cast In-situ Safe pile capacity 25 T	each	1.000	INR	40,000.00	40,000.00
24	01GG.207.1.3V48	01GG.207.1.3V48	Conducting ROUTINE LATERAL pile load test by direct loading on piles including finishing pile head, supply & erection of kentledge of suitable magnitude, labour, excavation, back filling, compaction etc. all complete as per specifications and directions of Engineer-in-Charge, analysing the results, making the report and submitting the same in 5 copies (cost of pile is excluded) Diameter of pile 450 mm, Type of pile Bored Cast In-situ Safe pile capacity 2 T	each	1.000	INR	53,000.00	53,000.00
25	01GG.207.1.3V49	01GG.207.1.3V49	Conducting ROUTINE LATERAL pile load test by direct loading on piles including finishing pile head, supply & erection of kentledge of suitable magnitude, labour, excavation, back filling, compaction etc. all complete as per specifications and directions of Engineer-in-Charge, analysing the results, making the report and submitting the same in 5 copies (cost of pile is excluded) Diameter of pile 300 mm, Type of pile Bored Cast In-situ Safe pile capacity 1 T	each	5.000	INR	42,000.00	210,000.00
26	01GG.300	01GG.300	GROUND IMPROVEMENT					
27	01GG.300.1	01GG.300.1	SAND GRAVEL MIX					
28	01GG.300.1.1	01GG.300.1.1	Supplying and filling sand gravel mix (1:1) with approved aggregate below road, RCC pavement, manholes, pits, foundations, bedding of UG piping etc. in layers of 150 mm loose thickness (maximum) including watering, ramming, rolling, compacting to achieve 85% relative density as per IS 2720 Part-XIV, quarrying, royalties, transportation, handling, etc. all complete as per drawings, specifications and directions of Engineer-in-Charge.(The rate shall be inclusive of the cost of all labour, material, equipment etc. all complete)	cum	130.000	INR	1,790.00	232,700.00
							SOR (C098-000-81-47-CD-SOR-8105-0-0M) Total :INR	**19883810.00**
							Part (0) Total :INR	**99873693.70**
							Grant Total :INR	**99873693.70**
							Grand Total (in words) :INR Nine Nine Eight Seven Three Six Nine Three Point Seven	

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Validate Print Help

Percentage BoQ

Tender Inviting Authority:

Name of Work : BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL AROUND THE SHRI RAM MANDIR COMPLEX IN AYODHYA

Bidding Document No.: JP/C098-000-CD-T-8105/1004

Name of the Bidder/ Bidding Firm / Company :	

SUMMARY OF PRICE [FORM SP-1]

1. This BOQ template must not be modified/replaced by the bidder and the same should be uploaded after filling the relevent columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter the Bidder Name and Values only.

2. If percentage is not quoted in Col. 5 of Form SP-1, it shall be considered "NIL" for price evaluation/award.

3. Bidder to select appropriate percentage option from "Percentage Option [Excess (+), Less (-)]"

NUMBER #	TEXT #	NUMBER #	TEXT #	NUMBER	NUMBER #	TEXT #
Sl. No.	Item Description	Quantity	Units	Estimated Rate in Rs. P	TOTAL AMOUNT inclusive of all Taxes & Duties except GST in Rs. P	TOTAL AMOUNT In Words
1	2	3	4	5	6	7
1	**BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL AROUND THE SHRI RAM MANDIR COMPLEX IN AYODHYA** **(BIDDING DOCUMENT NO.: JP/C098-000-CD-T-8105/1004)** **(As per prefilled Schedule of Rates - Form SP-0)**	1.00	Lumpsum	99873693.70	**99873693.70**	INR Nine Crore Ninety Eight Lakh Seventy Three Thousand Six Hundred & Ninety Three and Paise Seventy Only
Total in Figures					**99873693.70**	INR Nine Crore Ninety Eight Lakh Seventy Three Thousand Six Hundred & Ninety Three and Paise Seventy Only
	Percentage increase/ decrease on Total estimated cost as stated in COL.6 above, applicable uniformly on all items of pre-filled SOR		**Select**		**0.00**	INR Zero Only

FORM SP-2

NAME OF WORK: BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL AROUND THE SHRI RAM MANDIR COMPLEX IN AYODHYA

Bidding Document No: JP/C098-000-CD-T-8105/1004

NAME OF BIDDER:	

DETAILS OF GOODS AND SERVICES TAX (GST)

SL. NO.	**DESCRIPTION**	**Total Amount on which GST is applicable**	**Percentage (%) Rate of GST Applicable on (A)**	**SAC CODE as per GST act**
		(A)	**(B)**	**(C)**
i)	GST	As quoted in FORM-SP-1 in INR	_____%	_____

NOTES :

1)	GST shall not be loaded for Price Bid Evaluation.	
2)	Bidder to ascertain the applicability of Cess on GST as per GST Act/rules.Bidder to indicate GST compensation cess excluded in the quoted Price (SP-0) as under :-	
	GST Compensation Cess (if applicable) excluded in SP-1 price :	_____% of SP-1 Price
	In case GST Compensation Cess is not indicated above, the same shall be considered as Not Applicable.	
	GST compensation cess, if any, shall be loaded for Price Bid Evaluation..	

STAMP & SIGNATURE OF BIDDER

NAME OF WORK: BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL AROUND THE SHRI RAM MANDIR COMPLEX IN AYODHYA
Bidding Document No: JP/C098-000-CD-T-8105/1004

NAME OF BIDDER:

FORM SP-3

DETAILS OF CUSTOMS DUTY AND CUSTOMS RELATED DUTIES

	DESCRIPTION	CIF VALUE	Applicable merit rate of basic custom duty included in the Total Quoted Price	Other Customs Related duties included in Total Quoted Price (Other than IGST, Social Welfare Surcharge)	Social Welfare Surcharge on custom duty (considering the input tax credit of IGST, GST Compensation Cess on imported material) (Included in Total Quoted Price)	Custom Tariff Considered (Bidder to indicate)
		Amount IN INR	Amount IN INR	Amount IN INR	Amount IN INR	
	(1)	(2)	(3)	(4)	(5)	(6)
(i)	FOR BUILT IN IMPORT CONTENT INCLUDED IN PRICE SCHEDULE [FORM SP-1]					

NOTES :

1) The Customs Duty and other custom related duties as indicated above shall be included in the quoted price as per the provisions of the Bidding Document.

2) "Applicable merit rate of basic custom duty" (at Col-3 above), "Social Welfare surcharge, if applicable" (at Col-5 above) and "Custom Tariff" (at Col-6 above) shall be quoted/ mentioned by Bidder considering provisions of Bidding Document.

3) The total price quoted shall be inclusive of the impact if any, towards the credit/non-credit applicable to the bidder for the IGST on built-in import content. No IGST and/or any variation thereof on such built-in import content shall be separately payable by the EIL.

4) Bidder shall submit this format alongwith his unpriced bid, indicating 'Quoted' against Col-2 to Col-5 and indicating the appplicable Custom Tariff in Col-6. In the Price Bid, Bidder shall submit this format with appropriate values duly filled in against all Columns.

SIGN AND STAMP OF BIDDER

TENDER: BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL

PROJECT: BALANCE WORKS FOR CONSTRUCTION OF BOUNDARY WALL AT SHRI RAM MANDIR COMPLEX IN AYODHYA.

CLIENT : RAM JANMABHOOMI TRUST.

JOB NO : C098

TENDER NO. C098-000-81-41-CD-T-8105

विद्युत उपकरणों के लिए स्थापना विनिर्देश

SPECIFICATION FOR ELECTRICAL EQUIPMENT INSTALLATION

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	13 08 19	REVISED & ISSUED AS SPECIFICATION	RM	RS	SA	RKT
4	21 05 14	REAFFIRMED & ISSUED AS SPECIFICATION	FA	SA	BRB	SC
3	25 04 08	REVISED & ISSUED AS SPECIFICATION	RKS	SSM	JMS	VC
2	28 02 03	REVISED & ISSUED AS SPECIFICATION	HKM	RSG	VPS	SKG
1	26 08 97	REVISED & ISSUED AS STANDARD SPECIFICATION	RR	VPS	SG	AS

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Abbreviations:

AC	:	Alternating Current
ACDB	:	AC Distribution Board
AL	:	Aluminium
BIS	:	Bureau of Indian Standards
CCoE	:	Chief Controller of Explosives
CD	:	Compact Disc
CEA	:	Central Electricity Authority
CIMFR	:	Central Institute of Mining and Fuel Research
CT	:	Current Transformer
CTC	:	Carbon Tetrachloride
CU	:	Copper
DC	:	Direct Current
DCDB	:	DC Distribution Board
DGMS	:	Directorate General of Mines and Safety
Ex(d)	:	Flameproof
FRP	:	Fibre Reinforced Plastic
HV	:	High Voltage
IR	:	Insulation Resistance
IS	:	India Standard
LV	:	Low Voltage
HMI	:	Human Machine Interface
MV	:	Medium Voltage
OISD	:	Oil Industry Safety Directorate
OSR	:	Oil Surge Relay
OTI	:	Oil Temperature Indicator
PF	:	Power Factor
PI	:	Polarisation index
PRV	:	Pressure relief Valve
PT	:	Potential Transformer
SLD	:	Single Line Diagram
UPS	:	Uninterrupted Power Supply
VRLA	:	Valve Regulated Lead Acid
WTI	:	Winding Temperature Indicator
PESO	:	Petroleum and Explosives Safety Organization

Electrical Standards Committee

Convenor: Ms. Sumita Anand

Members: Mr. Parag Gupta
Mr. M.K. Sahu
Ms. ANP Singh
Mr. Harish Kumar
Ms. Shalini Verma
Mr. Raman Sood
Ms. Shirali Aggarwal
Ms. N.P. Guha (Projects)
Mr. Rajesh Sinha (Inspection)

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1.0 SCOPE

This specification defines the requirements for the installation, field inspection, testing and commissioning of electrical equipment, forming part of electrical power distribution and utilisation system, including Communication and Fire alarm system.

2.0 CODES AND STANDARDS

2.1 The work shall be carried out in the best workmanlike manner in conformity with this specification, EIL Installation Standards, layout drawings and to the following specifications/ codes of practice of Bureau of Indian Standards and OISD standards.

SP-30 (BIS)	National Electrical Code.
IS:7816	Guide for testing Insulation resistance of rotating machines.
IS:10028 (Part-2)	Code of practice for selection, Installation and maintenance of transformers; Part 2 : Installation.
OISD 137	Inspection of Electrical Equipment.
OISD 147	Inspection and safe practices during electrical installations

2.2 In addition to the above it shall be ensured that the installation conforms to the requirements of the following as applicable:

a. CEA Regulations.
b. Regulations laid down by CEA/Electrical Inspectorate.
c. Regulations laid down by PESO/DGMS (as applicable).
d. The petroleum rules (Ministry of Industry Government of India).
e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 INSTALLATION OF EQUIPMENT

Prior to start of installation of the electrical equipment, Contractor shall verify that equipment and complete materials have been received. Handling, shifting to required site location, installation, testing and commissioning of all electrical equipment shall be done by contractor with utmost care. Manufacturer's instructions and the requirements given in their technical manuals shall be strictly adhered. The substation/switchgear room wherein the equipment shall be installed shall be kept clean, dry and free from all debris. Panel floor cutouts not in immediate use shall be suitably covered to avoid any mishap. When handling the switchboard panels, care shall be taken to observe the correct lifting arrangements and to make sure that slings are attached to the manufacturer's designated lifting points,where applicable. No parts shall be subjected to undue strains or sudden stresses which could cause damage to the equipment.

The lifting position mark indicated on packing casing shall be adhered to strictly, for keeping it in required vertical position.

Contractor shall check and report to the Engineer-in-charge about any damaged item and / or missing component for getting the same replaced as per specifications. During installation, all accessories and loose items shall also be inspected by the contractor before their assembly/mounting.

Manufacturer checklist, manual for erection and installation and any specific requirement for equipment handling, installation and commissioning shall be strictly adhered to.

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3.1 Switchboards and Bus Ducts

3.1.1 The term switchboard here includes all HV / MV/ LV switchboard panels, motor control centers, power and lighting distribution boards, UPS panels, ACDB, Battery charger panels, DCDB etc.

The switchboard panels shall be handled with care, avoiding any impact to the equipment. Dragging of the panels directly on floor shall be avoided. Roller bars may be used for shifting of panels. Use of a crane and trailer shall be made for handling of equipment. The switchboard panels shall be properly supported on the truck or trailer by means of ropes to avoid any chance of tilting. The switchboards shall be lifted after ensuring that panel supports, nuts and bolts are all intact and tightened. While lifting the panels in packed conditions, utmost care shall be taken to avoid any damage to insulators, bushings, metering and protective equipment and if specified in the tender document tyre mounted hydraulic trolley shall be used.

The panels shall be preferably kept inside the packing cases till foundations are ready. Proper rain/sun/dust protection shall be ensured till switchboards are installed.

3.1.2 The switchboard panels shall be installed on prepared foundations or floor cutouts. Steel base channels shall be welded to inserts provided in floor slab. Cross members shall be provided at the junctions of each shipping section and other places as required.. It shall be ensured that the base plate level of HV switchboard shall match with the finished floor level.

The foundation pockets and the grouted bolts shall be cured for a minimum period of 48 hours. Proper level of base frames shall be maintained throughout and shall be checked with water level/spirit level. Steel Shims shall be provided below base frame wherever required.

3.1.3 The switchboard panels shall be taken out from the packed cases and shifted one by one to their proper place. All the panels shall be assembled, aligned and leveled. Alignment of panels shall be checked in both longitudinal and lateral directions. It shall be ensured that panel to panel coupling bolts, bus bar links etc. fit properly without any strain on any part. No new holes for jointing of the panels other than those recommended by the vendor shall be drilled. No gaps shall be left between the panels. Gap if any found between panels shall be suitably sealed using sealing compound or T-profile. The lifting, racking in and out operation of the breaker and all other motions shall be free from any obstruction.

The panels shall be checked for correct vertical position using Plumb line and spirit levels. The switchboard panels shall be tack welded at suitable intervals to base channel.

After erection of switchboard panels, all uncovered portions of floor cutouts shall be covered with 6 mm thick removable chequered plates finished with floor level. The design of the chequered plates shall be such that the maximum allowable deflection is L/200 (where L is the span of the chequered plates in meters) for a live load of 500 kg./sq. meters.

Additional stiffer shall be provided at the bottom if required. Suitable lifting arrangements shall be provided for chequered plates. The chequered plates shall be painted with a coat of red oxide zinc chromate primer after proper surface preparation as per specifications. Where specified, panels' cutouts provided for future use shall be filled with lean concrete.

3.1.4 After completion of Installation of switchboards, all the cubicles, switchboard components such as switches, starters, CT and PT chambers, bus bar chamber shall be cleaned and checked for tightness of all the components.

Vacuum circuit breakers shall be checked for integrity of bottle seals. All loosely supplied items shall be fitted up. Bus bar sections or links shall be inserted and where specified, of high

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voltage equipment shall be insulated. Interconnection wiring between shipping sections shall be done by contractor.

All the wiring connections shall also be checked. Contact resistance of all bus bar joints and contactors shall be checked. Insulator shall be checked for any damage. All the starters, switches, contacts shall be cleaned with CTC where required.

All the moving parts shall be checked for easy and free movement. Hinges of panel doors shall be lubricated to give free and noise less movement. All openings shall be kept completely closed to avoid ingress of any foreign particles inside the panel.

Functional scheme verification of individual feeder shall be carried out and minor wiring modifications in the panel wiring, if required shall be done as per the directions of Engineer-in-charge. Special attention shall be paid to CT circuits' polarity, wiring continuity and correctness in the protection as well as measurement circuits. Auto transfer scheme shall be simulated and verified. During the course of scheme verification tests, defective components if any shall be taken out, after bringing to the notice of Engineer-in-charge. The same shall be replaced by component supplied by owner.

3.1.5 Where switchboard is damp or having a low IR value due to damaged insulators/ bushings/any other insulated parts, or any other reason, the entire switchboard shall be dried-up according to the instruction of the Engineer-in-charge for the IR value to improve to a safe level for commissioning. Care shall be taken to protect the surrounding insulation from direct local heating during the drying up process.

3.1.6 All the metering instruments, protective relays and other relays and contactors shall be tested as per manufacturer's recommendations and according to the instructions of the Engineer-in-charge. Protection relays shall be inserted and connected and settings adjusted as required by the Engineer- in- charge

3.1.7 All moving parts, of closing/tripping mechanism, racking in and racking out mechanism, spouts and shutter closing mechanism shall be checked for proper operation. All the auxiliary contacts of breaker shall be checked-up, cleaned and contact pressure measured.

3.1.8 All the control wiring, PTs, bushings, bus bars, other live parts of switchgear, incoming and outgoing cables shall be meggered.

3.1.9 Electrical simulation tests shall be carried out for all the protective, alarm and annunciation relays and external interfaces to ascertain proper functioning.

3.1.10 Safety insulation mats of approved make and of required voltage grade shall be provided in the sub-station.

3.1.11 **Pre-Commissioning Check List**

Before commissioning any switchboard, following points shall be checked and ensured for safe energising of the switchboard:

i. That the installation of equipment to be commissioned is complete in all respects with its auxiliaries and all other mounting including earthing. Openings in floor within and outside panels have been sealed off. All cover and door gaskets are intact to make the enclosure vermin proof.

ii. That all the metering instruments have been checked and found in working order. Indicating lamps are healthy and are in correct position. All power and control fuses are of proper rating.

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iii. That the polarity test and ratio test of all the PTs and CTs is complete and phase sequence of CTs conforms to the correct vector group connections. Wiring continuity and correctness are ensured in the protection and measurement circuits. Polarity of D.C. supply for all the circuits is correct.

iv. That the high voltage tests of incoming and outgoing cables have been conducted and results are satisfactory.

v. That all the protective relays including both conventional and microprocessor based numerical relays and thermal overload relays/electronic motor protection relays have been tested for secondary injection tests. (Primary injection tests shall be carried out for differential protection, Restricted Earth fault protection at full / reduced current to ensure correctness of complete wiring). Relay settings, status indications, fault annunciations, data logging and display of switchboard SLDs shall be verified from HMI in case the same is provided.

vi. That IR Value has been recorded for bus bars, circuit breaker, incoming and outgoing cables, control wiring and potential transformers. Where required joint resistance of bus bars have been recorded and found to be satisfactory. All the surroundings and panels have been cleaned and temporary earth leads have been removed.

vii. Following tests shall be ensured for all CTs
- Insulation resistance test
- Ratio test through primary injection
- Polarity test
- Knee point voltage for class PS CTs

viii. Following tests shall be ensured for all PTs
- Insulation resistance test
- Ratio test through primary injection
- Polarity test

ix. Following tests shall be ensured for all breakers
- Insulation resistance test
- Breaker closing, opening sequence using 3 pole timers
- High voltage test both in open and close condition for HV breaker
- Contact resistance of all three poles using 100A DC Kit

x. Following tests shall be ensured for all meters
- Calibration of meters
- Functional verification and settings

xi. Following tests shall be ensured for all relays
- Secondary injection test
- Relay settings
- Timing check with timers
- Any other test recommend by the supplier

xii. Following tests shall be ensured for all bus bars
- Tightness of all nuts/bolts using Torque wrench
- IR value
- Contact resistance using 100A DC Kit
- Cleaning of bus bar chamber using vacuum cleaner
- Conducting jelly shall be applied on AL/CU joints as per manufacturer's recommendations
- HV test in case of HV switchboard

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xiii Following tests/Checks shall also be performed on the switchboards

- Functional verification of individual feeders including all spare feeders
- Simulation test for under voltage tripping of related feeders such as motor feeder, capacitor feeders etc
- Verification of control supply schemes
- Stability test for all differential protections
- Simulation test for bus auto/manual change over scheme, fast bus transfer scheme
- Checks for all panel illuminations, indicating lamps, sockets
- All upstream and down stream interlocks

3.1.12 Bus Ducts

The bus ducts as per issued drawings will be supplied in parts and all the parts shall be assembled and the bus bar connections shall be made at site. The insulators in bus ducts shall be inspected for any possible damage during transit and the defective ones shall be replaced. The insulators shall be cleaned. Contact surface of bus bars, bus bar bolts and nuts shall be thoroughly cleaned. Petroleum jelly shall then be applied and bolted connection made. The bus duct enclosure shall be checked for earth continuity and then earthed at two places. The bus duct shall be properly supported between switchgear and transformer. The opening in the wall where the bus duct enters the switchgear room shall be completely sealed to avoid rain water entry. Expansion joints, flexible connections etc. supplied by the manufacturer of the bus duct shall be properly connected. The bus duct levelling shall be checked with spirit level and pendulum weight.

The sandwiched busducts shall be stacked vertically for installation such that each phase and neutral busbar of each sandwich busduct are vertically aligned in a line. This arrangement would allow for shorting of busbars across sandwich busducts before connecting to switchboard.

Pre-commissioning check list

Before commissioning any bus duct, following points shall be checked and ensured for safe energising of the bus ducts

- All joints are tightened using torque trench
- Cleaning of bus duct chamber with vacuums cleaner
- Silica gel breather shall be connected if supplied. If required, silica gel shall be reactivated as per the instruction of engineer in charge.
- Space heater circuit shall be checked and tripping through thermostat shall be ensured
- Contact resistance shall be measured for all phases/neutral using 100A DC kit
- High voltage test in case of HV bus ducts

3.2 Transformers

Transformers on receipt at site shall be unloaded by means of crane or lifting devices of adequate capacity. All lifting lugs shall be used to avoid unbalanced lifting and undue stresses on lugs. Lifting lugs if any provided for partial lifting (e.g. for active part, conservator) etc. shall not be used for lifting complete transformer. Parts other than those identified for lifting of the transformer shall not be used for lifting. While slinging, care shall be taken to avoid slings touching other parts.

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3.2.1 Before lifting transformer, it shall be ensured that all cover bolts are tightened fully. In case when it is necessary to use jacks for lifting, projections provided for the purposes of jacking shall be used. Lifting jacks shall not be used under the valves or radiator tubes. For transporting transformers from stores to site, the transformers shall be loaded on a suitable capacity truck or trailer. The transformers shall be properly supported by steel ropes and stoppers on the trailer to avoid tilting of the transformers in transit due to jerks and vibrations. At no instance, the transformer shall be kept on bare ground. Where it is not possible to unload the transformer directly on a foundation, it shall be unloaded on a properly built wooden sleeper platform. A transformer shall never be left without putting stoppers to the wheels.

3.2.2 Transformers shall be examined, for any sign of damage in transit. Particular attention shall be given to the following in this regard.

i. Dents on tank wall or cooling tubes, radiators
ii. Damage to protruding parts like valves, sight glass etc.
iii. Loosening of bolts due to vibration in transit.
iv. Cracked or broken bushings.
v. Oil leakage particularly along welds.

If anything adverse is noted, the same shall be brought to the notice of Engineer- in- charge.

3.2.3 Contractor shall examine the transformer base, oil pit, fire walls and foundations made by the civil contractor. It shall be ensured that oil spills can not propagate along cable trenches. Any discrepancy noted will be brought to the notice of Engineer- in- charge. Transformers shall be placed on channels or rails over concrete foundations. The transformers shall be levelled, aligned and checked for free movement on the channels or rails. Stoppers shall be provided to the transformers immediately to prevent any movement. Normally transformers upto 1000 kVA rating shall be received duly fitted with radiator tubes, conservator tanks, valves, wheels and other accessories. While the transformers of above 1000 kVA rating may be supplied with loose accessories. All the accessories like radiators, cooling fans, valves, conservator tanks, explosion vent pipe, bushings and other devices which are supplied in different packages shall be checked for any transit damage and cleaned thoroughly before fixing on the transformer. All loosely supplied parts shall be assembled as per manufacturer's instruction manuals/ drawings and documents. All the connections for CTs bushings and other wiring shall be checked for tightness and correctness before replacing the lid or tightening all the bolts. Gravels shall be filled in the transformer bay, soak pit as per requirement.

3.2.4 **Topping of transformer with oil**

Before topping up with oil, transformer shall be fitted with all accessories such as valves, gauges, thermometers etc. Oil samples shall be taken from each drum and tested for determination of dielectric strength. Any sign of leakage of the barrel or of its having been opened shall be recorded and reported. It is necessary to filter the oil before the transformers are filled. It shall be ensured in oil filling operation that no air pockets are left in the tank and that no dust or moisture enters the oil. All air vents shall be opened. Oil shall be filled through a streamline oil filter using metal hose. To prevent aeration of the oil, the transformer tank shall be filled through the bottom drain valve. In a transformer with conservator tank, the rate of oil flow shall be reduced when the level is almost upto the bottom of the main cover to prevent internal pressure from rupturing the pressure relief-pipe diaphragm. Sufficient time shall be allowed for the oil to permeate the transformers and also for the locked -up air bubbles to escape. Any air accumulation in the buchholz relay shall be released.

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3.2.5 **Transformer Oil**

i. Sample of oil from transformer shall be taken from both top and bottom of the tank. In case of oil filled cable box with a separate conservator, separate oil samples shall be taken from cable box.

ii. **Testing of Oil**
For dielectric test, the oil shall be tested as described in IS: 335. The oil shall also be tested for acidity in accordance with the methods prescribed.

iii. Dissolved Gas analysis (DGA) of transformer oil sample may be carried out at site as per IS-9434.

3.2.6 Drying out of the transformers, if required, shall be carried out and record maintained in accordance with IS: 10028. Normally a streamline filter shall be used for drying-up. IR value versus time of both windings along with OTI/WTI and filtrations machine temperature curve for IR value Vs time shall also be plotted and recorded during the drying-up process.

Precautions when drying

i. The maximum sustained temperature to which transformer oil may be subjected shall be limited to 80^0 C.

ii. The transformer shall be carefully monitored throughout the drying out process and all observations shall be carefully recorded.

iii. Drying out shall be continued so that the insulation resistance as prescribed in the standard code of practice is attained and the value remains constant for more than 12 hours. However, a minimum number of cycles shall be done for each transformer as found necessary by the Engineer-in-charge. Generally a Megger reading of 2 megohms / kV at 60^0 C temperature with a 5 kV Megger may be a rough indication for stopping the dehydration.

3.2.7 The following work on transformers shall be performed by the contractor if specifically called for:

i. Before finally commissioning the transformer it may sometimes be desired to run it for a few hours on short-circuit, applying a low voltage, approximately equal to the impedance voltage of the transformer. During this process, regular readings of the insulation resistance of the winding to earth and winding to winding and temperature against time shall be recorded.

ii. Testing of radiator tubes for any leakage and rectifying these by welding / brazing.

3.2.8 **Pre-commissioning Check List**

Before commissioning of any transformer, the following points shall be checked for safe energisation of the transformer:

i. All the accessories have been fixed properly and transformer body and neutral are properly earthed. The transformer dehydration is over and results are satisfactory and approved by the Engineer-in-charge. In case transformers are idle for more than one month after dehydration, transformer oil has been given at least two circulations.

ii. Oil level, in the transformer conservator tank and all the bushings is upto the marked point and the oil has been tested for dielectric strength and acidity.

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iii. Silicagel is in reactivated condition. The breather pipe is clear from any blocking and contains oil upto the proper level.

iv. The explosion vent diaphragm does not have any dents. Accumulation of any oil and air had been released.

v. Operation of off-load and on-load tap changers on all the tap positions is satisfactory. The mechanical parts of the on-load tap changer are lubricated. Motor IR value has been taken and found satisfactory. Tap position mechanical indicator on the transformer and tap position indication meter on the control panel are reading the same tap positions. Tap changer limit switches are operating satisfactorily on the maximum and minimum tap positions. On-load tap changer contact pressure and resistance is as per manufacturers recommendations. Oil level of tap changer tank is upto the required level and oil has been tested for dielectric strength. The tap setting on which the off load tap switch is locked shall be recorded. Generally the off-load tap switch shall be kept on nominal tap.

vi. Buchholz relay (of main tank as well as that of oil filled cable box, as applicable) has been tested and checked up for any friction in the movement, and floats are free. All the other protective relays, alarm and annunciation relays have been tested.

vii. Metering equipment has been tested and polarity test of PT's and transformer winding is satisfactory. Phase sequence and connections have been checked for proper vector group.

viii. Ratio test and winding resistance on all the tap positions is satisfactory.

ix. Gaps of arcing horns for the bushings where provided are in order and earth connections for the surge diverters have been checked.

x. Winding and oil temperature thermometer pockets contain oil and the winding and oil temperature settings on dial gauges are in order.

xi. Transformers fitted with fans for forced air cooling have been checked up for starting and stopping of the fans both in manual and auto mode and air-displacement has been verified.

xii. Simulation tests for all external interface connection alarm, annunciation and trip circuits have been checked and are in order.

xiii. Insulation resistance of all the control circuits and IR value of the transformer windings and all the incoming and outgoing cables have been checked.

xiv. Valves in the cooling system and valve between the buchholz relay and the conservator tank are in open position.

xv. Setting of all the protective relays is at the desired value and DC Trip supply is healthy.

xvi. Magnetic, current and magnetic balance test have been conducted

xvii Simulation test for WTI,OTI,PRV (of main tank as well as that of oil filled cable box, as applicable), OSR

xviii Settings of WTI/OTI as per the instruction of the manufacturer

xix Earth resistance value for the neutral earthing

xx Before charging, it is ensured that water sprinker system, if provided, is installed and is operational.

xxi In case the fire protection system of transformer is by Nitrogen injection system, testing of this system is ensured.

xxii In case of power transformer rated 50MVA and above, SFRA (sweep frequency response analysis) has been conducted at site.

xxiii tan delta test of transformer has been conducted for 50 MVA and above transformer.

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3.2.9 **Observations after Commissioning**

After switching on the transformer the following points shall be observed and recorded.

i. The inrush magnetizing current and no-load current.
ii. Alarm, if any, or if any relay flag has operated.
iii. Voltage and current on all the three phases.
iv. Transformer hum or abnormal noise.
v. Circulation of oil and leakages.
vi. Record current, voltage, cooling air temperature, winding temperature and oil temperature readings, hourly for 24 hours.
vii. Cable end boxes for any over-heating.

3.3. HV and MV MOTORS

3.3.1 All the motors generally would be erected by the mechanical contractor.

3.3.2 Electrical contractor shall keep the motor space heater energised as per the directions of Engineer-in-charge. Electrical contractor shall measure the insulation resistance of motor windings and PI in case of HV motors. Insulation resistance of the motors shall be measured between the winding of the machine and its frame by means of a 500 / 1000 V Meggar in case of 415 V motors. A minimum value of 1 megohm for 415 V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be improved by any of the following methods as directed by the Engineer-in-charge.

i. Blowing hot air from external source.
ii. Putting the motor in oven.
iii. Placing heaters or lamps around and inside after making suitable guarding and covering arrangements so as to conserve the heat.

In case the insulation is low, the following method of drying has to be adopted, after consultation with Engineer-in-charge. During drying the temperature rise of winding shall not exceed the permissible value for the class of insulation used.

i. By locking the motor so that it can not rotate and then applying such a low voltage to the stator terminals so as to pass full load current in the stator keeping the stator winding temperature below 90^0 C . In this case a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. value becomes steady.

ii. By blasting hot air from external source, Maximum temperature of winding while drying shall be 70^0 C to 80^0 C (thermometer) or 90^0 C to 95^0 C by resistance method. Heating shall be done slowly first till steady temperature of winding is reached after 4 to 5 hours, and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, till steady temperature is reached. In case it is essential, the drying process can be supplemented by blower.

3.3.3 It shall be ensured that the motor leads are correctly connected in the terminal box, as indicated in the 'Name Plate'. The covers of all terminal boxes shall be properly fixed, the gaskets intact. The control circuit shall be tested for proper functioning as per circuit diagram.

3.3.4 In case of synchronous machines, slip rings and brush gear shall be polished and brushes shall be fixed in their holders with clearance and pressure as recommended by the manufacturers.

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3.3.5 Before commissioning, the ventilation and cooling system of the motor must be inspected. In case of motor with forced ventilation the air inlet shall be examined to ensure that it is free from moisture and any foreign material. It shall also be ensured that recommended flow and pressure of air is available to produce the required cooling effect.

3.3.6 The motor control gear shall also be carefully examined, the over-load settings may be reduced or time lags bypassed from protective gear to ensure rapid tripping of switchgear in event of faults. The direction of rotation of a new motor especially of large capacity, and phase sequence of supply shall be kept in view while joining and connecting to the motor terminals

3.3.7 Finally the motor shall be started on no-load after decoupling, and shall be allowed to run for a minimum period of 4 hours, or for a time as instructed by Engineer-in-charge. Attention shall be given to the proper running of the bearings, vibration or unusual noises if any. Voltage, starting current, no load current, stator winding and bearing temperature shall be recorded after every 1 hour during this test. Direction of rotation shall be checked and recorded. Normally the motors run in clockwise direction as viewed from the driving end with reference to the phase sequence R, Y, B.

3.3.8 After switching off the motor, the insulation resistance of the motor shall be recorded under hot and cold conditions.

3.3.9 If the no load test run is found satisfactory, the motor shall be allowed to run for 8 hours and all readings shall be recorded.

3.3.10 The following work on motors, may be performed by the contractor if specifically called for.

i. The proper level of bearing oil has to be checked. The condition of grease in bearings shall be checked and in case it is necessary, complete replacement of bearing with specified grade of grease after proper cleaning of the bearing shall have to be done. Wherever external greasing facility exists, the condition of grease may be checked by pumping some new grease of specified grade at start. If the grease coming out is deteriorated grease shall be replaced.

ii. All the motors, motor exciter set and induction generators directly coupled or coupled through reduction gears shall be checked for abnormal vibration, if any Large rated HV motors with journal type bearings are liable to get damaged from shock, rough handling during transit. Any minor defect in a race or roller may give rise to considerable amount of vibration and noise. Contractor shall check and bring to the attention of Engineer-in-charge any defect noticed in this regard.

iii. Due care shall be taken to avoid any damage to bearing insulation wherever provided.

3.4. Batteries/Battery charger

Battery (Lead acid, Nickel Cadmium or VRLA type as specified) shall be erected on stands and insulators supplied by the manufacturer of the batteries. The installation shall be done as per the layout drawings and manufacturer's instructions. Electrolyte if required / as applicable shall be filled as per manufacturer's instructions. Interrow connections shall be made with the leads supplied by the manufacturer. Functional check shall be done on the battery charger including battery charging and discharging, recharging as per the recommendation of the manufacturer.

3.5. Neutral Earthing Resistor

The neutral earthing resistor shall be inspected for any damage to the resistor grid and other components. The resistor shall be levelled and installed. All covers etc. shall be checked for

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tightness to ensure that the enclosure of the resistor is dust, vermin and weatherproof. Earthing conductors shall be taken from the out end terminal of the resistor, for connection to earth electrodes and to the main grid. Check such as IR, operation of space heater, earth resistance shall be done before the commissioning.

3.6 Welding Receptacles

The welding receptacles shall be erected on steel/concrete structures as per the drawings. In isolated places a separate support shall be fabricated and installed.

3.7 Push Button/Control Stations

The push buttons / control stations shall be installed near to the motors to be controlled. Individual channel supports shall be installed as per EIL standard. If control stations for hazardous areas are to be supplied by contractor, these shall be of Ex (d) type, tested by CIMFR and approved by PESO or other applicable certifying authorities. All outdoor push buttons / control stations shall preferably have integral canopies for additional weather protection. The canopy shall be made of 2 mm thick galvanized sheet steel or FRP where these are not integral with the equipment.

3.8 Gang operated Isolators/outdoor Disconnectors

The isolators shall be transported to site in the dismantled condition. All the insulators may be also supplied loose. The contractor shall inspect, clean, assemble and install the isolator on the base structure previously fabricated, erected and levelled by him. The operating mechanism shall be installed on the structure and connected to the isolator poles. The operating mechanism shall be tested by slowly bringing the isolator to the closed position and carrying out the necessary adjustment as per the manufacturer's instructions. The earthing switches, frames and operating handle etc. shall be earthed.

3.9 Contractor shall provide the following items in substation, as per CEA Regulations.

3.9.1 Fire buckets filled with clean dry sand and ready for immediate use for extinguishing fires and fire extinguisher (carbon dioxide, dry chemical extinguisher etc.) suitable for dealing with electric fires shall be conspicuously marked and kept.

3.9.2 First aid boxes containing ointments and medicines for immediate treatment of injuries (As prescribed by Indian Red Cross Society or equivalent).

3.9.3 Instructions of restoration of persons suffering from electric shock in English, Hindi and local language of the district shall be affixed in a conspicuous place.

3.9.4 Danger boards (HV, MV) shall be provided on transformer bay gate, switchboards, entrance to switchgear room and at other places as required by Engineer-in-charge.

3.10 The Communication system and Fire alarm system panels and equipment shall be installed complying to manufacturer's instructions. The location of field station (call back station unit, break glass unit, telephone set etc.) shown on the drawing are indicative. The exact location shall be decided at site by contractor in consultation with Engineer-in-charge. Correct type of equipment with regard to hazardous protection as specified on drawing shall be adhered to by contractor, for installation.

4.0 EQUIPMENT COMMISSIONING

4.1 Field inspection, testing and commissioning of the complete electrical installation shall be carried out as per EIL specification no. 6-51-0087.

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After the equipment is installed properly in accordance with drawings and specifications, contractor shall carry out all pre-commissioning checks and tests as per EIL format in the presence of Engineer-in-charge and test readings shall be recorded and furnished to EIL in triplicate.

4.2 All equipment layout drawings shall be marked by the Contractor for "AS BUILT STATUS" and two sets of hard copies shall be submitted to EIL.

5.0 LIST OF CONSTRUCTION EQUIPMENT

The contractor shall have all necessary construction equipment, tools and tackles and testing instruments to carry out the erection works and to commission the system as specified. These shall include but not be limited to the following, and these shall be brought to site by contractor before the start of work.

5.1 Equipment

i. Portable grinder.
ii. Portable welding machine.
iii Portable gas cutting / welding set.
iv. Pipe threading machine.
v. Pipe bending machine (hydraulic).
vi. Portable drill machine suitable to take up drilling for different sizes as per requirement.
vii Dewatering pump sets (diesel driven).
viii. Power Hacksaw.
ix. Conduit dye set.
x. Hydraulic crimping machine with round/hexagonal dye set.
xi. Hand crimping tool.
xii. Portable electric blowers, vacuum cleaners.
xiii. Miscellaneous items such as slings, pulleys, tarpaulins, wooden sleepers, ladders. etc. as required.
xiv. Safety belts, safety goggles, and gloves.
xv. Separate tool kit for each Electrician.
xvi. Hydraulic/Hand held grease gun

5.2 Test Instruments

i. Insulation tester 1000 V hand driven.
ii. Insulation tester 2500 V motor/hand driven.
iii. Insulation tester 5000 V motor/hand driven
iv. Phase sequence indicator.
v. Earth Resistance tester.
vi. Single phase variac
vii. 3 phase variac of adequate capacity.
viii. Secondary and primary injection testing kit.
ix. Multimeter, both analogue and digital
x. Portable Ammeters, Wattmeters, P.F. meters.

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xi. Portable Voltmeters.
xii. Clip on meters of different ranges.
xiii. Tacho-meter.
xiv. Kelvins double bridge for measurement of very low resistance.
xv. D.C. high -pot test kit.
xvi. A.C. high -pot test kit.
xvii. Oil filtration machine of adequate capacity.
xviii. Lux Meter to measure illumination levels.
xix. Breaker timing 3 pole kit
xx. Timers
xxi. 100A DC milli volt drop (Contact resistance) kit
xxii. Vibration measuring Instrument
xxiii. Thermo meters

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केबल डालने के लिए विनिर्देश

SPECIFICATION
FOR
CABLE INSTALLATION

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	24.01.24	REVISED AND ISSUED AS STANDARD SPECIFICATION	DKC	RS	MKS	MN
5	26.02.18	REVISED AND ISSUED AS STANDARD SPECIFICATION	DC/RM	RS	BRB	RN
4	21.11.13	REVISED AND ISSUED AS SPECIFICATION	FA	SA	UAP/JMS	SC
3	25.04.08	REVISED AND ISSUED AS SPECIFICATION	RKS	SSM	JMS	VC
2	28.02.03	REVISED and ISSUED AS SPECIFICATION	HKM	RSG	VPS	SKG
1	04.08.97	REVISED and ISSUED AS STANDARD SPECIFICATION	RR	VPS	SG	AS

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Abbreviations:

BIS	:	Bureau of Indian Standards
BS	:	British Standards
CCOE	:	Chief Controller of Explosives
CD	:	Compact Disc
CEA	:	Central Electricity Authority
CIMFR	:	Central Institute of Mining and Fuel Research
DC	:	Direct Current
DGFASLI	:	Directorate General Factory Advice Service & Labour Institutes
DGMS	:	Directorate General of Mines and Safety
EHV	:	Extra high voltage
ET	:	Electrical Thread
FGL	:	Finished Ground Level
FLP	:	Flame Proof
FRP	:	Fibre Reinforced Plastic
GI	:	Galvanized Iron
HV	:	High Voltage
IS	:	Indian Standards
ISMC	:	Indian Standard Medium Channel
MS	:	Mild Steel
OISD	:	Oil Industry Safety Directorate
PVC	:	Poly Vinyl Chloride
RCC	:	Reinforced Concrete Cement
SWG	:	Standard Wire Gauge
FO	:	Fibre Optic

Electrical Standards Committee

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Ms. Arvind NP Singh
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1.0 SCOPE

This specification defines the requirements for supply of materials, wherever applicable, installation, testing and commissioning of cable installation.

2.0 CODES AND STANDARDS

2.1 The work shall be carried out in the best workman like manner in conformity with this specification, EIL installation standards, layout drawings, the latest edition of relevant specifications, codes of practice of Bureau of Indian Standards and OISD standards listed below :

SP:30 (BIS)	Special Publication - National Electrical Code.
IS:1255	Code of practice for installation and maintenance of power cables upto and including 33 KV rating.
IS:10810(Part 43)	Method of Test for cables ; Part 43 Insulation resistance.
IS:10810(Part45)	Method of Test for cables ; Part 45 High voltage test.
OISD RP- 147	Inspection and safe practice during electrical installation
OISD 173	Fire prevention and protection system for electrical installation

2.2 In addition to the above it shall be ensured that the installation conforms to the requirements of the following as applicable:

a. CEA Regulations

b. Regulations laid down by CEA/Electrical Inspectorate.

c. Regulations laid down by CCOE/DGMS/DGFASLI (as applicable).

d. The petroleum rules (Ministry of Industry, Government of India)(As applicable)

e. Any other regulations laid down by central/state/local authorities and insurance agencies

3.0 MATERIAL SPECIFICATIONS

All materials and hard wares to be supplied by the contractor shall be new, unused and of best quality and shall conform to the latest specifications of Bureau of Indian Standards.

3.1 Cable Trays

These shall be ladder type trays either prefabricated hot dip galvanised sheet steel trays or site fabricated angle iron painted trays or FRP trays as specified in job specification.

3.1.1 Pre-fabricated hot dipped galvanised trays

The cable trays shall comply with the requirements specified in EIL installation standard enclosed with the specification/Tender.

3.1.2 Site fabricated angle iron trays

Angle iron cable trays shall be fabricated from standard rolled angle iron sections of size 75x75x8 for runners for supporting spans limited to 3000 mm. Cross support shall be 25 x 6

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mm MS flat for tray width upto 500 mm and 32 x 6 mm flat for tray of more than 500 mm wide and spacing between two cross supports shall not exceed 250 mm.

3.1.3 Vertical supports for both the prefabricated and site fabricated type trays shall be fabricated out of ISMC 100 and horizontal supports shall be with 65 x 65 x 6 mm angle iron sections.

Outer most tier of all vertical cable trays shall be covered with GI sheet for protection against physical damage to cables. Bottom most cable tray shall also be provided with GI sheet from the bottom side for the protection of the cables from the hydrocarbon pipes located below. GI Covers also shall be provided for the top most cable trays located outdoors.

Cable racks and trays shall be covered by removable top covers on upper most tiers allowing adequate ventilation in following cases where:

- Mechanical damage of cables is likely to occur during maintenance in the plant.
- Oil or spillage of chemicals can be expected.
- Protection from exposure to sun is required.

GI cover sheet shall allow adequate ventilation to the cables and shall be in standard length of 3000 mm, flanged on both sides for fixing on cable tray.

3.1.4 **FRP type cable trays**

The cable trays shall comply with the requirements specified in EIL standard specification and installation standard enclosed with the specification/Tender

3.2 Cable Glands

Cable glands shall be of nickel plated brass unless otherwise specified. The single compression type cable glands shall be used for indoor panels/equipment (e.g. substation, control room etc). The cable glands for outdoor terminations shall be weather protected, double compression type. Cable glands forming a part of relevant FLP enclosure shall be FLP type, tested by CIMFR or any other recognized independent testing laboratory and approved by CCoE/DGMS or any other statutory authority as applicable. Indigenous FLP glands shall have valid BIS license as per the requirements of statutory authorities. All cable glands shall comply with the requirements given in IS/IEC-60079 Part 0.

Entry thread of cable gland shall be compatible to the entry thread provided in the equipment (BS, ET, NPT, PG as applicable). If required, suitable reducers/adopters shall be used.

3.3 Connectors

Terminations of cables with stranded conductor shall be made with crimped type tinned copper solder less lugs which shall be suitable for the cable size mentioned in cable schedule.

Cable lug material shall be selected based on the applicable as under. For HV cable terminations, heavy duty, long barrel, crimping type lugs shall be supplied. Sector shaped/ circular barrel lugs shall be provided for making connections for cables having sector shaped/ circular geometry of conductors respectively.

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Copper conductor cable & copper bus bar/ terminals	Tinned copper
Copper conductor cable & Aluminium bus bar/ terminals	Bi-metallic (Copper barrel with Aluminium palm)
Aluminium conductor cable & Copper bus bar/terminals	Bi-metallic (Aluminium barrel with tinned Copper palm)
Aluminium conductor cable & Aluminium bus bar/ terminals	Aluminium

3.4 Ferrules

Ferrules shall be of approved type and of size to suit core size mentioned and shall be employed to designate the various cores of control/signal cable by the terminal numbers to which the cores are connected, for ease of identification. Ferrule shall be printed type.

4.0 CABLE LAYING

4.1 General

Cable installation shall include power, control, lighting, fire alarm, telephone and communication cables. These shall be laid in trenches/ cable trays /Duct as detailed in the cable layout drawings. Cable routing given on the cable layout drawings shall be checked in the field so as to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. Any change in routing shall be done to suit the field conditions wherever deemed necessary, after obtaining approval of Engineer-in-charge.

4.1.1 EHV, High voltage, medium voltage power and control cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cables trays, as shown on layout drawings/installation standards. Details of cable routes and cable spacing not shown in detail on these drawing shall be determined by the contractor and approved by the engineer- In-charge.

The individual cable fixing clamps and spacers for laying of single core cables shall be of non-magnetic material. As a general practice, the metallic sheath, screen and armour of single core cables shall be earthed at one point to keep the same at earth potential unless otherwise stated. The continuity of armour and semiconductor screen shall be broken at each joint. Single core cables, when laid in trefoil formation shall be braced by suitable clamps at a distance, not exceeding 3 meters along the cable routing.

If straight through joints are required to be provided on single core cables, armour shall be broken at joints as per manufacturer's recommendations. For single core cables, armour shall be earthed at one end for the cable run length as per manufacturer's recommendation. The armour & screen of EHV cables shall be earthed at one end/both end and surge voltage limiters shall be installed at the straight through joints as specified in job specification/data sheet.

The Telephone, Communication and Fire alarm cables shall run on instrument trays/ducts/ trenches in the units. Wherever these are not available, cables shall be taken in a separate trench/tray with a minimum spacing of 300 mm from power and control cables

Telephone, fire alarm and plant communication cables shall be directly buried in road berm area, (unless otherwise specified in cable layout drawings). These cables shall cross power cables preferably at right angles. Street lighting cables shall be laid on the other side of road berm area.

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Above ground FO cable shall be laid in HDPE ducts and shall run in cable trays of control cables, underground FO cables shall be laid in HDPE duct above layer of control cables & shall be protected with sand & bricks.

Fire barriers shall be deployed at locations where cable enter/exit the substation above ground or/and cable enter/exit between cable cellar to switchgear room through cutouts. Fire barriers shall be as per job specification.

At every 30 meter distances cable tray shall be painted with tray numbers as per cable layout drawings for identification purpose.

The earth continuity of cable trays shall be maintained by providing bonding jumpers as per earthing schedule while changing the level of cable trays.

4.1.2 The lengths indicated in the cables schedule are only approximate. The contractor shall ascertain the exact length of cable for a particular feeder by measuring at site. All cable routes shall be carefully measured .Before the start of cable laying, the contractor shall prepare cable drum schedule and get that approved by Engineer-in-charge to minimize/avoid straight through joints and then the cables cut to the required lengths, leaving sufficient lengths for the terminations of the cable at both ends. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. Extra loop length shall be given for feeder cables where required as per the directions of Engineer-in-charge to meet contingencies

Cables shall be laid in directly buried trench or in RCC trench (underground trench) or in cable tray along pipe sleepers or in over head trays as shown on cable layout drawings. RCC covers of trenches shall be effectively sealed to avoid ingress of chemicals and oils.

Overhead trays shall be installed 2700 mm (minimum) above grade level and 300mm above FGL in case cable trays are installed along with pipe sleepers. At road crossings overhead trays shall be installed at 7000 mm (minimum) above grade level or cables shall be routed through cable tray culvert/ Electrical road crossings as per layout drawings.

Sufficient care shall be taken while laying cables to avoid formation of twist, sharp bend etc. in order to avoid mechanical injuries to cables. Rollers shall be used for pulling of cables.

Cable installation shall provide minimum cable bending radii as recommended by cable manufacturer.

4.1.3 Cables shall be neatly arranged in the trenches / trays in such a manner that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cables within the trenches / trays shall be in line with cable layout drawings. Cable routing between cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size or branch cable trench as indicated in cable layout drawing. Pipe sleeves shall be laid at an angle of maximum 45 to the trench wall. Bending radii of pipes shall not be less than 12D. It is to be ensured that both the ends of GI pipe sleeves shall be sealed with approved weather proof sealing plastic compound after cabling. In places where it is not possible, cables shall be laid in smaller branch trenches. Different rows of cable trays in cable cellar below the cutout shall be so fixed such that the trays don't obstruct cable entry to the panels.

4.1.4 All cables shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tag numbers shall be punched on stainless steel straps (2mm thick, 20 mm wide and of enough length) securely fastened to the cable and wrapped around it.

Each underground cable shall be provided with cable tags of stainless steel straps securely fastened every 30 m of its underground length with at least one tag at each end before the cable

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enters/leaves the ground. In unpaved areas, cable trenches shall be identified by means of cable markers as per installation drawing. These cable markers shall be placed at location of changes in the direction of cables and at intervals of not more than 30 m and also at cable straight through joint locations. Cable route markers shall extend 600mm above ground.

4.1.5 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of cables shall be covered with an approved PVC end cap or rubber insulating tape.

4.1.6 Each row of cables shall be laid in place and before covering with sand. All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench. Every cable shall be given an insulation test in presence of Engineer-in-charge/Owner before filling the cable trench with sand Any cable which is found defective shall be replaced.

4.1.7 Where cables pass through foundation walls, the necessary openings shall be provided in advance for the same by another agency. However, should it become necessary to cut holes in

existing structures for example floor slab etc., the electrical contractor shall determine their location and obtain approval of the Engineer-in-charge before carrying out the same.

4.1.8 Cables for road crossings shall be taken through ERC (Electrical Road Crossing)/cable duct as shown in the cable layout drawings and sleeves/ducts shall be effectively sealed thereafter.

At road crossing and other places where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.

4.1.9 Wherever cable trench crosses storm water, waste water channel/drain, cables shall be taken through PVC/RCC pipes. Where cables are required to cross drains of depth more than 1200 mm, cables shall be taken over the drain on cable trays supported suitably using ISMC 150/200 sections.

4.1.10 Ends of cables leaving trench shall be coiled and capped and provided with protective cover till such time the final termination to the equipment is completed.

4.2 Cables Laid Direct in Ground

Cables shall be laid underground in excavated cable trenches where specified in cable layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables. Cables shall be properly spaced as per installation standards. Maximum number of cable layers in trench shall be preferably limited to 6 layers.

Minimum depth of directly buried cable trench shall be 750 mm for medium voltage and 900 mm for HV Cables. The depth and the width of the trench shall vary depending upon the number of layers of cables as per EIL installation Standards.

Cables shall be laid in buried trenches at depth as shown in the cable layout drawings. It is to be ensured by the contractor that the bottom of buried trenches shall be cleared of all rocks, stones and sharp objects before cables are placed. The trench bottom shall be filled with a layer of sand or stone dust. This sand /stone dust shall be leveled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the largest diameter cable and sand shall be lightly compacted. A flat protective covering of 75 mm thick second class red bricks or concrete tiles as per specification shall then be laid and the remainder of the trench shall then be back - filled with natural soil, rammed and leveled.

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4.3 Cables Laid in Concrete Trench

Cables shall be laid in 5 or 6 tiers in concrete trench as shown on layout drawings. Concrete cables trenches shall be filled with sand /stone dust in hazardous area, switchyard and in transformer bay to avoid accumulation of hazardous gases and oil. RCC covers of trenches shall be effectively sealed to avoid ingress of chemical and oil in process area. Removal of concrete covers where required for the purpose of cable laying and reinstating them in their proper position after cables are laid shall be done by electrical contractor.

Minimum depth of RCC cable trench shall be 500mm for all voltage grades with 300mm clearance between the bottoms of the trench cover and top of the cable. The depth and the width of the trench shall vary depending upon the number of layers of cables and bending radius required for cables as per EIL installation Standards

All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water.

4.4 Above Ground Cables

4.4.1 Cables installed above grade shall be run in cable trays, clamped on walls, ceiling or structures and shall be run parallel or at right angles to beams, walls or columns. Cable routing shall be planned to be away from heat sources such as hot piping, gas, water, oil drainage piping, air-conditioning duct etc. Each cable tray shall contain only one layer of cables as far as possible for power cables. However control cables may be laid in multiple layers in the cable trays. For power & control cables at least 20% space shall be kept as spare in cable trays after completion of cable laying for future use.

4.4.2 Individual/group of cables which run along steel/concrete structures shall be taken through 60/100/150 mm slotted channel tray or channel ISMC-75/100. Cables shall be supported so as to prevent sagging. In general, distance between supports shall be approximately 300 mm for cables upto 25 mm diameter and maximum 450 mm for cables larger than 25 mm dia. to prevent the sagging of cables.

4.4.3 Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of GI saddles / clamps, whereas cables in horizontal run of cable trays shall be tied by means of nylon cords. Distance between supporting angles shall not exceed 600 mm.

4.4.4 All cable trays (other than galvanized/FRP trays) and supporting steel structures shall be painted before laying of cables. The under surfaces shall be properly degreased, derusted, descaled and cleaned. The painting shall be done with one coat of redoxide zinc chromate primer. Final painting shall be done with two coats of approved bituminous aluminium paint unless otherwise specified.

4.4.5 Where cables rise from trench to motor, lighting panel, control station, junction box etc., they shall be taken in GI pipe for mechanical protection upto a minimum of 300 mm above grade for outdoor area. Cable ends shall be carefully pulled through conduit to prevent damage to cable.

4.4.6 All GI Pipes shall be laid as per layout drawings and site conditions. Before fabrication of various profiles of pipes by hydraulically operated bending machine (which is to be arranged by the contractor) all the burrs from the pipes shall be removed. GI Pipes having bends shall be buried in soil / concrete in such a way that the bend shall be totally concealed. For G.I. pipes buried in soil, bitumen coating shall be applied on the buried lengths. Installation of G.I. pipes

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shall be undertaken well before paving is completed and necessary co ordination with paving agency shall be the responsibility of Electrical Contractor.

Following guide shall be used for sizing of GI. pipe.

a) 1 cable in a pipe - 53% of pipe cross-sectional area occupied by cables.

b) 2 cables in a pipe - 31% of pipe cross-sectional area occupied by cables.

c) 3 and above cables in a pipe - 40% of pipe cross-sectional area occupied by cables.

4.4.7 After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/bitumen/suitable sealing compound. Alternatively rubber bushes shall be employed for the purpose of sealing.

4.4.8 Fire proofing of end of power cables at least 1 meter at each end as per OISD norms for the refinery and Petroleum industry, shall be carried out as per the recommendation of the paint supplier .Rates for the fire proofing of cables shall be included in the cable installation and no separate payment shall be made for the painting.

5.0 TERMINATIONS

5.1 All cables up to 1100V grade and higher levels shall be terminated at the equipment by means of compression type cable glands suitable for the cable size. They shall have a screwed nipple with electrical threads and check nut. The cables shall be identified close to their termination points at both the ends of cable(cable numbers shall be punched on stainless steel straps 2mm thick and securely fastened to the cable, wrapped around it) and also along the route at regular intervals, by cable tag numbers.

All cable entries for outdoor termination shall be through bottom/side. Outdoor cable termination through top of equipment shall not be permitted.

5.2 Power cables cores wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections are made, necessary bimetallic washers shall be used.

5.3 In case of control cables, all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules suitable for core size. Wire numbers shall be as per schematic/ wiring/inter-connection diagram. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends, for future use.

5.4 Contractor shall drill holes for fixing glands wherever necessary. Gland plate shall be of non-magnetic material/ aluminium sheet in case of single core cables. All unused cable entries on equipment/panels shall be plugged/sealed.

5.5 The cable shall be terminated at electrical equipment/switchboards through glands of proper size. The individual cores shall then be dressed and taken along the cables ways or shall be fixed to the panels with polyethylene straps. The cable glanding shall be done as per manufacturer's instructions. Cable armour shall not be exposed after termination is complete.

In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit holes shall be drilled in the gland plate for all the cables in one line, then gland plate shall be split in two parts along the centre line of holes. After fixing bottom plate, uncovered cable holes/gaps shall be sealed with cold setting compound.

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5.6 Crimping of lugs to cable leads shall be done by hand crimping / hydraulically operated tool as per requirement. Insulation of the leads shall be removed before crimping. Conductor surface shall be cleaned and shall not be left open. Suitable conducting jelly shall be applied on the conductor lead. Lugs shall enclose all strands of cable core. Cutting of strands shall not be allowed.

5.7 The contractor shall bring to the notice of Engineer-in-charge any mismatch in cable glands, lugs provided with the equipment vis-à-vis to the cable size indicated in cable schedule for taking corrective action.

5.8 The cable joints shall be avoided as far as possible . In case a joint is unavoidable, the following shall be insured:

- The number of joints shall be restricted to minimum as far as possible.
- The location of joints shall be identified with permanent markers.
- No joints shall be allowed in hazardous areas without the approval of Engineer-in-charge.

The jointing and termination of medium voltage power cables shall be carried out by trained personnel only. Jointing and termination of high voltage and EHV cables shall be done by skilled and experienced jointer duly approved by Engineer-in-charge. Only type tested jointing and termination kits of approved make shall be used.

5.9 No unauthorized repairs, modifications shall be carried out on the hazardous area equipment terminal boxes and junction boxes. Damaged enclosures of hazardous area equipment shall be brought to the notice of Engineer-in-charge by contractor. After termination is complete, all the bolts, nuts, hard wares of terminal box shall be properly placed in its position and tightened.

5.10 All cables glands installed outdoor shall be provided with suitable sized shrouds and rates for the same shall be included in the scope of the termination of the cable glands. No separate payment is envisaged for the same.

6.0 TESTING AND COMMISSIONING

6.1 Field testing and commissioning of electrical installation shall be carried out as per EIL specification.

6.2 Before energising, the insulation resistance of every circuit shall be measured from phase to phase, phase to neutral and from phase/neutral to earth.

6.3 Where splices or terminations are required in circuits rated above 650 volts, insulation resistance of each length of cable shall be measured before splicing and or / terminating. After completion of splices and /or terminations, measurements shall be repeated.

6.4 The insulation resistance of directly buried cables shall be measured before cable trenches are backfilled. Measurements shall be repeated after back filling.

For cables upto 1.1 KV grade 1000 V Megger and for H.V. Cables 2.5 KV / 5 KV Megger shall be used.

6.5 D.C. High Voltage test shall be conducted on cables given below after installation.

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a) All 1100 volts grade power cables in which straight through joints have been made.
b) All cables above 1100 V grade.
c) The DC High Voltage test shall be performed as detailed below in the presence of the Engineer-in-charge or his authorized representative only.

Cables shall be installed in final position with the entire straight through joints complete. During the high voltage test, all other electrical equipment related to the cable installation, such as switches, instrument transformers, bus bars, etc., must be earthed and adequate clearance shall be maintained from the other equipment and framework to prevent flash over.
In each test, the metallic sheath/screen/armour shall be connected to earth.

6.6 All checks and tests shall be made as per EIL standard test Performa available with site engineer.

All test readings shall be recorded and submitted to EIL in triplicate sets.

6.7 Cable schedule, cable layout drawings, Interconnection drawings shall be revised and marked by contractor for 'AS BUILT STATUS' and two sets of copies along with CD shall be submitted to EIL.

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प्रकाश व्यवस्था के उत्थापन के लिए विनिर्देश

SPECIFICATION FOR LIGHTING INSTALLATION

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	31 12 2019	REVISED AND ISSUED AS SPECIFICATION	DK/RM	RS	SA	RKT
5	10 03 15	REVISED AND ISSUED AS SPECIFICATION	AKG	SA	BRB	SC
4	15 01 14	REVISED AND ISSUED AS SPECIFICATION	FA	SA	UAP	SC
3	25 04 08	REVISED AND ISSUED AS SPECIFICATION	RKS	SSM	JMS	VC
2	28 02.03	REVISED and ISSUED AS SPECIFICATION	HKM	RSG	VPS	SKG
1	01 09 97	REVISED and ISSUED AS STANDARD SPECIFICATION	RR	VPS	SG	AS
0	31 03 82	ISSUED AS STANDARD SPECIFICATION	RR	VPS	--	--

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Abbreviations:

AC	:	Alternating Current
BIS	:	Bureau of Indian Standards
CCoE	:	Chief Controller of Explosives
CD	:	Compact Disc
CEA	:	Central Electricity Authority
CFL	:	Compact Fluorescent Lamps
CIMFR	:	Central Institute of Mining and Fuel Research
DC	:	Direct Current
DG	:	Diesel Generator
DGMS	:	Director General Mines and Safety
ELCB	:	Earth Leakage Circuit Breaker
FFL	:	Finished Floor Level
FRP	:	Fibre Reinforced Plastic
GI	:	Galvanised Iron
HPMV	:	High Pressure Mercury Vapour
HPSV	:	High Pressure Sodium Vapour
HRC	:	High Rupturing Capacity
IP	:	Ingress Protection
IS	:	Indian Standards
JB	:	Junction Box
LED	:	Light Emitting Diode
MCB	:	Miniature Circuit Breaker
MCCB	:	Moulded Case Circuit Breaker
MDB	:	Main Distribution Board
MS	:	Mild Steel
PE	:	Polyethelene
PVC	:	Polyvinyl Chloride
TPN	:	Three Phase and Neutral
SS	:	Stainless Steel

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1.0 SCOPE

This specification defines the requirements for the supply of equipment, materials, installation, testing and commissioning of the lighting system (lighting fixtures, lighting power distribution, telephone wiring etc.).

2.0 CODES AND STANDARDS

2.1 The work shall be carried out in the best workman like manner in conformity with this specification, EIL installation standards, layout drawings, the latest edition of relevant specifications, codes of practice of Bureau of Indian Standards and OISD standards listed below :

SP:30 (BIS)	Special Publication - National Electrical Code.
IS:5	Colours for ready mixed paints and enamels.
IS:3854	Switch for domestic & similar purpose
IS/IEC 60947	L.V. Switch gear and control gear
IS: 1293	Plugs & socket outlets of rated voltage upto and including 250V & rated current upto 16A.
IS:9537	Conduits for electrical installations
IS 694	Polyvinyl Chloride insulated unsheathed & sheathed cables/cords upto & including 450/750V
OISD RP- 147	Inspection and safe practice during electrical installation
OISD 173	Fire prevention and protection system for electrical installation

2.2 In addition to the above it shall be ensured that the installation conforms to the requirements of the following as applicable:

a. CEA Regulations
b. Regulations laid down by CEA/Electrical Inspectorate.
c. Regulations laid down by CCoE/DGMS (as applicable).
d. The petroleum rules (Ministry of Industry Government of India).
e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 EQUIPMENT SPECIFICATIONS

All materials, fittings and appliances to be supplied by the contractor shall be new, unused and of the best quality and shall conform to the specifications given hereunder. These shall be manufactured in accordance with the latest revision of the specifications of Bureau of Indian Standards/International standards. In the absence of any specifications for a particular item, contractor shall bring material samples along with proven track record to site and get the same approved by Engineer-in-Charge/Owner before installation.

3.1 Lighting and Power Panels

3.1.1 Lighting and Power panels (general purpose panels for safe area) shall be made of 1.6mm thick sheet steel or polycarbonate material as specified and shall be dust and vermin proof. All metal surfaces shall be cleaned free of rust, given a coat of red-oxide primer and finished with two coats of epoxy based paint of shade 632 of IS 5. Panels shall be indoor/outdoor type as specified. Indoor type panels shall have IP42 degree of protection and shall be suitable for surface or flush mounting on wall surface as specified. Lighting and power panels located outdoor shall be IP55 weather protected and shall also preferably have integral canopy for

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additional weather protection. The canopy shall be made of 2mm thick galvanized sheet steel, FRP, SS (1mm) where these are separate from the equipment.

3.1.2 Lighting and Power panels shall have TPN incoming feeder and single phase outgoing feeders. Lighting circuit feeders shall be rated for 10 amps and power circuit feeders shall have current rating of 16Amps.In power panels for window Air conditioning units, power circuit feeder shall be rated for 20 amps. Panels shall be equipped with phase and neutral bus bars of required current carrying capacity. The outgoing feeders shall be provided with single pole miniature circuit breakers (MCBs) for safe areas and double pole MCBs for hazardous areas. The incomer shall be with MCB and ELCB unit unless otherwise specified. In case of panel for Green Buildings incomer shall also be provided with Energy Meter as per GRIHA requirements. Accordingly, CTs shall be provided in all the three phases for current measurement and voltage shall be tapped directly from phases through control fuses. Miniature circuit breakers shall be mounted in such a way that the operating levers project outside the front Bakelite cover plates for ease of operation. A hinged door to cover the operating knobs shall be provided. In addition, a circuit diagram indicating incomer details and outgoing details viz. Circuit number, circuit rating, and load connected and details of the load shall be pasted inside the panel. Also a laminated copy of the diagram shall be provided inside the panel in a suitably designed pocket. Two external earthing studs for connection to the plant earthing grid shall be provided on the panel. Further, the panel shall be provided with an earth bus bar with terminal studs for connection to the third core of each outgoing circuit. Each circuit phase and neutral shall be given ferrule numbers. Complete wiring inside the panel, shall be neatly bunched with PVC tape and button. Sufficient terminals shall be provided in the terminal block so as to ensure that not more than one wire (core) is connected to a terminal. The panel shall have knock out holes or removable gland plate for the entry of incoming and outgoing conduits or cables. The panels shall be complete with requisite number of cable glands as specified.

3.1.3 The Main distribution board (MDB) where used, shall be made of 2mm thick sheet steel panel, dust and vermin proof similar in construction to Lighting and Power panels but with TPN MCCB or switch fuse incoming and TPN outgoings (MCB with ELCB units and MCB without ELCB unit as applicable) of required numbers as specified.

3.1.4 All MCBs shall be of M9 category as per IS 8828 and sensitivity of ELCBs shall be 100 mA-300 mA unless otherwise specified.

3.1.5 Wherever the size of incoming cable to lighting, power panels/MDB is more than 35 sq.mm a suitable cable adapter box shall be provided and attached to the panel. The incoming cable leads shall be connected to terminal block (bolted type terminals) of required size. This terminal block shall be connected to TPN incomer unit through separate PVC insulated copper conductor wires/bus bars. Sufficient space shall be provided (minimum 300mm) between gland plate and the bottom of terminal block for easy termination.

3.2 Lighting Fixtures

The types, makes and catalogue numbers of various types of lighting fixtures shall be as given in Fixture schedule, job data sheet. HPMV/HPSV/fluoroscent lighting fixtures shall be complete with ballast, starters and capacitor, as required. Control gears for these fixtures shall be integral or non-integral as specified in lighting layout drawings. LED lighting fixtures shall be complete with its driver. All lighting fixtures should have sufficient number of cable entry for loop in & loop out and also should have sufficient terminals & size for connection of cable/wire. All lighting fixtures to be installed in battery room should be flame proof type, suitable to IIC gas group and should have anticorrosive feature. Unless otherwise specified, all fixtures shall be supplied complete with lamps. Ballast for fixture shall be copper wound or electronic type. The fixtures shall be of high power factor type i.e. at least 0.9 or more.

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3.3 Switches

Switches, manufactured in accordance with IS: 3854 shall be used for non hazardous areas. Switches in areas where concealed wiring has been adopted, shall be flush mounting Modular type unless otherwise specified. For surface conduit wiring, Modular type switches in surface mounted box shall be provided. Industrial Type switches (Weather protected) shall be used for outdoor areas. Industrial Type switches (Flame proof/Weather proof) shall be provided for tall structures, columns, vessels, walkways etc as shown in lighting layout drawings.

3.4 Receptacles

Three pin type 5A/15A receptacles manufactured in accordance with IS: 1293 shall be used for non hazardous areas. The receptacles and the controlling ON/OFF switch shall be mounted in the same enclosure box but these shall be in separate units to facilitate replacement by parts. Flush mounting type receptacles shall be used in areas where concealed wiring has been adopted and surface type shall be used in other areas. For exhaust fans and wall mounted air circulators, socket and switch enclosures shall be separate. In buildings such as sub-station, DG. Shed, Workshop, maintenance shop etc. industrial type metal clad socket outlets and plugs shall be provided. These sockets shall be supplied complete with plugs. Modular type receptacles along with required boxes shall be provided for indoor application in case shown in the layout.

3 phase, 5 pin, 40A, 415V sockets shall be provided for tower air conditioners in control rooms. The receptacles and the controlling ON/OFF switch shall be mounted in the same enclosure box but these shall be in separate units to facilitate replacement by parts.

3.5 Outlet Boxes

The outlet boxes used as point outlets shall be prefabricated GI sheet steel of 18 gauge thickness and of adequate depth. Outlet boxes custom fabricated for sockets, switches, fixtures and fan regulators etc. shall be made of MS sheet having minimum thickness of 1.6mm.Outlet boxes shall be galvanized/ nickel plated after fabrication. These shall be complete with terminal block suitable for connection of wires up to 4 sq. mm Front cover plate shall be of 3mm thick Bakelite / PE sheet. The colour shall suit the shade of the walls or shall be white if the shade of the walls is not finalised. The sheet shall extend at least 2 cm on all sides of outlet box. Cover plate shall be fixed by cadmium plated brass screws and cup washers. Outlet boxes shall be provided with adequate number of knock outs on all the sides for ease of wiring either with conduits or without conduits.

3.6 Conduit and Accessories

Conduits for Electrical installations shall conform to IS: 9537. The type of conduit (steel / GI/ PVC) shall be as specified on drawing. Black enameled steel or GI conduit shall be of 1.6mm thick and the minimum wall thickness of PVC conduit shall be 1.6mm. Generally PVC conduits shall be used in concealed wiring and for surface wiring GI conduit (in plant buildings) and black enameled steel conduit (in non plant buildings) shall be used.

3.7 Lighting Poles

Lighting poles shall be fabricated as per EIL installation standards enclosed with the specification from ERW steel tubular pipes of specified section, with joints, swaged together when hot and beveled on outside edges or hexagonal shape. Poles shall be coated with bituminous preservative solution on the ground portion of the outside surface. Remainder of the outside surface shall be given one coat of redoxide primer and finished with two coats of aluminium paint. The pole shall have a marshalling box near the bottom to contain HRC

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fuses, a neutral link, an earth stud and terminal block. FRP/GRP type lighting poles shall be provided in case shown in the layout.

3.8 Lighting Mast

3.8.1 Lighting masts (Lattice tower) where used, shall be fabricated as per EIL Standard Drawing enclosed with the tender/specification. They shall be complete with 2 nos. MS flats provided at the base plate for connection to the plant earthing grid. A ladder, platform, handrail, a weather protected TPN switch (at 1500mm from ground level) and a weather protected distribution board fabricated out of sheet steel shall be provided at the top of mast. The TPN Switch and the distribution board shall also have a canopy for additional weather protection. The TPN switch shall be suitable for looping one more lighting mast from the same incoming power supply. The distribution board shall have TPN bus bars of 30 Amps. rating and 12 Nos. outgoing circuits each with a 6A single pole MCB. The distribution board shall have cable entries from bottom. Necessary space provision and suitable mounting arrangement shall be made on top of the tower for mounting of ballast (choke) and condensers for all the circuits and the lighting fixtures. The masts shall be given one coat of red oxide primer and two coats of aluminium paint. Distribution board shall be fabricated out of 2mm thick sheet steel and shall be painted with two coats of enamel over a base coat of red oxide.

3.8.2 Unless otherwise specified the flood lighting high masts shall be telescopic type conforming to EIL specification and data sheet.

3.9 Wires

Wires shall be PVC insulated and shall be of 660 Volts grade as per IS694. Conductor shall be of stranded copper and size shall be minimum 1.5 Sq. mm for lighting, 2.5 Sq. mm for 15A power socket circuits and 4 sq. mm for split A/C power socket circuits. Red/Yellow/blue wires for phases, black wire for neutral and green wire for earth shall be used (size of earth wire shall be same as for phase and neutral size). Wire size for air conditioning circuit feeders shall be as indicated in the panel schedule.

3.10 Ceiling fan/Exhaust fan

Ceiling fans shall be of 1200mm sweep with BEE (Bureau of energy efficiency) rating of minimum 3 star, unless otherwise specified with double ball bearing and regulator. The suspension down rod shall be sturdy mild steel rod of adequate diameter and of minimum length of 300mm with shackles suspension arrangement as per IS. For exhaust fans, the sweep dia. and air CFM shall be as specified in job specification. Exhaust fans for battery room shall be flame proof type, suitable to IIC gas group and with anticorrosive blades suitable for use in acidic fumes. Exhaust fans shall be with BEE rating of minimum 3 star.

3.11 Decorative switches and sockets

Decorative lighting switches and sockets where specified, shall be modular in design. All these items shall fit into the same frame with overall standard dimensions. Frames shall be suitable for surface and flush mounting in brick / concrete wall. The frames shall be suitable for conduit entry from all the sides. Switches and sockets shall match colors of the frame and cover plates to obtain a combination which shall match décor of the interiors of Control Room, Administrative buildings, offices rooms etc.

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4.0 LIGHTING INSTALLATION

4.1 General

4.1.1 The lighting fixtures in the plant shall be fed from lighting panel. All outdoor lighting shall be group controlled manually or through synchronous timer or photocell. Lighting wiring between panel and lighting fixtures shall be done with PVC insulated 3-core (phase, neutral and earth) copper conductor armoured cable for hazardous areas. Wiring in the building shall be done by means of 3-core copper, conductor PVC insulated, un-armoured cables, or PVC insulated copper conductor wires in conduit/Metsec channel as specified. All joints of conductors in Switch boards/JBs Fittings shall be made only by means of approved mechanical connectors (nylon/PVC connectors). Bare twisted joints shall not be permitted any where in the wiring system.

4.1.2 The lighting layouts furnished by owner will indicate approximate locations of lighting fixtures. The electrical contractor shall determine, with approval of Engineer-in-Charge, the exact locations of each fixture in order to avoid interference with piping or other mechanical equipment and also with a view to obtain as much uniform illumination as practicable, and to avoid objectionable shadows. Conduits shall be laid out by the contractor to suit field conditions and as per directions of the Engineer-in-Charge.

4.1.3 On walkways, platforms and other outdoor area, lighting fixtures shall be located nearer to landing of stairs or ladders, gauges, flow meters, panel boards and other equipment to provide proper illumination.

4.1.4 The minimum height of any lighting fixture shall be preferably not less than 2.5 meters above the floor level.

4.1.5 All outdoor cable terminations to outdoor junction boxes, panels, socket outlets etc. shall be through bottom or from side. Top entries for cables shall be avoided to avoid water entry. All cable glands for outdoor terminations shall be double compression type and the gland shall be covered with PVC or rubber boot shroud. All unused cable entries shall be plugged with suitable blanking plugs.

4.1.6 Mounting height of equipment shall be as under:-

Top of Switch Box	:	1200 mm from FFL (Finished floor level)
Top of Lighting/Power Panel	:	1800mm from FFL
5/15 Amp. receptacle	:	300mm from FFL unless otherwise specified (1200 mm for process areas and industrial sheds)
Lighting fixture	:	As indicated in layout drawing
Exhaust fan	:	In the cutout provided / as indicated in Layout drawings.

4.1.7 Fixtures shall be firmly supported from the structures. Support clamps etc. may be bolted or welded to the existing steel work or metal inserts. In case of concrete structures, where metal inserts are not available, fixtures shall be suspended from concrete surfaces with the help of anchor fasteners. In such cases special care shall be taken to see that anchoring is firm. In places where ceiling fans are provided, lighting fixtures shall be suspended below the level of fan to avoid shadow effect.

4.1.8 The lighting fixtures on various circuits shall be suitably interlaced so that failure of any one circuit does not result in complete darkness.

4.1.9 Circuit cables in a group shall be cleated to structure by using galvanised strip clamps or cable run in cable trays wherever trays are available. Spacers and cleats shall be of required size to

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accommodate the cables. All hardware shall be galvanised or zinc passivated. Underground lighting cables (in paved areas) shall be taken in suitable GI sleeves buried at a minimum depth of 300mm from FFL. GI pipe sleeves shall be extended to 300mm above FFL. Exact termination/layout of GI pipes (for protection of cables) shall be decided at site as per site convenience in consultation with Engineer-in-charge.

4.1.10 Wiring for all outlet sockets shall be done with 3 cores of equal sizes for phase, neutral and earth. The terminals of switch sockets shall be suitable to receive the size of wire specified.

4.1.11 All lighting fixtures shall be provided with terminal block with required terminals suitable for connection of wire up to 2.5 sq. mm copper conductor.

4.1.12 The cable shall be straightened after unwinding it from the drum. All cables are clamped/laid in straight run without any sag and kink.

4.1.13 For location where fan points are shown, fan hooks with junction box shall be provided during concreting.

Where fan hooks and JBs. are provided separately JB shall be located within a distance of 300mm from hook for mounting of ceiling rose.

4.1.14 Industrial type plug sockets with 20A MCB or rating as per job specification shall be provided at a height close to window/split AC units so that plugging of power cable coming from AC units can be easily achieved without adding any extensions to it, however, its switch should be installed at a height of 1200 mm from FFL.

Socket outlets and plugs for installation in Sub-station building, DG shed, workshop, and maintenance shop etc. shall be of industrial metal clad type.

4.1.15 Wiring for exhaust fans shall be terminated in receptacles as specified in layout drawing and the connection from receptacle to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires. Switch for exhaust fan shall be located in a separate switch board along with other switches.

4.1.16 Identification of indoor receptacles shall be done through stickers/paint.

4.1.17 Wherever in process units fire proofing of structural columns has to be done, it would be the responsibility of lighting installation agency to weld adequate size of angles to such structures before its fireproofing which length should be such that it is projected at least 65 mm outside from the finished surface of fireproofing. These welded angles shall be utilized latter to install lighting cable trays, bracket & clamps of lighting fixtures, frame of lighting/power panels, welding/ conveyance receptacles, control gears & other electrical equipments as required. It should be the responsibility of lighting installation agency to coordinate with other agencies which are involved in fireproofing works to complete the all structural/welding works before completion of fire proofing works.

4.2 Conduit System

4.2.1 Surface or concealed conduit system of wiring shall be adopted, as specified in the drawings. Required number of pull boxes shall be used at intervals to facilitate easy drawing of wires. Separate conduit shall be run for lighting and power circuits. Further, conduits for Normal lighting/Emergency lighting/DC critical lighting shall be separate. Conduit layout shall be decided at site as per site conditions. Drop conduits for switch boards shall be decided by contractor as per wall locations shown in Architectural drawings. All exposed run of conduits on surface, shall be vertical or horizontal.

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4.2.2 Only threaded type conduit fittings shall be used for metallic conduit system. Pin grip type or clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed.

Conduit shall be of minimum 25mm dia. Maximum number of wires permissible in a conduit shall be seven/nine for wire size of 2.5 sqmm/1.5 sq.mm. respectively.

4.2.3 The exposed outer surface of the conduit pipes, including all accessories forming part of the conduit system, shall be adequately protected against rusting. In all cases, bare threaded portion of conduit pipe shall not be exposed unless such bare threaded portion is treated with anti corrosive preservative or covered with approved plastic compound.

4.2.4 Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side. Where concealed wiring is done, junction boxes shall be used so as to rest on shuttering properly. Conduits shall be laid above reinforcement. All conduit connections shall be properly screwed and Junction box covers shall be properly fitted so as to avoid entry of concrete slurry.

4.2.5 Conduit pipes shall be fixed by 1.6mm thick GI saddles on 3mm thick GI. saddle bars of required width in an approved manner at intervals of not more than 50cms for straight run. At places near junction boxes, bends, or similar fittings, saddle and bars shall be provided on either side.

4.2.6 Where concealed wiring is to be adopted, conduits shall be laid in time before concreting of the slab. Pull wire (GI or steel) shall be provided inside conduit for the ease of wire pulling. The contractor shall coordinate his work with other agencies involved in the civil works in such a way, that the work of the other agencies is not hampered or delayed. Vertical conduit runs shall be made in wall before plastering is done so as to avoid chasing. Where chases are made for conduit run contractor shall fill these chases or any other openings made by them after completing the work and patch the surface. During installation, care shall be taken to see that proper covers are provided to prevent rusting of conduits. Locations of all point outlets, junction boxes shall be marked with brick powder or sand so that these are easily identified after shuttering removal. As built conduit layout drawing shall be submitted by contractor after completion of the work.

4.2.7 All junction boxes, bends and other accessories shall be of the same material as that of conduit and shall have the same protective coatings.

4.2.8 After erection, the entire conduit system shall be tested, for mechanical and electrical continuity and shall be permanently connected to earth by means of approved type of earthing clamps.

4.3 Hazardous Area Installation

4.3.1 Wiring in hazardous area shall be done by using minimum 2.5mm^2 copper conductor armoured cable.3rd core of the cable shall be used as earth conductor for earthing of lighting fixture. Circuit wiring feeding hazardous areas shall be controlled by two pole switches/MCBs (for phase as well as neutral isolation).Switches for lighting panels installed in hazardous area shall have a pole to break the neutral in addition to poles for phases.

4.3.2 Correct type of lighting equipment (fixtures and JBs) with regard to hazardous protection as specified in the drawing shall be installed for the areas classified as Zone 1, Zone 2 etc.

4.3.3 The terminations in the junction boxes and the lighting fittings shall be done avoiding possibility of loose connections due to vibrations. After the terminations are made the cover of the junction boxes and the lighting fittings shall be closed properly with all bolts and hard wares in correct position, retaining its explosion and weather protections. In fixtures having

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double cable entries, both the entries shall be used for looping in and looping out connection, thus minimising the use of a separate junction box. Wherever separate control gear boxes (CG box) are provided looping in and looping out connections shall be through CG box, thus avoiding the use of an additional junction box. All unused cable entries shall be sealed with suitable plugs.

4.3.4 Circuit cables shall be firmly cleated in a group along columns/ beam/ladders/side channels/platform using 1.6mm thick GI saddles on 25x3 mm GI saddle bar at intervals of 400mm to 500mm for straight run and on either side close to bending and at both termination ends as per the directions of Engineer-in-charge. Where required 3 or more of cables shall be taken in perforated150mm wide slotted channel cable tray after getting the approval of Engineer-in-charge. Minimum straight run shall be 3000mm.Cables shall not be routed along hand rails.

Where fire proofing column/structures are encountered, all cabling shall be taken in GI pipes of required size and both ends shall be sealed, well before fire proofing is done. Similarly equipment such as lighting fixture, control gear box, lighting/ power panels, field call stations, junction boxes etc. shall be installed on suitable steel mounting frame/distance bracket, thereby avoiding direct contact with the concrete used for fire proofing.

4.3.5 Cable glands for terminating cable on flameproof equipment shall be of double compression FLP type. Any material/equipment specified to be supplied by contractor for installation in hazardous areas, shall be tested by CIMFR and duly approved by CCoE or DGMS or any other applicable statutory authority. All indigenous FLP equipment shall also have valid BIS license as required by statutory authorities.

4.4 Building Lighting

4.4.1 The type of wiring system shall comprise surface/concealed conduit system or cable wiring as specified on layout drawings.

4.4.2 Mounting details of fixtures shall be indicated on the drawings. If specified on the drawings, a group of fluorescent lighting fixtures which are to be mounted end to end shall be fixed to mild steel cold rolled sections of 50mm x 50mm and of 1.2mm thick (Metsec channel). The entire assembly shall be fixed to the ceiling with necessary number of supports which may be by means of steel conduit or chromium plated chain link as required. The `Metsec' Channel shall run continuous in suitable sections from one end to other end of wall. The complete channel shall be spray painted, with approved colour as per the directions of Engineer-in-Charge. All wires inside channel shall be neatly bunched by nylon tape and buttons.

4.4.3 Wiring in areas above false ceiling shall be done in Surface Conduit (25mm dia GI conduit) suitably clamped to the true ceiling. Vertical drops from true ceiling for panels, switches, receptacles etc. shall be taken in 25mm dia PVC conduit concealed in walls upto switchboards/panels. Lighting fixtures shall be supported from true ceiling. Exact location of fixtures shall be finalised in co-ordination with air-conditioning duct diffuser layout, panel's layout and false ceiling grid layout. To facilitate easy maintenance `Looping back system` of wiring shall be followed throughout. Accordingly supply tapping's and other interconnections including for earthing are made only at fixture connector blocks or at switch boards. Required number of junction boxes shall be used at intervals for wire pulling and inspection.

4.4.4 All wires in conduit shall be colour coded as specified. Each circuit shall have independent phase neutral and earth wire. However when group of circuits are run in a single conduit the earth wire can be common.

4.4.5 Building conduit lighting system of wiring where measurement is done on point wiring basis generally consists of two parts. The first part is the circuit wiring which includes the work necessary from lighting panel up to switch box and from switch box to another switch box.

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The second part is the point wiring which shall include the work necessary from tapping point in the switch box upto various fixtures or fan outlets/ceiling roses.

4.4.6 Switches for light fixtures/exhaust fans in battery room shall be provided outside the Battery room.

4.4.7 Lighting layouts for non-plant buildings (such as ware house, cement godown, gate house, workshop, service building, rest room, etc.) shall be prepared by installation contractor as defined in the scope of work.

The following basic data/document for preparation of layouts will be provided to the contractor.

i) Architectural drawings
ii) Illumination level required
iii) Type of lighting fixture
iv) Type of wiring (concealed/surface conduit/cable wiring etc.)

Based on the above input, contractor shall prepare and submit lighting layout drawings, panel schedules, conduit layout drawings for concealed wiring, design calculations wherever required, for review by purchaser before erection work is started. The lighting layout drawing shall show the location, type and mounting details of lighting fixtures, receptacles, junction boxes, layout of circuit indicating number of wires etc. The number of points in a circuit shall not exceed ten and the load in each circuit shall be less than 1000 Watts.

The panel schedule shall include rating of incoming and outgoing feeders, number of outlets, load for each outgoing circuit, etc.

All drawings shall be prepared preferably in A0 and A1 size. Panel schedules shall be in A4 size drawings. Final submission of drawings shall be in soft copies (CD form) and in bound volumes.

4.5 Street Lighting

4.5.1 Street lighting poles to be located on road side shall be installed at a minimum distance of 300mm from the edge of the walkway of the road (road berm). Size of wires from marshalling box upto fixture shall be 1.5mm²/2.5mm², copper conductor PVC insulated.

4.5.2 Each pole shall be earthed at two points by connecting to the plant earth grid as shown on Installation standards.

4.5.3 Street lighting fixture shall be mounted on steel tubular poles as per standard drawings. The foundation for the street lighting poles will be made by electrical contractor. Street lighting poles shall be supplied with a base plate.

4.5.4 The poles shall be numbered as per the drawings/ directions of Engineer Incharge.

4.6 Mast Lighting

4.6.1 The lattice structure masts shall be installed on concrete foundations with the base plate bolted on to the anchor bolts. The lattice structure shall be painted with a coat of primer and two coats of aluminium paint, the second coat to be given just before handing over to the owner. The masts shall be numbered as per drawings. The masts shall be connected to the plant earth grid at two points

4.6.2 The main feeder upto the distribution board of lighting mast shall be through PVC insulated armoured cable of size as specified in the respective drawing. Wiring from Distribution Board to each flood-light fixture shall be by means of a 3-core 2.5sqmm, copper conductor PVC

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insulated armoured cable. All the cables shall be neatly clamped to the structure at intervals not exceeding 25 cms.

4.6.3 Exact orientation of flood lighting fixtures shall be decided at site to achieve optimum utility of these fixtures.

4.7 Telephone Wiring

Conduits for telephone wiring in buildings shall be of 1.6mm thickness. 25mm dia black enameled steel conduit/PVC as per IS 9537, installed on wall surface or concealed or as specified in job specification.

Conduit installation system shall comply with the requirements given in clause 4.2 `conduit system'. Required number of pull boxes shall be provided at interval for easy drawing of wires. The telephone wiring shall be done with 0.63mm dia annealed copper conductor PVC insulated 660V grade, twin flat wire, unless otherwise specified in job specification. One telephone socket outlet shall be provided for connection to telephone instrument.

5.0 TESTING AND COMMISSIONING

5.1 Lighting installation shall be tested and commissioned by installation contractor as per EIL specifications. Precommissioning checks and tests shall include but not be limited to the following:

(i) The insulation resistance of each circuit without the lamps (load) being in place shall be measured and it should not be less than 500,000 ohms. (Between phases, phases to neutral, phase/neutral to Earth).

(ii) Current and voltage of all the phases shall be measured at the lighting panel bus bars with all the circuits switched on with lamps. If required load shall be balanced on the three phases.

(iii) The earth continuity for all socket outlets shall be checked. A fixed relative position of the phase and neutral connections inside the socket shall be established for all sockets.

(iv) After inserting all the lamps and switching on all the circuits, minimum and maximum illumination level shall be measured in the area and recorded.

(v) It shall be ensured that switch provided for ON/OFF control of point (light/fan/socket) is only on LIVE side.

(vi) Operation of ELCB's shall be checked.

Contractor shall duly fill in all the above test results and submit the test reports to Engineer-in-Charge in triplicate.

5.2 All lighting layout drawings shall be marked by contractor for 'AS BUILT STATUS' and two sets of hard copies plus 1 set of soft copy in CD, shall be submitted to EIL.

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अर्थिंग डालने के लिए विनिर्देश

SPECIFICATION FOR EARTHING INSTALLATION

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	26 02 19	REVISED AND ISSUED AS SPECIFICATION	DC	RS	BRB	RKT
4	26 03 14	REVISED AND ISSUED AS SPECIFICATION	FA	SA	BRB	SC
3	25 04 08	REVISED AND ISSUED AS SPECIFICATION	RKS	SSM	JMS	VC
2	28 02 03	REVISED & ISSUED AS SPECIFICATION	HKM	RSG	VPS	SKG
1	16 07 97	REVISED & ISSUED AS STANDARD SPECIFICATION	RR	VPS	SG	AS

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Abbreviations:

BIS	:	Bureau of Indian Standards
CD	:	Compact Disc
CEA	:	Central Electricity Authority
DGMS	:	Director General Mines and Safety
GI	:	Galvanized Iron
IEC	:	International Electrotechnical Commission
IS	:	Indian Standard
MS	:	Mild Steel
OISD	:	Oil Industry Safety Directorate
PESO	:	Petroleum and Explosive safety organization.
UPS	:	Uninterrupted Power Supply

Electrical Standards Committee

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Members: Ms. S. Anand
Mr. Parag Gupta
Mr. M.K. Sahu
Mr. Saeed Akhtar (Inspection)
Ms. N.P. Guha (Projects)
Ms. NS Bhattacharya

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1.0 SCOPE

This specification defines the requirements for the supply of earthing and lightning protection materials and installation of the earthing and lightning protection systems.

2.0 CODES AND STANDARDS

2.1 The work shall be carried out in the best workman like manner in conformity with this specification, EIL Installation Standards, layout drawings, the latest edition of relevant specifications, codes of practice of Bureau of Indian Standards and OISD Standards listed below :

SP:30 (BIS)	Special Publication-National Electrical Code
IS/IEC:62305	Protection against lightning.
IS:3043	Code of practice for earthing
IS:7689	Guide for control of undesirable static electricity.
OISD 110	Recommended practices on static electricity
OISD 147	Inspection and safe practice during electrical installation.
OISD GDN 180	Lightning protection.

2.2 In addition to the above, it shall be ensured that the installation conforms to the requirements of the following as applicable:

a. CEA Regulations

b. Regulations laid down by CEA/Electrical Inspectorate.

c. Regulations laid down by PESO/DGMS (as applicable).

d. The petroleum rules (Ministry of Industry, Government of India).

e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 MATERIAL SPECIFICATIONS

3.1 All materials and hardware to be supplied by the contractor shall be new, unused and of best quality and shall conform to the specifications given here under and to latest specifications of Bureau of Indian Standards. Contractor shall bring material samples to site and get it approved by Engineer-in-charge before installation.

3.2 The main earth grid conductor shall be hot dip galvanised M.S. flat unless otherwise specified. Sizes for main conductors shall be as indicated on the earthing layout drawing .Amount of galvanizing shall be 610gm per sq.metre. Earth electrodes and Earth plate shall be as per EIL Installation Standards.

4.0 EARTHING NETWORK

4.1 This consists of main earth conductor (grid conductor) forming a closed ring network with required number of earth electrodes connected to it to provide a common earth for electrical devices and metallic structures. From each earth electrode two distinct connections shall be made to the main earth conductor. The earth plates shall be used for taking multiple earth connections to two or more equipments.

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4.2 The earth conductor shall be laid along cable trays/cable trench/pipe racks/ buried in pavement/ below finished grade level as indicated on the earthing layout drawing. Where lined cable trenches are available, the earth conductor shall be preferably laid in the trenches and shall be firmly cleated to the sidewall of concrete trenches using GI clamps at interval of 400 mm to 500 mm and near to the termination end. The earthing conductor shall run along one of the cable trays along the overhead cable route. The earthing conductor shall be suitably cleated and electrically bonded to all the other cable trays on the same cable route at a regular interval of 25 to 30 meter through copper flexible (insulated) . The earthing for equipment shall be tapped from the main earth conductor and not from cable tray support structure. Earth conductor when laid underground shall be at a depth of 500mm below finished grade level.

4.3 Joints and tapping's in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and shall be suitably protected by giving two coats of bitumen and covering with Hessian tape. Earth strip laid above ground shall be welded across straight through joints and joints shall be suitably protected by giving two coats of bitumen to avoid oxidation and insulation film formation of the strip surface. When two earth strips are to be jointed by means of welding, lap welding with an overlapping of strip equivalent to double the width of the strip and all four sides(three on the Top and one bottom) shall be continuously welded. All joints at tappings above ground shall be by means of connector/lugs. A minimum of two bolts of adequate size shall be used for this purpose. Earthing strip joints at earth plate and equipment shall be through GI bolts, nut etc.

5.0 INSTALLATION OF EARTH ELECTRODE

5.1 Earth Electrode shall be installed as shown on installation standard and layout drawings. The location shown on the layout drawings are indicative.

The exact location of earth electrodes in the field shall be determined by contractor in consultation with the Engineer-in-charge, depending on the soil strata and resistivity. Earth electrodes shall be located avoiding interferences with road, building foundation, column, pipelines etc. The civil area drawings shall be referred for this. The distance between two electrodes shall not be less than twice the depth of electrode. However in the areas where there is physical limitation to meet the above separation distance between two electrode, the mutual spacing can be reduced to a value not less than the driven depth of each earth electrode.

5.2 Electrodes shall preferably be located in a moist soil which has a fine texture, grain size and distribution. Wherever practicable the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes and soil packed by watering and ramming as tight as possible.

5.3 The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.

5.4 All earth electrodes shall be tested for earth resistance by means of standard earth test meter. The tests shall take place in dry months, preferably after a protracted dry spell.

5.5 The disconnect facility shall be provided for the individual earth electrode to check its earth resistance periodically.

5.6 Location of earth electrodes shall be marked by permanent markers for easy identification. All earth Electrodes shall be serial numbered and also marked on 'As Built' drawing for future reference.

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5.7 Individual earth electrodes shall be provided for each lightning arrestor, each dropper of building earthing protection system and flood light mast.

5.8 Earthing system provided for concrete paved area by other agency where applicable; shall be connected to the plant earthing system below ground by minimum two earth connections.

5.9 Top of earth pit shall be flushed with finished floor level in paved areas. In unpaved areas, top of earth pit shall be projected 100 mm above finished ground level.

6.0 CONNECTION

The earth system connections shall generally cover the following:

- Equipment earthing for personnel safety
- System neutral earthing
- Static and lightning protection

6.1 The following shall be earthed.

- System neutral
- Current and potential transformer secondary neutral
- Metallic non-current carrying parts of all electrical apparatus such as transformers, switchboards, bus ducts, motors, neutral earthing resistors, capacitors, UPS, battery charger panels, welding receptacles, power sockets, lighting/power panels, control stations, lighting fixtures etc.
- Steel structures/columns, rail loading platforms etc.
- Cable trays and racks, lighting mast and poles
- Storage tanks, spheres, vessels, columns and all other process equipment.
- Fence and Gate for electrical equipment (e.g. transformer yard etc.)
- Cable shields and armour
- Flexible earth provision for Wagon, Truck
- Shield wire
- Ladder, staircase as per layout drawing/job specification.

Conductor size for branch connection to various equipment shall be as per EIL Installation Standards unless otherwise stated on earthing layout drawings.

6.2 All process pipelines shall be bonded and earthed at the entry and exist points of unit battery limit of hazardous area.

6.3 Steel pipe racks in the process units and offsite area shall be earthed at every 24 meters.

6.4 Equipment/street light pole etc. located remote from main earth network may be earthed by means of individual earth electrode and earth conductor unless otherwise stated in job specifications/earthing layout drawing.

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6.5 Lightning protection shall be provided for the equipment, structures and buildings as shown on layout drawing. Self conducting structures shall not require separate aerial rod and down conductors. These shall however be connected to the earthing system at two or more points as shown on layout drawing. Each down conductor shall be provided with an earth electrode with test pit and all earth electrodes shall be interconnected through underground strip. Lightning protection system may be bonded to electrical safety earthing system, inside ground. Lightning down conductor shall be brought to earth electrode in shortest straight path as feasible to minimise surge impedance.

6.6 The main earthing network shall be used for earthing of equipment to protect against static electricity.

6.7 All medium and high voltage equipment (above 250V) shall be earthed by two separate and distinct connections with earth.

6.8 Plant instrument system clean earthing, UPS system clean/safety earth, Data concentrator panel, HMI etc shall be separate from the electrical earthing system, if mentioned in job specification/ layout drawings.

6.9 All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.

6.10 All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground wherever provided

Equipment foundation bolts shall not be used for earthing connection.

6.11 Earth connections shall be made through compression type cable lugs/by welded lugs.

6.12 All hardware used for earthing installation shall be hot dip galvanised or zinc passivated. Spring washers shall be used for all earthing connections and all connections adequately locked against loosening.

6.13 Lighting fixtures and receptacles shall be earthed through the extra core provided in the lighting circuit/cable for this purpose.

6.14 The reinforcements of sub-station building coulumns/beams and the sub-station floor slab shall be connected to main earth grid.

7.0 TESTING AND COMMISSIONING

7.1 Field inspection, testing and commissioning of electrical installation shall be done as per EIL standard specification.Earthing systems/connections shall be tested as follows:

7.2 Resistance of individual earth electrodes shall be measured after disconnecting it from the grid by using standard earth test meggar.

7.3 Earthing resistance of the grid shall be measured after connecting all the earth electrodes to the grid. The resistance value of an earth grid to the general mass of earth shall be as follows:

- For the electrical system and equipment, a value that ensures the operation of the protection device in the electrical circuit but not in excess of 4 ohm. However for generating stations and large sub-systems, the value shall not be more than 1 ohm.
- For lightning protection, the value of 5ohms as earth resistance shall be desirable, but in no case it shall be more than 10 ohms.

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7.4 The resistance to earth shall be measured typically at the following points:

a) At each electrical system earth or system neutral earth.

b) At each earth provided for structure lightning protections.

c) At one point on earthing system used to earth electrical equipment enclosures.

d) At one point on earthing system used to earth wiring system, enclosures, such as metal conduits and cable sheaths or armour.

e) At one point on fence enclosing electrical equipment.

7.5 All earthing layout drawings shall be marked by contractor for 'AS BUILT STATUS' and two sets of hard copies plus 1 set of soft copy, shall be submitted to EIL. For projects, where layout drawings have been prepared based on 3D modeling, contractor shall carryout necessary changes for 'AS BUILT STATUS' in the 3D model.

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विद्युत संस्थापनों के साइट निरिक्षण, परिक्षण व कमीशनिंग के लिए विनिर्देश

SPECIFICATION FOR FIELD INSPECTION, TESTING AND COMMISSIONING OF ELECTRICAL INSTALLATIONS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	13 08 19	REVISED & ISSUED AS STANDARD SPECIFICATION	RM	RS	SA	RKT
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0	02 08 01	ISSUED AS STANDARD SPECIFICATION	UAP	RR	VPS	MI

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Abbreviations:

AC	:	Alternating Current
AFC	:	Approved for Construction
BIS	:	Bureau of Indian Standards
CCOE	:	Chief Controller of Explosives
CEA	:	Central Electricity Authority
DC	:	Direct Current
DCS	:	Distributed Control System
DGMS	:	Director General for Mines and Safety
ECS	:	Electrical Control Station
GI	:	Galvanized Iron
HV	:	High Voltage
IS	:	Indian Standard
MV	:	Medium Voltage
OISD	:	Oil Industry Safety Directorate
PESO	:	Petroleum and Explosives Safety Organization

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1.0 SCOPE

This specification covers the requirements for the field inspection, testing and commissioning of Electrical Equipment and Installation, forming part of electrical power distribution and utilisation system.

2.0 CODES AND STANDARDS

2.1 The field inspection, testing and commissioning of electrical equipment shall be carried out in line with this specification and the latest edition of following Indian Standards and OISD standards.

SP-30(BIS)	National Electrical Code.
IS 1255	Code of practice for installation and maintenance of power cables up to & including 33 kV rating.
IS-7816	Guide for testing Insulation resistance of rotating machines.
IS 10810(Part 43)	Method of Test for cables; Part 43 Insulation resistance.
IS 10810(Part 45)	Method of Test for cables; Part 45 High voltage test.
IS 12729	HV Switchgears
OISD 137	Inspection of Electrical Equipment.
OISD 147	Inspection and safe practice during electrical installation.

2.2 In addition to the above it shall be ensured that the installation conforms to the requirements of the following as applicable:

a. CEA Regulations
b. Regulations laid down by CEA / Electrical Inspectorate.
c. Regulations laid down by Tariff Advisory Committee/Loss prevention council.
d. Regulations laid down by PESO/DGMS (as applicable).
e. The petroleum rules (Ministry of Industry, Government of India).
f. Any other regulations laid down by central / state / local authorities / insurance agencies

3.0 FIELD INSPECTION, TESTING AND COMMISSIONING

3.1 Contractor shall carry out complete field inspection, testing and commissioning of electrical equipment as per Inspection & Test plans.

3.2 Before the completed installation or an addition to the existing installation is put into service, inspection / pre-commissioning checks and tests shall be carried out by contractor. In the event of defects being found out, the same shall be rectified and the installation retested as applicable.

3.3 The pre-commissioning inspection among other requirements shall include visual inspection, checking the workmanship of the installation, the rating of equipment, safety clearances, sizes of cables installed, conformance to the AFC document, soundness of switchgear bus connections, wiring properly dressed and labeled, sealing of unused cable entries, checking of all safety interlocks, control/interface functions as per requirement etc.

3.4 Visual inspection for soundness of bus bar connections of busducts, terminal connections of equipment/motor shall be carried out. It shall be ensured that no foreign materials are present inside busduct and equipment terminal boxes. After the visual inspection, all the covers of terminal boxes, inspection chambers shall be refitted with gaskets, bolts & nuts as per equipment manufacturer's instructions.

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3.5 Pre-commissioning tests shall include but not be limited to the following:

- Continuity test for each winding and power and control circuits.
- Insulation test for each winding and power and control circuit
- High voltage test for cables
- Dielectric strength test on transformer oil.
- Checking the correctness of wiring schemes, control circuit interlocks for intended functioning.
- Verification of phase sequence.
- Testing of all types of relays/releases for required operation.
- Testing of measuring instruments for proper functioning.
- Earth continuity test for all circuits.
- Checking of safety features for correctness of operation, etc.
- Checking of all wired interface contacts (analogue, digital input/output contacts) for DCS and ECS interface, at panel and equipment terminal chambers as applicable.

  (Electrical contractor shall co-ordinate with other agencies involved for the above and provide support services for checking interfaces of electrical equipment and the intended functioning)

- Earth resistance measurement for each earth electrode, and the earthing system as a whole.
- Lighting installation shall be tested for correct illumination levels, with fittings installed. Fittings shall be operated only with specified type of a lamp or tube.

3.6 After the above tests and inspection are completed, control circuits shall be tested for correct operation under all operating combinations and proved correct before applying power to main circuit.

3.7 Plant Communication, Fire alarm detection and telephone system shall be checked for correct operation and intended function.

3.8 A close visual inspection of electrical equipment in hazardous areas shall be made to ensure that equipment is suitable for the classified zone and gas group and correctly installed, with all covers, bolts, nuts and hardwares intact and there is no physical damage mark seen on the enclosure

3.9 Site Acceptance Test procedure for specific equipment shall be furnished by the respective equipment vendor in line with testing requirements as per relevant standard, this specification & relevant equipment specifications. The Site Acceptance Test Procedure/ Site Testing Procedure shall be duly reviewed by the site Engineer-in-Charge. The contractor shall provide necessary assistance to the equipment vendor to perform Site acceptance testing to enable the equipment vendor to perform the same.

3.10 All pre-commissioning checks and tests shall be carried out as per the directions of Engineer-in-charge. In addition to the equipment manufacturer's instructions, pre-commissioning check requirements shall also be complied. All tests shall be carried out by contractor in the presence of EIL/Owner's representatives

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3.11 The contractor shall bring to site all required tools, tackles, and testing instruments for carrying out field testing. Contractor shall use only calibrated measuring and test instruments and shall maintain valid calibration records.

3.12 The **Insulation Resistance** test values for various electrical equipment shall be as below:

3.12.1 **Cables**

The insulation resistance test values for cables shall be as per following table:

Rated voltage of the Cable	**DC Test Voltage in Volts**	**Minimum Insulation resistance in Mega ohms**
Lighting and power circuit wiring	250	1
650/1100V grade cables	1,000	10
1,900/3,300V grade cables	1,000	200
3,800/6,600V grade cables	1,000	200
6,350/11,000V grade cables	5,000	200
8,700/15,000V grade cables	5,000	200
12,700/22,000V grade cables	5,000	200
19,000/33000V grade cables	5,000	200
38000/66000V (72500V) grade cables	5,000	500

3.12.2 **HV, MV and Miscellaneous Switchboards**

The insulation resistance test values for the switchboards shall be as per following table:

Rated voltage of the Switchboard	**DC Test Voltage in Volts**	**Minimum Insulation resistance in Mega ohms**
33,000V	5,000	200
11,000V	5,000	200
6,600V	1,000	200
3,300V	1,000	200
415V	1,000	100
240V	500	10
110V	500	10

3.12.3 **Generators and Motors**

3.12.4 The insulation resistance test values for Generators and Motors shall be as per following table:

Rated voltage of the Generators and Motors	**DC Test Voltage in Volts**	**Minimum Insulation resistance in Mega ohms at 40 °C**
11,000V	5,000	120
6,600V	1,000	80
3,300V	1,000	50
415V	1,000	15
240V	500	12

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3.12.5 **Transformers**

The insulation resistance test values for the Transformers shall be as per following table:

Rated voltage of the Transformers	**DC Test Voltage in Volts**	**Minimum Insulation resistance in Mega ohms at 40 °C**
Up to 600V	1,000	100
601 to 5000V	2,500	1,000
5001 to 15,000V	5,000	5,000
15001 to 35,000V	5,000	10,000
35001 to 66,000V	5,000	10,000
66001 to 132,000V	5,000	10,000

3.12.6 It shall be ensured that during insulation tests, electronic devices and components that are liable to get damaged on applied test voltage shall be disconnected from circuit. The instructions of equipment/panel manufacturer shall be followed strictly in this regard.

3.13 High-voltage Testing

3.13.1 DC high voltage test shall be conducted as per following table on all HV feeder cables and also on 1100 V grade cables where straight through joints have been made. This table shall be used as a reference and the DC high voltage test shall be conducted considering equivalent IS/ IEC voltage grades upto 66kV

Rated Voltage of Cable (kV)	**TEST VOLTAGE (kV) BETWEEN**		**Duration (Minutes)**
U_o / U*	**Any Conductor and Metallic Sheath/ Screen/Armour**	**Conductor to Conductor (For Unscreened Cables)**	
0.65/1.1	3	3	5
1.9/3.3	5	9	5
3.3/3.3	9	9	5
3.8/6.6	10.5	18	5
6.6/6.6	18	18	5
6.35/11	18	30	5
11/11	30	30	5
12.7/22	37.5	-	5
19/33	60	-	5

*U_o : Phase Voltage

U : Line Voltage

The cable cores must be discharged on completion of DC high voltage test and cable shall be kept earthed until it is put into service.

DC test voltage for old cables shall be 1.5 times rated voltage or less depending on the age of cables, repair work or nature of jointing work carried out, etc. In any case, the test voltage shall not be less than the rated voltage.

3.13.2 AC high voltage test shall be conducted as per following table on all HV Switchboards.

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Rated Voltage (rms Value in kV)	Rated 1 Min. Power Frequency Withstand Voltage (rms Value in kV)		Duration in Minutes
U	To Earth, Between Poles and Across Open Switching Device	Across the Isolating Distance	
3.6	10	12	1
7.2	20	23	1
12	28	32	1
24	50	60	1
36	70	80	1
72.5	140	160	1

The withstand voltage values across the isolating distances are valid only for switching devices, where the clearance between open contacts is designed to meet the safety requirements specified for disconnectors.

3.13.3 DC Voltage test of the cable over-sheath shall be conducted as per IEC 60840 & IEC 60229:- A D.C. voltage of 4kV per millimetre of specified thickness of extruded over-sheath shall be applied with a maximum of 10kV D.C. between the underlying metallic layers and the outer electrode, for a period of 1 min. All metallic layers under over-sheath shall be connected together.

This test requires that the over-sheath has an outer "electrode" which may be moist backfill or a conductive layer.

No breakdown of the over-sheath shall occur during the test

3.13.4 AC voltage test of the cable insulation shall be conducted as per IEC 60840, rated voltage may be applied for 24 hours.

3.14 All protective relays including thermal overload relays shall be tested by secondary injection current. Primary injection tests shall be carried out for differential protection, restricted earth fault protection at full/reduced current to ensure correctness of complete wiring.

3.15 Before energizing any equipment, 'COMMISSIONING CLEARANCE FORM' as per standard format shall be duly filled in by contractor and submitted to EIL/owner.

3.16 It shall be ensured that the electrical inspectorate approval is available before energizing the equipment

4.0 RECORDS

Contractor shall keep up-to-date records of all activities carried out and test results. Field inspection / test reports shall be submitted to EIL / Owner by the contractor in bound volumes (triplicate copies).

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STANDARD SPECIFICATION FOR ROADS AND FLEXIBLE PAVEMENTS (UPTO WMM LAYER)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
2	16 03 20	REVISED & ISSUED AS STANDARD SPECIFICATION	NS	GS/AK	RS	RKT
1	25 06 14	REAFFIRMED & ISSUED AS STANDARD SPECIFICATION	GYAS	RKS	RBB	SC
0	18 05 09	ISSUED AS STANDARD SPECIFICATION	VG	RBB	NK	ND

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Abbreviations:

IS	:	Indian Standard
IRC	:	Indian Road Congress
LSTK	:	Lump Sum Turn Key
P.I.	:	Plasticity Index
POL	:	Petroleum Oil and Lubricant
WMM	:	Wet Mix Macadam

Structural Standards Committee

Convener: Mr. Rajanji Srivastava

Members:
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Mr. Gyasuddin
Mr. Charanjeet Singh (Projects)
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1.0 SCOPE

This specification covers the material and construction details for earthwork in filling for road embankments, filling with sand/murrum, Granular Sub-Base (GSB) as sub-base, WMM as base course for roads and flexible pavements.

2.0 REFERENCES

2.1 Codes & Standards

IS: 460	Specifications for Test Sieves
IS: 2720	Methods of Test of Soil
IRC: 109	Guidelines for Wet Mix Macadam
IRC: 36	Recommended Practices for the Construction of Earth Embankments for Road Works

2.2 Specifications

Specifications for Road and Bridge Works – Ministry of Road Transport & Highway (Orange Book)

NOTE: -Latest Edition of all Codes, Standards and Specifications shall be followed.

3.0 CONSTRUCTION OF EMBANKMENTS, SUBGRADE AND SHOULDERS

3.1 Materials

Only those materials, considered suitable by the Engineer-in-Charge shall be employed for the construction and that considered unsuitable shall be disposed off as directed by Engineer-in-Charge at contractor's cost and no claim for compensation will be entertained. The Contractor shall give the samples of earth, he proposes to use for filling along with the following characteristics of the sample to Engineer-in-Charge prior to collection and use, for approval.

i) Mechanical analysis or gain size analysis as per IS: 2720 Part IV.

ii) Liquid limit as per IS: 2720 Part V.

iii) Plastic limit as per IS: 2720 Part V.

iv) Moisture density relationship as per IS: 2720 Part VIII.

The material (soil) used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.

Material (soil) having plasticity index less than 20 shall be used for filling purposes. Soil having laboratory maximum dry density of less than 1.5gm/cc shall not be used. Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the materials proposed to be used for filling.

The material (soil) shall have a minimum CBR of 8% for filling in subgrade.

The work shall be so planned and executed such that the best available material (soil) is reserved for the top portion of embankment.

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3.2 Filling and Compaction

3.2.1 The area where filling is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 97% of maximum laboratory dry density of the soil as per IS: 2720 Part VIII. All soft patches must be worked out to remove the soft soil and selected approved earth must be filled back and compacted. The minimum CBR of the natural soil shall be 3%. In case, the CBR of the natural soil is less than 3%, Geotechnical recommendation for the same shall be obtained and accordingly the treatment shall be carried out.

3.2.2 Payment for the removal of loose top soil as described in clause 3.2.1 above shall be included in the item for earthwork in filling. No separate payment for consolidation of exposed ground surface will be made. The rate quoted for the earth fill shall be inclusive of the cost of clearing and stripping, consolidation, including watering, testing etc. of the exposed ground.

3.2.3 Approved fill material shall be spread in uniform layers not exceeding 20 cm in loose depth for embankment filling. Shoulder construction shall be so organised as to keep pace with the construction of different layers of the pavement, which may require earth fill thickness less than 20 cm. All clods, lumps etc. shall be broken before compaction.

3.2.4 In general the soil shall be spread uniformly over the entire width of embankment or shoulder as the case may be. For large embankments, the spreading of soil shall he as directed by Engineer-in-Charge.

3.2.5 Successive layers of filling shall not be placed until the layer under construction has been thoroughly compacted to satisfy the requirements laid down in this specification.

3.2.6 Prior to rolling, the moisture content of material shall be brought to within $\pm 2\%$ of the optimum moisture content as described in IS: 2720 - Part-VIII. The moisture content shall preferably be on the wet side for potentially expansive soils.

3.2.7 After adjusting the moisture content as described in Clause 3.2.6, the layers shall be thoroughly compacted by means of 8-10T rollers or equivalent vibratory rollers till 97% of maximum laboratory dry density for both road embankment and sub-grade as per IS:2720 Part VIII is obtained.

3.2.8 Each layer shall be tested in field for density and accepted by Engineer-in-Charge subjected to achieving the required density before laying the next layer. A minimum of one test per 500m^2 area for each layer shall be conducted.

3.2.9 All type of rollers that should be employed for compaction shall be as per direction of Engineer-in-Charge.

3.2.10 If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Engineer-in-Charge to obtain the required density.

3.2.11 The filling shall be finished in conformity with alignment, levels, cross-sections and dimensions as shown in the drawings.

3.2.12 Extra material shall be removed and disposed off as directed by Engineer-in-Charge.

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3.3 TOLERANCE

Embankment and shoulders for roads, units etc. shall be carried to within a tolerance of plus minus 2.5 cm. from final lines but shall be to required grades and slopes.

4.0 FILLING WITH SAND/MURRUM

4.1 Sand for filling shall preferably be locally available sand, clean and free from any chemical or other impurities. Murrum for filling shall be clean and well graded. Sand/Murrum shall not contain any vegetation, organic, clayey or other material and shall be obtained from a source approved by Engineer-in-Charge.

4.2 Murrum/Sand shall be spread in layers not exceeding 15 cm in loose thickness over the areas. Each layer shall be uniform in density, quality of material and ' moisture content before compaction. The moisture content shall be within two percent of the optimum moisture content as per IS: 2720 Part VIII.

4.2.1 In case of pure sand, flooding with water is permissible.

4.3 Compaction of each layer shall be by mechanical means as per directions of Engineer-in-Charge. Only in accessible reaches shall be worked manually. Each layer shall be uniformly compacted to obtain 85% relative density in case of sand and 95% of maximum laboratory dry density in case of murram. If the material fails to achieve the required density, the layer shall be reworked with necessary alteration in compaction, so that the required compaction is obtained. A minimum of one test per 500 m^2 area for each layer shall be conducted.

4.4 Subsequent layers shall be placed only after the layer already laid has been compacted to the required density-and approved by Engineer-in-Charge.

4.5 The finished surface must be dressed to required grade and slope. Excess material must be removed from compaction site, as directed by Engineer-in-Charge.

5.0 GRANULAR SUB BASE (GSB) COURSE

The Granular sub-base course shall consist of one or more layers, each of minimum 100 mm compacted thickness and maximum 200mm compacted thickness provided suitable type of compacting equipment shall be used.
The sub-base course shall be provided as per Section 401 of the Orange Book.

5.1 MATERIALS

5.1.1 The material shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and shall conform to the Grading II as given in Table 400-1 of the Orange Book and the physical requirements given in Table 400-2 of the Orange Book. If the water absorption of the aggregates determined as per IS:2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS:5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS:5640).

5.2 LAYING OF GSB

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5.2.1 Preparation of Sub-Grade

The sub-grade shall be prepared as explained above free from all vegetation and other extraneous matter, lightly sprinkled with water, if necessary and rolled with two passes of 80- 100 kN smooth wheeled roller.

5.2.1 Spreading & Compacting

The clauses as given in Clause 401.3.2 of the Orange Book shall be followed.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2720 (Part VIII). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

5.2.2 TESTING

The surface finish of the completed construction shall conform to the requirements of Clause 902 of the Orange Book. All materials and workmanship shall comply with the provisions set out in Section 900 of the Orange Book.

6.0 WET MIX MACADAM BASE COURSE

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be upto 125 mm with the approval of the Engineer-in-Charge.

The base course shall be provided as per Section 406 of the Orange Book.

6.1 MATERIALS

6.1.1 AGGREGATES

6.1.1.1 Coarse aggregates shall be crushed stone. The aggregates shall conform to the physical requirements as per Table 400-12 of the Orange Book. The grading requirements shall conform to the Table 400-13 of the Orange Book. Material finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.
The final gradation approved within these limits shall be graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

6.2 CONSTRUCTION OF WMM

The construction shall be carried out as per Clause 406.3 of the Orange Book.

6.2.1 Preparation of Base and Provision of Lateral Confinement of Wet Mix

6.2.1.1 The sub grade or sub-base to receive WMM course shall be prepared to the required grade and camber and made free of dust and other extraneous matter. Before starting with WMM construction, side shoulders shall be constructed in advance to a thickness corresponding to the compacted layer of the WMM course for lateral confinement of aggregate. After shoulders are ready, their inside edge shall be trimmed vertical to receive WMM. The practice of

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constructing WMM in a trench section excavated on the embankment/formation must be avoided.

6.2.2 Preparation of Mix

6.2.2.1 WMM shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement, like, pug mill or pan type mixer. The mixing plant features shall be as per Clause 406.3.3 of the Orange Book.

6.2.2.2 Optimum moisture for mixing shall be determined in accordance with IS:2720 (Part VIII), after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

6.2.3 SPREADING OF MIX

6.2.3.1 Immediately after mixing, the mixed material shall be transported to site and spread uniformly and evenly upon the prepared sub-base/ base in required quantities. Hauling of the mix over a freshly completed stretch is not permitted.

6.2.3.2 The mix may be spread either by a paver finisher or motor grader or a combination of both as directed by Engineer-in-Charge. However, the use of paver finisher should be preferred to motor grader for spreading. For portions where mechanical means cannot be used, manual method of spreading can be adopted with approval of Engineer-in-Charge. The equipment used for spreading shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic controls suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

6.2.3.3 The paver finisher shall be self-propelled, conforming to the features as given in Clause 406.3.4 of the Orange Book.

6.2.3.4 The surface of the layer as spread shall be carefully checked with templates and all high or low spots remedied by removing or adding wet mix materials as may be required. The layer thickness may be checked by depth blocks during construction. No segregation of coarse or fine particles shall be allowed. The layer as spread shall be of uniform gradation and shall not have pockets of fine materials.

6.2.4 Compaction

6.2.4.1 After the mix has been laid to the required thickness, grade and cross-fall/camber, the same shall be uniformly compacted to the full depth with a suitable roller. If the thickness of the single compacted layer does not exceed 100mm, a smooth wheel roller of 80 to 100 KN static weights may be used. For compacting single layer of higher thickness upto 200mm, the compaction shall be done with the help of vibratory roller of minimum static weight 80-100 KN with an arrangement for adjusting the frequency and amplitude. An appropriate frequency and amplitude may be selected. The speed of roller shall not exceed 5km/hr.

6.2.4.2 In portions having uni-directional cross-fall/super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line of the road, uniformly over-lapping each preceding track by at least one-third width until the entire surface has been rolled upto the centre line. Alternate trips of the roller shall be terminated in stops at least 1m away from the preceding stop. The process of compaction is then to be repeated from the other edge of the pavement upto the centre line,

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until the entire pavement is compacted. Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected.

6.2.4.3 Along forms, kerbs, walls or other places not accessible to the roller, the mix shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without sacrificing the surface to permit proper bonding of the added material shall not be permitted.

6.2.4.4 Rolling should not be done when the sub-grade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or sub-grade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 m straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and cross-fall. In no case should the use of unmixed material be permitted to make up the depressions.

6.2.4.5 Rolling shall be continued till the density achieved is at least 98% of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part VIII).

6.2.4.6 After completing, the finished surface shall present a well-closed appearance, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layers and re-compacted.

6.2.4.7 Longitudinal joints and edges shall be constructed true to the delineating line parallel to the centre line of the road. All longitudinal and traverse joints shall be cut vertical to the full thickness of the previously laid mix before laying the fresh mix.

6.2.5 Setting and Drying

After final compaction of the wet mix macadam course, the road shall be allowed to dry for 24 hours before overlaying with any bituminous layer.

6.2.6 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902 of the Orange Book. Control on the quality of materials and works shall be as per Section 900 of the Orange Book.

6.2.7 Where the surface irregularity of the WMM course exceeds the permissible tolerances, or where the course is otherwise defective, the rectification of that area shall be carried out as per Clause 406.6 of the Orange Book.

7.0 PAYMENT

7.1 FILLING IN EMBANKMENT, SUB GRADE AND SHOULDERS

7.1.1 Payment for filling shall be made on cubic meter of volume calculated on the basis of cross section plotted from the level of the ground surface prepared as described in clause 3.2 above and from where filling is to be carried out and the levels reached after filling and due consolidation.

7.1.2 Rates for embankment, shoulder or fill formation shall include cost of material for filling, royalties, transportation, breaking clods, watering, consolidation, providing testing apparatus and testing the degree of consolidation, providing and operating, including POL and operator

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charges of necessary road rollers and other equipment, dressing and levelling of sides and top surfaces and any work incidental to this etc.

7.2 FILLING WITH SAND / MURRUM

Payment for sand/murrum filling shall be made on the basis of volume of fill, after placement and compaction. The rate quoted shall include cost of sand/murrum, royalties, transportation, handling, compacting, watering, testing at various stages, dressing, removal of surplus material and any other work incidental to this etc.

7.3 GRANULAR SUB BASE COURSE

Payment for granular sub-base shall be made on cubic meter basis, measured after consolidation and finishing. Rate shall include supply of all materials, royalty, taxes, handling, transportation, spreading in layers, including compacting, cost of carrying the material to work for all leads and lifts, providing all equipment, testing etc. complete as per specifications and satisfaction of Engineer-in-Charge.

7.4 WET MIX MACADAM BASE COURSE

Payment for laying WMM shall be made on cubic meter basis of each layer of WMM laid, measured after compaction and finishing. Rate shall include supply of all materials, royalty, taxes, handling, transportation, spreading in layers, including compaction by vibration roller, cost of carrying the material to work for all leads and lifts, providing all equipments etc. complete as per specifications and satisfaction of Engineer-in-Charge.

7.4 The payment clause(s) as described in the above clauses shall not be referred / applicable for LSTK Jobs

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STANDARD SPECIFICATION FOR CLASSIFICATION OF SOIL FOR EARTHWORK IN SITE GRADING

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4	14 03.19	REAFFIRMED AND ISSUED AS STANDARD SPECIFICATION	AVM	AJS	RS	RKT
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Abbreviations:

gm/cc : Gram Per Cubic Centimeter

Structural Standards Committee

Convener: 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 SCOPE

This specification covers classification of soil for earthwork in excavation and filling for site grading work. Method of field density for soil compaction, using soft rock and hard rock, is also explained.

2.0 ORDINARY SOIL

2.1 Soft Soil / Loose Soil

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

Sand, gravel, loam, clay, mud, black cotton soil

Vegetables or organic soil, turf, peats, soft shale or loose moorum

Mud concrete below ground level

Any mixture of soil mentioned above.

2.2 Hard/ Dense Soil

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

i) Stiff heavy clay, hard shale or compact moorum requiring grafting tool and/ or pick and shovel

ii) Shingle and river or nallah bed boulders

iii) Soling of roads, paths etc. and hard core

iv) Macadam surface of any description (water bound, grouted tarmac etc.)

v) Lime concrete, stone masonry in lime or cement mortar below ground level

vi) Soft conglomerate when the stone can be detached from the matrix with picks and shovels

3.0 SOFT ROCK

This is fissured / disintegrated rocky strata, boulders (volume less than 0.4 m^3 and more than 0.028 M^3) and also which cannot be quarried/ excavated by using above manual tools but can be quarried/ excavated manually by using crow bars is classified as soft rock. Soft rock shall include all kinds of stiff and stratified rock, such as shales, thinly bedded philites, laterite hard conglomerate, lime stone, sand stone and unreinforced cement concrete below ground level. Soft rock may be quarried or split with crow bar or picks and can also be excavated by rippers, dozers and other mechanical equipment, but without the aid of blasting. If required, light blasting may be restored to, for loosening the materials, but this will not, in any way entitle the material to be classified as "Hard Rock".

4.0 HARD ROCK

4.1 Hard Rock (Not Requiring Blasting)

This shall include all types of hard and compact rock, having closely spaced fissures or joints, on account of which blasting is not considered necessary.

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4.2 Hard Rock (Requiring General Blasting)

This shall include all types of hard and compact rock occurring in unfissured masses or similar foundations, boulders (volume more than $0.4m^3$) for excavation in which blasting is considered necessary such as quartzite, granite, basalt stones, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.

4.3 Hard Rock (Requiring Controlled Blasting)

This type of excavation becomes necessary when excavation is done in formations, mentioned in Clause 4.2, in the vicinity of existing foundations/ structures. Mode of blasting shall be decided by Engineer-in-Charge, keeping in view the sensitivity of structures.

4.4 Hard Rock (Blasting Prohibited)

Hard rock requiring blasting as described in clause 4.2 above, but when blasting is prohibited for any reason and excavation has to be carried out by chiseling, splitter or any other agreed method.

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

5.0 FILLING SOIL

5.1 Ordinary soil used for filling shall meet requirements of clause 4 of Standard Spec. No. 6-65-0017, for Site Grading.

5.2 Use of soft rock for filling shall be determined based on compaction test of filling material. Well graded soft rock with sufficient fines should make a good filling material. This shall be tested in field for compaction and then density of compacted soils shall be determined. Test patches shall be made in field using this material and number of passes of rollers determined for each patch. A minimum of 3 test patches of 10m x 10m shall be made. Density of compaction shall be determined in each patch. A density of 1.90 gm/cc or more shall be acceptable.

5.3 Use of hard rock with soft rock and soil for filling shall be determined based on compaction test of rock material to be used for filling. Test patches shall be made as in case of soft rocks and number of rolls shall be determined for each test patch. Density of material in all test patches shall be found, which should not be less than 2.0 gm/cc.

5.4 The decision of Engineer-in-Charge with regard to suitability of such materials shall be final.

6.0 METHOD OF FILLING / FIELD DENSITY FOR SOIL COMPACTION

6.1 Filling With Soft Rock/ Hard Rock Soil

The earth for filling shall be rock soil mass, available from cutting areas. Filling shall be done in loose thickness of 400 mm. Voids shall be filled with smaller size material to ensure well graded and compacted fill. Watering, ramming and compacting with rollers or other suitable means as approved by Engineer-in-Charge shall be done to achieve at least 90% maximum dry density. Stones used in fill material shall not exceed 150 mm in size.

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6.2 Field Testing for Density

Each layer shall be tested in field for density and accepted by the Engineer-in-Charge, subject to achieving the required density, before laying the next layer. In the event, if it is not possible to conduct compaction test due to presence of stones, the compaction shall be determined at site by excavating a pit of size 0.5m x 0.5m x 0.3m (depth) in compacted area. The excavated soil shall be weighed. The pit shall be filled with water after laying a thin polythene sheet and weight of water so filled shall be determined. Alternatively, sand can also be used for filling the pit for determining the density.

Density of filled material shall be equal to the weight of soil / weight of water

This shall not be less than 1.90 gm/cc for soft rock and 2.0gm/cc for hard rock fill area. One test per 4000 m^2 compacted area shall be done for every layer of filling. Number of tests can be increased due to variation in quality of fill material and / or at the discretion of Engineer-in-Charge.

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साईट ग्रेडिंग तथा साईट ग्रेडिंग के लिये चटट्ान काटने हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR SITE GRADING AND ROCK CUTTING FOR SITE GRADING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	14 08 19	REAFFIRMED AND ISSUED AS STD SPEC	AVM	AJS	RS	RKT
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2	25 06 99	REVISED & ISSUED AS STD SPEC	PKT	PCS	MMK	A SONI

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Abbreviations:

DGMS	Director General of Mines Safety
gm/cc	Gram Per Cubic Centimeter
IS	Indian Standard
NGL	Natural Grade Level

Structural Standards Committee

Convener: 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 SCOPE

This specification and the method of measurements described thereon are applicable for earthwork involved in Site Grading & Rock Cutting.

2.0 CODES & STANDARDS

IS:2720 Part IV	Methods of tests for soils.
IS:2720 Part V	Methods of tests for soils-Part 5 :Determination of liquid & plastic limit.
IS:2720 Part VII	Methods of tests for soils Part-VII :Determination of water content – Dry Density Relation using Light Compaction.
6-65-0016	Std. specification for classification of soil for earthwork in site grading.
NOTE:-	Latest Edition of all Codes and Standards shall be followed.

3.0 GENERAL

3.1 CONTRACTOR shall maintain adequate drainage facilities at SITE at all times during the execution of work. Additional ditches, drains & such other temporary means to achieve this, over and above what is shown in the drawings, shall be provided and maintained by CONTRACTOR at his own cost.

3.2 Adequate dewatering facilities like dewatering pumps and piping etc. shall also be provided by the CONTRACTOR for this work, including dewatering during excavation etc. as required, at his own cost.

4.0 MATERIAL FOR EARTHWORK

4.1 Only soil considered suitable by the Engineer-in-charge shall be deployed for the construction and that considered unsuitable shall be disposed off, as directed by Engineer-in-charge, at his own cost and no claim for compensation will be entertained.

4.2 The CONTRACTOR shall give the samples of soil he proposes to use for filling, along with the following characteristics of the samples, to Engineer-in-charge for approval, prior to collection and use. The tests for these characteristics shall be done in a laboratory / test house as approved by Engineer-in-charge.

i. Mechanical analysis or grain size analysis as per IS: 2720 Part IV.
ii. Liquid limit as per IS: 2720 Part V.
iii. Plastic limit as per IS: 2720 Part V.
iv. Moisture density relationship as per IS: 2720 Part VII.

4.3 The soil used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.

4.4 Soil having plasticity index less than 20 shall be used for filling purpose.

4.5 Soil having laboratory maximum dry density of less than 1.5 gms/cc shall not be used.

4.6 Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the material, proposed to be used, for filling.

4.7 The work shall be so planned and executed that the best available soil are reserved for the top portion of Embankments.

5.0 CUTTING TREES

5.1 All trees having girth above 30 cms, which are not marked for preservation, shall be cut down and their roots dug up to a depth of 1 metre from the existing ground level.

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5.2 All holes or hollows produced by digging up roots shall be carefully filled with approved soil, including all leads and lifts, rammed and compacted to obtain 90% of maximum laboratory dry density of soil and levelled as directed.

5.3 All uprooted trees shall be stacked or disposed off as directed by Engineer-in-charge.

5.4 Payment

Cutting of trees above 30 cms girth shall be paid per number. The rate quoted shall include cutting, uprooting removing the trees within plant boundary as directed, including filling holes or hollows produced by removal of roots etc. as per specifications.

6.0 CLEARING AND STRIPPING

6.1 All the areas, including depressions, where filling or cutting is to be carried out shall be cleared and stripped completely of bushes, roots, vegetation, plantation trees, shrubs, trees upto 30 cms girth, organic and other objectionable materials. All these shall be completely uprooted and virgin soil exposed and not merely scrapped at the surface. The roots of trees of girth upto 30 cms shall be removed to a minimum depth of 1M below existing ground level and holes, hollows filled up with selected approved available soil within all leads and lifts and compacted to obtain 90% of laboratory dry density of soil as per IS: 2720, Part VII and leveled as directed by Engineer-in-charge. All soft patches must be worked out to remove soft soil and selected approved earth must be filled back and the areas (areas coming under filling) compacted to obtain 90% of maximum laboratory dry density of soil, as per IS: 2720 Part VII. The depth of stripping shall be generally 50 to 150 mm as decided by Engineer-in-Charge.

6.2 Material obtained from clearing shall be stacked or disposed off as directed by Engineer-in-charge within a lead as per directions of Engineer-in-Charge.

6.3 Payment

No separate payment shall be made for clearing, stripping and disposal of materials obtained from clearing. This shall be considered as part of cutting work in areas of cutting and filling work in areas of filling and the rates quoted under the respective items of

i. Earthwork in Excavation/ Cutting
ii Earthwork in filling (both with available earth & earth obtained from approved borrow areas), shall be inclusive of clearing and stripping with all operations described above in clause no.6 in respective areas of cutting and filling.

No separate payment shall be made for clearing, stripping and disposal of materials obtained from clearing of borrow areas for earth. This shall be considered as part of filling work in area of filling and the rate quoted under the respective items.

7.0 EARTHWORK IN EXCAVATION / CUTTING

7.1 After clearing and stripping of areas as specified above in clause No.6, spot levels at intervals and pattern as decided by the Engineer-in-charge, shall be taken jointly by CONTRACTOR and Engineer-in-charge. Excavation / cutting shall commence only after the levels are signed by the contractor as a token of his acceptance.

7.2 Excavation/ cutting shall be carried out strictly as per the instruction of Engineer-in-charge.

7.3 If the contractor excavates/ cuts beyond the required level, additional quantity of earthwork shall not be paid for. The excavation taken below the specified level shall be made good by filling with approved material, to the required compaction, at Contractor's cost.

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7.4 The final bed and sides of excavation must be levelled, dressed and compacted. In case of areas under excavation for site grading, the final surface shall be levelled, dressed and consolidated by means of sheep foot / power driven rollers to obtain maximum compaction. However, no test control is required in such areas.

7.5 Shoring and strutting shall be adopted only with the permission of Engineer-in-charge in writing. Such shoring and strutting shall follow the necessary specification.

7.6 Provisions for dewatering shall be governed by the relevant clauses.

7.7 Payment

Payment for Excavation shall be on the basis of volume of excavation calculated on the basis of joint level taken as per clause 7.1 and the final finished grade levels, the volume being calculated by the Trapezoidal rule including dewatering, if required. Intermediate payment will be on the basis of volume calculated based on spot levels taken during the time of the billing. Reference is also invited to clause 7.3.

8.0 EARTHWORK IN FILLING

8.1 After clearing, stripping and consolidation of areas as specified in clause 6, spot levels at intervals and pattern as decided by Engineer-in-charge shall be taken jointly by the CONTRACTOR and Engineer-in-Charge and filling shall commence only after the levels are signed by the CONTRACTOR as a token of his acceptance. Approved fill Material shall be spread in uniform layers not exceeding 30 cms in loose depth.

The contractor has to make his own approach and access roads from the borrow area to the demarcated filling areas. While the CONTRACTOR may make use of such short cuts as may be available to him for earth movement from borrow areas to the filling areas, the OWNER does not guarantee any passage way or right of way for the CONTRACTOR's work other than available at site. No claim shall also be admissible to the CONTRACTOR on account of his having to take longer leads or routes for earth movement, than envisaged by him, either due to any road cuttings, non-availability of routes, or any other grounds whatsoever.

In case total filling required in any area consists of soil both from borrow areas and available approved excavated material from within plant area, then joint levels, shall be taken before commencing filling with earth from borrow area.

However, earth available from borrow areas required for filling can be used only after the available earth from excavation within demarcated area has been utilised and clearance to this effect obtained from the Engineer-in-charge.

8.2 All clods, lumps etc, shall be broken before compaction.

8.3 Successive layers of filling shall not be placed until the layer below has been thoroughly compacted and tested to satisfy the requirements laid down in this specification.

8.4 Prior to rolling, the moisture content of material shall be brought to within plus or minus 2% of the Optimum Moisture Content as described in IS: 2720 Part VII. The moisture content shall preferably be on the wet side for potentially expansive soil.

8.5 After adjusting the Moisture Content as described in clause 8.4, the layers shall be thoroughly compacted by either sheep foot roller or power driven roller or vibratory roller, as approved by Engineer-in-charge, till the specified maximum laboratory dry density is obtained.

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8.6 Each layer shall be tested in field for density and accepted by Engineer-in-charge, subject to achieving the required density, before laying the next layer. A minimum of one test per 500m2 for each layer shall be conducted.

8.7 If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Engineer-in-charge to obtain the required density.

8.8 The filling shall be finished in conformity with the alignment, levels, cross-section and dimensions as shown in the drawing.

Earthen embankment shall be filled 300mm more on both sides, where height is more than 1M and this extra filling shall be dressed, after compaction, in conformity with alignment, level, cross-section and dimension as shown in the drawing, to achieve proper compaction in the slope. No extra payment shall be made in this regard.

8.9 Extra material shall be removed and disposed off as directed by the Engineer-in-charge.

8.10 Tolerances

General site grading, including cutting and filling in depressions, shall be carried out to within up down tolerance of ±5 cms of final lines, grades and slopes.

8.11 Earth Work in Filling in Open Lined/Unlined Wells

For earth work in filling in open lined/unlined wells, only locally available coarse sand shall be used, in layers of 500 mm thickness. Each layer shall be thoroughly wetted by sprinkling water, before next layer is filled up. Filling shall be done upto 1m depth below NGL as above. Layers from a depth of 1m below NGL, upto NGL, shall also comprise of locally available coarse sand and compacted with suitable Mechanical / manual means, to obtain same level of compaction as required for filling above NGL. Filling above NGL shall be done as per Cl. 8.1 to 8.10 above.

8.12 Payment

8.12.1 Payment for filling shall be made on cubic metre of volume calculated on the basis of cross section plotted from the levels of ground, where filling is to be carried out and the levels reached after filling is duly consolidated, volume being calculated by Trapezoidal method.

8.12.2 In case of simultaneous cut and fill operation, wherever specified, payment shall be made on the basis of one composite rate for cutting and filling. All other details about measurement etc. remaining same as above.

8.12.3 Payment for filling in open wells, lined or unlined, shall be made on the basis of volume calculated on the basis of average area mult6iplied with depth of open well

8.12.4 No extra payment shall be made towards testing.

9.0 REMOVAL OF SURPLUS EARTH

9.1 Surplus earth and soil from excavation and general site grading shall be removed from the construction areas to the area demarcated by the Engineer-in-charge.

9.2 Payment

Payment shall be made only for lead beyond initial lead from construction area. Rate shall include loading, transportation, dumping, stacking the surplus earth and soil in the area demarcated by the Engineer-in-charge.

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Payment shall be made on cubic metre basis of the difference of measurements of the volumes of the excavation and the measurement of the filling with the excavated earth. However, the contractor's entitlement to payment shall be restricted to the actual quantity of earth removed. Quantity generated due to void in back filled volume of earth shall also be removed by the contractor at no extra cost and this disposal of earth shall not be measured and paid under any item.

10.0 EXCAVATION IN ROCK

10.1 Blasting operations shall be carried out with the prior permission and in the presence of the Engineer-in-charge or his authorised representative and during fixed time hours of the day. Blasting operations shall be carried out as per Indian Explosive Rules 1983, amended up to date. The contractor shall have a valid license from Controller of Explosives to carry out blasting operations as well as for obtaining and storing the explosives as per Indian Explosive Rules (latest). All safety precautions such as providing safety nylon netting etc. shall be carried out as per instructions of the Engineer-in-charge.

In case the contractor is not having a valid license from Controller of Explosives to carry out blasting operations and storing / handling explosives as per Indian Explosives Rules (latest). The contractor may engage an agency for blasting who is having valid license required to carry out blasting operation. Prior to start of blasting operation, contractor shall submit all the relevant licenses required for blasting operation to Engineer-in-Charge.

10.1.1 The contractor shall ensure that all workmen and the personnel at site except those who have actually to light the fuse are evacuated from the unsafe area to be determined by the Engineer and warned by loud speaker in local language to safe distance, not less than 200 metres at least 15 minutes before firing time by sounding warning siren. The area shall be encircled by red flags. The contractor shall be responsible for any accident to workmen, public or property due to blasting operation.

10.1.2 Gunpowder, gelatin and other safe explosives only shall be used wherever possible. Explosives with nitroglycerine shall be used only under exceptional circumstances, with prior approval of the Engineer-in-Charge.

10.1.3 All fuses shall be cut to the length required, before being inserted into the holes.

10.1.4 The no. of charges to be fired and the actual no. of shots heard shall be compared and the person responsible must satisfy himself by examination that all the charges have exploded before work people are permitted to approach the scene. The withdrawal of a charge, which has not exploded shall under no circumstances be permitted, such charges shall be flooded with water and the hole marked into a distinguishing manner. The next hole to be fired shall be at a distance of about 500 mm from the unexploded hole and fired in the usual way.

The contractor or sub contractor or any of his competent authorised person shall be in charge of the blasting operations and shall be held responsible for strictly observing the safety rules, particularly applicable to blasting operations, in addition to other safety rules.

10.1.5 For blasting rocks with dynamite, the following general principles shall be observed.

In general, the following diameter of drills shall be used for different depth of boreholes.

From 1-2 metres	25mm diameter
From 2-3.25 metres	37-50mm diameter
From 3.25-4.75metres	50-65mm diameter

The boreholes should generally be not more than 1.5m deep and the distance apart should be from one and a half to twice their depth.

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Cracks and fissures in the rock to be blasted shall be carefully studied to ascertain the best position for the boreholes. The charge shall always be placed in a sound piece of rock, if possible not nearer than 300mm from the crack.

10.2 Rules for Blasting with Dynamite and other High Explosives

10.2.1 The Person-in-charge must show that he is thoroughly acquainted with the blasting operations and that he understands the rules laid down herewith. He will be held responsible for any accident that may occur. He must be a licenced blaster with a valid licence from DGMS.

10.2.2 Boreholes must be of such a size and uniform that the cartridges can easily pass down them.

10.2.3 The position of all holes to be drilled must be marked out with white paint and the person-in-charge must take particular note of these positions.

10.2.4 The drilling operation after being finished, the person-in-charge must make a second inspection and satisfy himself that the boreholes marked out by him have been drilled and cleaned properly.

10.2.5 The person-in-charge must prepare all charges necessary for boreholes.

10.2.6 Number of holes to be loaded and fired at one time shall be as per explosive rules. Boreholes must be thoroughly cleared before a cartridge is inserted.

The loading is to be done by the person-in-charge himself and the position of the charge holes carefully noted by him. Circular wooden tamping rods only to be used in charging holes with flat bottom, (one cartridge at a time must be inserted) and cartridge gently pressed with the tamping rod.

10.2.7 Immediately before firing a blast, due warning must be given and the person-in-charge must see that all the labours have retired to safety.

10.2.8 The safety fuses of the charged holes are to be lighted in the presence of the person-in-charge, who must see that the fuses of the holes charged have properly ignited.

After the blast, the person-in-charge must carefully inspect the work and satisfy himself that all the charges have exploded.

10.3 Misfires

10.3.1 Misfires are a source of great danger. If it is suspected that part of the blast to fire is delayed, sufficient time shall be allowed to elapse before entering the danger zone. When fuse and blasting caps are used, a safe time of at least an hour should be allowed.

10.3.2 None of the drillers are to work near these holes until the three following operations have been done by the person-in-charge.

a. The Person-in-charge should very carefully extract the tamping with a wooden scrapper and withdraw the fuse with the primer and detonator attached, after which a fresh primer and detonator with fuse should be placed in this hole and fired; or

b. The hole may be cleared of 300mm of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 150mm away and parallel to it: this hole to be then charged and fired when the other charge should explode.

c. Drilling in holes not completely exploded by blasting shall not be permitted.

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10.4 Precautions Against Misfire

10.4.1 The safety fuse should be cut in an oblique direction with a knife.

10.4.2 All saw dust must be cleared from the inside of the detonator; this can be done by blowing down the detonation and tapping the open end. No instrument shall be inserted into the detonator for this purpose.

10.4.3 After inserting the fuse in the detonator, it shall be fixed by means of nippers.

10.4.4 If there is water present, or if the boreholes be damp, the junction of the fuse and detonator must be made water tight by means of grease, white lead or tar.

10.4.5 The detonator should be inserted into the cartridge, so that about one third of the copper tube is left exposed outside the explosives. The safety fuse outside the detonator, should be necessarily tied in position in the cartridge. Waterproof fuse only to be used in the damp boreholes, or when water is present in the borehole.

10.4.6 If a misfire has been found to be due to defective fuse, detonator or dynamite, the whole quantity or box from which the detective article was used shall be rejected.

10.4.7 Storage of materials for blasting shall be as per statutory regulations / stipulations of the concerned authorities.

It shall be the Contractor's responsibility to arrange for proper storage of explosives and obtain required permissions from concerned authorities. No separate payment shall be payable for the above.

10.4.8. **Cleaning of Excavation**

Excavation shall be cleaned, trimmed to exact shape and all disturbed material and other debris shall be removed. When the excavation have been taken out to the lines specified as shown on the drawings and the surface cleaned as specified, the contractor shall notify the Engineer that the excavation is ready for inspection and no further work shall be done with concrete or backfill until it has been inspected and approved by the Engineer. Cost of this work is deemed to have been included in the unit rates for excavation.

10.4.9. **Use of Excavation Material**

Where any material obtained from the excavation is, in the opinion of the Engineer, suitable for use in a particular section of the work as fill or backfill, such material shall be selected and if necessary, loaded, hauled, placed, spread and used to construct the fill or backfill with respect to the lines and grades specified for the work. As far as possible the most suitable of the materials excavated for the work shall be used to construct the fill and backfill embankments, roads and storage areas, where required. The useful rock available shall be stacked at the locations as decided by the Engineer and the cost of this work is deemed to have been included in the Unit rate of excavation.

Materials containing brush roots or other perishable materials shall not be considered suitable. The suitability of the materials and their disposition in the work shall be subject to the approval of the Engineer-in-Charge.

10.4.10 **Disposal of Surplus material**

All surplus materials shall be carried away from the site and disposed at dumping sites selected by the Engineer, up to a lead as indicated in the relevant items of the schedule of rates. The Engineer may ask the contractor to dump the excavated materials in regular heaps, bunds, blankets, riprap with regular slopes as directed by the Engineer and levelled so as to provide natural drainage. As a rule, all softer material shall be laid along the centre of heaps, with the harder and more weather resisting

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materials forming the casing on the sides and the top. Excavated rocks, which can be used in soling as road metals or for making concrete aggregate shall be stacked separately, as directed by the Engineer. All such works as mentioned above is deemed to have been taken into account while quoting for the excavation and the contractor for the above works shall claim no extras.

All rock excavated from the pits shall be the property of the Owner.

10.4.11 **Stock Piles**

When the removal of material from excavation progresses at a faster rate or at different times than placement in backfill is being accomplished, such excavated materials shall be stock piled at approved locations adjacent to the work until their use is authorised.

10.4.12 **Spoil Areas**

Material excavated for the works, which is rejected as unsuitable or not required by the Engineer, shall be disposed of in spoil areas as specified by the Engineer.

The spoil areas shall be left in a neat and sighty condition and sloped to drain properly as may be directed by the Engineer.

10.5 Control Blasting

10.5.1 **General**

This specification lays down the requirements for control blasting for rock excavations wherever required.

Wherever required by the Engineer, the rock blasting shall be controlled, so that vibration generated during the blasting do not cause damage to the buildings and installation around built up areas. Similarly the rock pieces should not fly off the pits and thus damage the buildings and installation around. Apart from the general precautions mentioned in the preceding paragraphs, following protective measures are suggested as guidelines. Tenderers are requested to carefully check the site conditions and submit the details of the scheme they propose to adopt for controlling the blast.

10.5.2 **Protective Measures**

a. Short delay blasting with light charges shall be used.

b. The blast hole shall be covered with 0.6 to 1.0 sqm. mild steel plate of minimum 6mm thickness.

c. Reinforcement rod mesh, not less than 20mm dia at 150mm centres in both directions, shall be put over the steel plates.

d. Steel plate and reinforcements shall be inspected after every blasting operation and all twists shall be removed before reuse, to the satisfaction of the Engineer-in-Charge.

e. The thickness of the covering plate and the kind of dead weight shall be duly got approved from the Engineer-in-Charge.

When blasting is necessary adjacent to partially or completely built structures, the contractor shall take all precautions necessary to prevent flying rock from causing damage to the structures.

In no case shall blasting be allowed closer than 15m to any structure after concrete placing has started.

The contractor shall be responsible for all damage caused by blasting, whether permanent or temporary structure and shall replace or repair the structures at his own cost.

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10.6 Classification of soil

If soil of any classifications other than that specified in the Schedule of Rates is met during excavation, the decision of the Engineer-in-charge as to the classification of soil, levels of the strata of different classifications and their locations shall be binding.

In above case, the total quantity of Excavation shall be computed from the measurement of the area excavated. The hard rock and soft rock shall be measured separately from the relevant stacks and each shall be reduced by fifty percent for voids, and paid under the relevant items. The balance, that is the total quantity of excavation minus the reduced (for voids) quantity of excavation for rocks shall be paid as soil as per the discretion of the Engineer-in-Charge. However, the maximum payment shall be limited to the volume of the area excavated, as approved by Engineer-in-charge.

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सड़को एवं लचीले पेवमेंटो हेतु मानक विनिर्देशन (डब्लू. बी. एम. सतह तक)

STANDARD SPECIFICATION FOR ROADS AND FLEXIBLE PAVEMENTS (UPTO WBM LAYER)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
8	14 08 19	REAFFIRMED AND ISSUED AS STD SPEC	AVM	AJS	RS	RKT
7	24 06 13	REVISED AND ISSUED AS STD SPEC	RBT	RKS	RBB	DM
6	12 03 08	REVISED AND ISSUED AS STD SPEC	GAURAV	RKS	NK	VC
5	11 04 01	REVISED AND ISSUED AS STD SPEC	RC	PCS	MMK	MI
4	15 11 99	REVISED AND ISSUED AS STD SPEC	RB	PCS	MMK	AS

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Abbreviations:

cm	Centimeter
IRC	Indian Road Congress
IS	Indian Standard
mm	Millimeter
P.I	Plasticity Index
WBM	Water Bound Macadam

Structural Standards Committee

Convener: 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 SCOPE

This specification covers the material and construction details for earthwork in filling for embankments, filling with sand/murrum, WBM sub-base, WBM base course and shoulders for roads and flexible pavements.

2.0 REFERENCES

2.1 Codes & Standards

IS: 460	Specifications for Test Sieves
IS 2430:	Methods for sampling of aggregates for concrete
IS: 2720	Methods of Test of Soil
IRC: 19	Standard Specification and Code of Practice for Water Bound Macadam
IRC: 36	Recommended Practice for the Construction of Earth Embankments for Road Works

2.2 Specifications

Specifications for Road and Bridge Works – Ministry of Surface Transport (Road Wing)

NOTE: -Latest Edition of all Codes, Standards and Specifications shall be followed.

3.0 CONSTRUCTION OF EMBANKMENTS SUBGRADE AND SHOULDERS

3.1 Materials

Only those materials, considered suitable by the Engineer-in-Charge shall be employed for the construction and that considered unsuitable shall be disposed off as directed by Engineer-in-Charge at contractor's cost and no claim for compensation will be entertained. The Contractor shall give the samples of earth, he proposes to use for filling along with the following characteristics of the sample to Engineer-in-Charge prior to collection and use, for approval.

i) Mechanical analysis or gain size analysis as per IS: 2720 Part IV.

ii) Liquid limit as per IS: 2720 Part V.

iii) Plastic limit as per IS: 2720 Part V.

iv) Moisture density relationship as per IS: 2720 Part VIII.

The material (soil) used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.

Material (soil) having plasticity index less than 20 shall be used for filling purposes. Soil having laboratory maximum dry density of less than 1.5gm/cc shall not be used. Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the materials proposed to be used for filling.

The work shall be so planned and executed such that the best available material (soil) is reserved for the top portion of embankment.

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3.2 Filling and Compaction

3.2.1 The area where filling is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 95% of maximum laboratory dry density of the soil as per IS: 2720 Part VIII. All soft patches must be worked out to remove the soft soil and selected approved earth must be filled back and compacted.

3.2.2 Payment for the removal of loose top soil as described in clause 3.2.1 above shall be included in the item for earthwork in filling. No separate payment for consolidation of exposed ground surface will be made. The rate quoted for the earth fill shall be inclusive of the cost of clearing and stripping, consolidation, including watering, testing etc. of the exposed ground.

3.2.3 Approved fill material shall be spread in uniform layers not exceeding 20 cm in loose depth for embankment filling. Shoulder construction shall be so organised as to keep pace with the construction of different layers of the pavement, which may require earth fill thickness less than 20 cm. All clods, lumps etc. shall be broken before compaction.

3.2.4 In general the soil shall be spread uniformly over the entire width of embankment or shoulder as the case may be. For large embankments, the spreading of soil shall be as directed by Engineer-in-Charge.

3.2.5 Successive layers of filling shall not be placed until the layer under construction has been thoroughly compacted to satisfy the requirements laid down in this specification.

3.2.6 Prior to rolling, the moisture content of material shall be brought to within plus or minus 2% of the optimum moisture content as described in IS: 2720 - Part-VIII. The moisture content shall preferably be on the wet side for potentially expensive soils.

3.2.7 After adjusting the moisture content as described in Clause 3.2.6, the layers shall be thoroughly compacted by means of 8-10T rollers or equivalent vibratory rollers till 95% of maximum laboratory dry density for embankment and 97% of maximum laboratory dry density for sub-grade as per IS:2720 Part VIII is obtained.

3.2.8 Each layer shall be tested in field for density and accepted by Engineer-in-Charge subjected to achieving the required density before laying the next layer. A minimum of one test per 500m^2 area for each layer shall be conducted.

3.2.9 All type of rollers that should be employed for compaction shall be as per direction of Engineer-in-Charge.

3.2.10 If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Engineer-in-Charge to obtain the required density.

3.2.11 The filling shall be finished in conformity with alignment, levels, cross-sections and dimensions as shown in the drawings.

3.2.12 Extra material shall be removed and disposed off as directed by Engineer-in-Charge.

3.3 Tolerance

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Embankment and shoulders for roads, units etc. shall be carried to within a tolerance of plus minus 2.5 cm. from final lines but shall be to required grades and slopes.

4.0 FILLING WITH SAND/MURRUM

4.1 Sand having Plasticity Index 6 (Max) shall be used for filling. Sand for filling shall preferably be locally available sand, clean and free from any chemical or other impurities. Murrum for filling shall be clean and well graded. Sand/Murrum shall not contain any vegetation, organic, clayey or other material and shall be obtained from a source approved by Engineer-in-Charge.

4.2 Murrum/Sand shall be spread in layers not exceeding 15 cm in loose thickness over the areas. Each layer shall be uniform in density, quality of material and ' moisture content before compaction. The moisture content shall be within two percent of the optimum moisture content as per IS: 2720 Part VIII.

4.2.1 In case of pure sand, flooding with water is permissible.

4.3 Compaction of each layer shall be by mechanical means as per directions of Engineer-in--Charge. Only in accessible reaches shall be worked manually. Each layer shall be uniformly compacted to obtain 85% relative density in case of sand and 95% of maximum laboratory dry density in case of murram. If the material fails to achieve the required density, the layer shall be reworked with necessary alteration in compaction, so that the required compaction is obtained. A minimum of one test per 500 m^2 area for each layer shall be conducted.

4.4 Subsequent layers shall be placed only after the layer already laid has been compacted to the required density-and approved by Engineer-in-Charge.

4.5 The finished surface must be dressed to required grade and slope. Excess material must be removed from compaction site, as directed by Engineer-in-Charge.

5.0 WATER BOUND MACADAM SUB BASE/BASE COURSE

The sub-base course shall consist of one or more layers, each of 100 mm compacted thickness.

The base course shall consist of one or more layers, each of 75 mm compacted thickness.

5.1 Materials

5.1.1 Stone Aggregate for WBM

5.1.1.1 The coarse aggregates shall be hard, crushed or broken stone metal from quarries approved by Engineer-in-Charge, it shall be hard durable and free from flat elongated, soft and disintegrated particles. It shall not have excess of dirt and other objectionable matter. The quality, size and grading of the coarse aggregate shall be conforming to IRC: 19.

a) The grading of the coarse aggregates for the sub-base course shall be as below:

Size Range	**Sieve Designation (IS: 460)**	**% by weight passing the sieve**
90mm to 45mm Grade-I	125mm	100
	90mm	90-100
	63mm	25-60

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45mm	0-15
22.4mm	0-5

b) The grading of the coarse aggregate for the base course shall be as below:

Size Range	Sieve Designation (IS: 460)	% by weight passing the sieve
63mm to 45mm Grade-2	90mm	100
	63mm	90-100
	53mm	25-75
	45mm	0-15
	22.4mm	0-5

c) Physical requirement of coarse aggregates for sub-base course shall be as below:

i)	Los Angles Abrasion Value	60% (Maximum)
	or	
ii)	Aggregate Impact Value	50% (Maximum)

d) Physical requirement of coarse aggregates for base course shall be as below:

i)	Los Angles Abrasion Value	50% (Maximum)
	or	
	Aggregate Impact value	40% (Maximum)
ii)	Flakiness index value	15% (Maximum)

Samples of test shall be representative of the material to be used and collected as per IS: 2430.

5.1.1.2 The aggregates shall be unloaded at the road side on firm, well drained ground, as directed by Engineer-in-Charge. The various grades shall be placed separately and contamination by earth and other extraneous matter shall be prevented effectively.

5.1.2 **Screenings**

5.1.2.1 Screening to fill voids in the course aggregates shall, as far as possible be the same material as the course aggregates where it is decided by the Engineer-in-Charge to use other materials, the same shall be predominantly non plastic materials such as kankar nodules gravel (other than river-borne rounded aggregate) or murrum provided that the liquid limit and plasticity index of such material is below 20 and 6 respectively and the fraction passing 75 micron sieve does not exceed 10 percent.

Grading Requirement of Screening

Size of Screening	Sieve Designation (IS: 460)	Percentage by Weight Passing the Sieve
13.2mm	13.2mm	100
	11.2mm	95-100

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5.6mm	15-35
180micron	0-10

This grading, however, shall not be mandatory, in case either murrum or gravel is used as screening.
For procurement of quantities for course aggregates and screenings required for 100mm and 75mm compacted thickness of WBM sub base course and base course shall be as per the IRC-19

5.1.3 **Binding Material**

Binding material, to prevent revelling of WBM, shall consist of fine grained material possessing P.I value up to 6.
Application of binding material shall not be necessary where murrum or gravel is used as screenings.
Binding material shall be obtained from quarries/ sources approved by the Engineer-in-charge.

5.2 Laying of WBM

5.2.1 **Spreading Course Aggregates**

5.2.1.1 The sub grade or sub-base to receive WBM course shall be prepared to the required grade and camber. Before starting with WBM construction, side shoulders shall be constructed in advance to a thickness corresponding to the compacted layer of the WBM course for lateral confinement of aggregate. After shoulders are ready, their inside edge shall be trimmed vertical to receive the aggregate. The practice of constructing WBM in a trench section excavated on the embankment/formation must be avoided.

5.2.1.2 The coarse aggregate shall be spread uniformly and evenly on the prepared base in required quantities from the stacks. The aggregate shall be spread to proper profiles by using templates across the road about 6 m apart.

5.2.1.3 The surface of the aggregate spread shall be carefully, trued up and all high or low spots remedied by removing or adding aggregate as may be required. The surface shall be checked from time to time, during the spreading and rolling of the coarse aggregate to ensure a finished surface without variation greater than 12 mm, when a 3 meter long straight edge is laid parallel to centre line of the road.

5.2.1.4 The WBM layer shall be tested by depth blocks. No segregation on large or fine particle shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pocket of fine materials.

5.2.1.5 The coarse aggregate shall not be spread in lengths more than 3 days average work in advance of the rolling, spreading murrum and bonding of the preceding section.

5.2.2 **Rolling Road Metal**

5.2.2.1 Immediately following the spreading of the coarse aggregates, it shall be compacted to full width by rolling with either three wheeled power roller of 8 to 10 tonne weight or equivalent vibratory roller true to the line and camber as shown in the drawing. The course shall not be rolled when the sub-grade is soft or yielding or the rolling causes a wave like motion in the base course or sub-grade. When rolling develops irregularities that exceed 12mm when tested with a 3 meter straight edge, the irregular surface shall be loosened and then

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aggregate added to or removed from it as required and the area rolled until it gives uniform surface conforming to the desired cross-section and grade. The surface shall also be checked transversely by template and any irregularities corrected as above. The use of murrum to make up depression shall not be permitted.

5.2.2.2 The rolling shall begin from edges with roller running forward and backward until the edges have been firmly compacted. The rolling shall then progress gradually from edges to the centre parallel to the centre line of the road lapping uniformly each preceding rear wheel track by one half width and shall continue until the entire area of the course has been rolled by the rear wheel. On the super elevated portions of road, the rolling shall commence from the lower edge and progress gradually towards the upper edge of the road.

5.2.2.3 Rolling shall be discontinued when aggregate are thoroughly keyed and creating of stone wheel of roller is no longer visible partially compacted with sufficient void space in them to permit application of screenings. Slight sprinkling of water may be done if required.

5.2.3 **Application of Screening**

5.2.3 After the coarse aggregate has been rolled as described in Clause 5.2.2, screenings shall be applied uniformly and gradually over the surface to completely fill the interstices. Dry rolling shall be continued while the screenings are being spread so that the jarring effect of the roll will cause them to settle into the voids of the coarse aggregates.

5.2.3.2 The screenings shall not be dumped in piles on coarse aggregate but shall be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanic spreaders.

5.2.3.3 The screenings shall be applied at a uniform and slow rate (in three or more applications so as to ensure filling of all voids. Rolling and brooming shall continue with the spreading of the screenings. Either mechanical brooms or hand brooms or both may be used. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface making the filling of voids difficult or preventing the direct bearings of the roller on the coarse aggregates. The spreading, rolling and brooming of screenings shall be performed on sections which can be completed within one day's operation and shall continue until no more screenings can be forced into the voids of the coarse aggregates. Damp and wet screening shall not be used under any circumstances.

5.2.3.4 The quantity of screenings used shall be such as to fill all voids in the water bound macadam courses.

5.2.4 **Sprinkling and Grouting**

5.2.4.1 After spreading the screening, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling shall be continued and additional screenings applied where necessary until the coarse aggregates are well compacted and grout of screenings and water form a wave ahead of wheels of the roller. Care shall be taken to see that the base of the sub-grade does not get damaged due to the addition of the excessive quantity of water during the construction.

5.2.5 Application of Binding Material

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5.2.5.1 After the application of screenings as described above, the binding material shall be applied at a uniform and slow rate (in two or more successive thin layers) so as to ensure filling of all voids.
After each application of binding material, the surface shall be copiously sprinkled with water and the resulting slurry swept in with hand brooms/ mechanical brooms or both so as to fill the voids properly. This shall be followed by rolling with a 8-10 tone roller during which water shall be applied to the wheels to wash down the binding material that may get stuck to them. The spreading, rolling and brooming of binding material shall be performed on sections which can be completed within one day's operation and shall continue until no more binding material can be forced into the voids of the coarse aggregates and until the slurry of the binding material and water forms a wave ahead of the wheels of moving roller. Damp and wet binding material shall not be used under any circumstances.

5.2.5.2 The quantity of binding material used shall be such as to fill all voids in the water bound macadam.

5.2.6 **Setting and drying**

After final compaction of the course, the layer shall be allowed to dry overnight. Next morning, hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set.

5.2.7 **Subsequent layers of WBM**

Before laying the subsequent layers of WBM, the surface shall be scarified and reshaped to the required camber and profile, and all ruts, depressions, pot holes etc. made good. The second layer shall be laid after the surface preparation is approved by Engineer-in-Charge. The specification and mode of measurement for subsequent layers of WBM will be similar to that described before.

6.0 CONSTRUCTION OF SHOULDERS OR BERMS

6.1 After the WBM course is laid and compacted, the existing surface at side berms or shoulders of the roadway must be scarified. Fresh quantity of approved earth must be spread in layers for building up of berms upto the required level and scope.

The earth must be consolidated by at least three passes of an 8-10 tonne road roller. The edges must be well compacted by suitable means to prevent edge slips and the work properly trimmed and dressed.

7.0 PAYMENT

7.1 Filling in embankment, sub grade and shoulders

7.1.1 Payment for filling shall be made on cubic meter of volume calculated on the basis of cross section plotted from the level of the ground surface prepared as described in clause 3.2 above and from where filling is to be carried out and the levels reached after filling and due consolidation.

7.1.2 Rates for embankment, shoulder or fill formation shall include cost of breaking clods, watering, consolidation, providing testing apparatus and testing the degree of consolidation, providing and operating, including POL and operator charges of necessary road rollers and other equipment, dressing and levelling of sides and top surfaces etc.

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7.2 Filling with sand / murrum

Payment for sand/murrum filling shall be made on the basis of volume of fill, after placement and compaction. The rate quoted shall include cost of sand/murrum, royalties, transportation, handling, compacting, watering, testing at various stages, dressing, removal of surplus material and any other work incidental to this.

7.3 Water Bound Macadam Sub Base/ Base Course

Paying for laying WBM shall be made on square meter basis of each layer of WBM laid, measured after consolidation and finishing. Rate shall include supply of all materials, royalty, taxes, handling, transportation, spreading metal in layers, including screenings, consolidation by power roller, binding with murrum or other approved binding material, cost of carrying the material to work for all leads and lifts, providing and running roller etc. complete as per specifications and satisfaction of Engineer-in-Charge.

7.4 Subsequent layers of WBM

Payment for surface preparation, rectification of damaged portions of Proceeding layers of water bound macadam and filling in ruts and depressions shall be made in M2 or M3 as % per schedule of items. Payment for subsequent layer of WBM shall be made on M2 basis as per Cl. No.5.2.6.

7.5 The payment clause indicated above are not applicable in case of LSTK Jobs

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पाइप पुलिया तथा ई आर सी/ आई आर सी क्रासिंग हेतू मानक विनिर्देश

STANDARD SPECIFICATION FOR PIPE CULVERTS & ERC/ IRC CROSSING

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	14 03 19	REAFFIRMED AND ISSUED AS STANDARD SPECIFICATION	AVM	AJS	RS	RKT
3	23.05 11	REVISED & ISSUED AS STD SPEC	AS	RKS	RBB	DM

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Abbreviations:

ERC	:	Electrical Road Crossings
IRC	:	Instrumentation Road Crossings
IS	:	Indian Standard
PVC	:	Poly Vinyl Chloride
RCC	:	Reinforced Cement Concrete

Structural Standards Committee

Convener: Mr. Rajanji Srivastava

Members:
Mr. Anurag Sinha
Mr. VK Panwar
Mr. Samir Das
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1.0 SCOPE

The scope of this specification covers RCC pipe culverts and ERC/ IRC crossings with RCC or PVC pipes.

2.0 CODES & STANDARDS

IS: 458	Precast Concrete Pipes (with and without reinforcement)
IS: 783	Code of practice for laying of RCC pipes
IS: 4985	Unplasticised PVC pipes for potable water supplies
NOTE: -	Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIALS

3.1 All pipes must be new and perfectly sound, free from cracks, cylindrically straight and of standard nominal diameter and length, with even texture. PVC Pipes shall be Class-I as per IS: 4985.

For pipe culverts, class of RCC pipe shall be NP3 / NP4 or as mentioned in the drawings.

3.2 The Contractor shall submit manufacturer's test certificate for acceptance of RCC/PVC pipes.

3.3 Spun yarn for pipe joints shall be of best quality. It shall be free from dust etc.

4.0 TRANSPORTATION AND STACKING

4.1 The transportation of materials to the worksite and stacking shall be done in a manner to cause minimum inconvenience to the traffic and other construction work.

4.2 The pipe shall be protected during handling against impact, shocks and free fall to avoid cracks and damage.

4.3 The Contractor shall be fully responsible for the safety and security of materials transported and stacked in the field.

4.4 Earthwork

Refer standard specification No.6-68-0003 for earthwork.

5.0 LOWERING AND LAYING OF RCC PIPES

5.1 General

The laying and jointing of RCC pipes shall confirm to IS: 783.

The trench shall be checked for proper level, grade and alignment before lowering the pipes.

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5.2 Lowering

The RCC pipe shall be lowered cautiously to prevent disturbance to the bed and sides of the trench. The heavy RCC pipes shall be lowered by means of proper tripods, chain pulley blocks or as directed by Engineer-in-charge. Great care should be taken to prevent sand etc. from entering the pipes.

5.3 Laying

5.3.1 Laying of RCC pipes shall proceed up grade of slopes.

5.3.2 The error of grade shall not be rectified by packing up earth underneath the pipe. If required, concrete shall be used for packing.

5.3.3 The end of RCC pipes shall be kept closed to keep dirt, mud and foreign materials out. Adequate provision shall be made to prevent floating of pipes in the event of flooding of trenches.

The body of RCC pipe, for its entire length, shall rest on an even bed in the trench.

5.4 Jointing of RCC pipes.

5.4.1 Cement mortar 1:2 (1 cement: 2 sand) shall be slightly moistened and must on no account be soft or sloppy and shall be carefully inserted by hand into the joint. The mortar shall than be punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar.

5.4.2 Any surplus mortar projecting inside the joint is to be removed and guarded against any damage. Sack or gunny bags shall be drawn past each joint after completion.

5.5 Curing.

The Cement mortar joints in RCC pipes shall be cured at least for seven days.

5.6 Testing.

All joints in culvert pipelines shall be tested to a head of 1.5 m of water above the top of the highest pipe, if required, by Engineer-in-Charge.

5.7 Payment

Payment shall be made on running meter basis, which includes supplying, transporting, lowering, laying, jointing and curing, concreting around RCC pipes etc., all complete.

6.0 LOWERING AND LAYING OF PVC PIPES

6.1 Lowering and laying of PVC pipes shall be done as per IS: 4985. The jointing of the pipes shall be done by expanding one end after heating and using solvent cement.

6.2 Payment

Payment shall be made on running meter basis of PVC pipes, which includes supplying, transporting, lowering, laying and jointing, concreting around PVC pipes etc., all complete.

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ABBREVIATIONS

ABD	AMINE BLOW DOWN
A/G	ABOVE GROUND
API	AMERICAN PETROLEUM INSTITUTE
ANSI	AMERICAN NATIONAL STANDARD INSTITUTE
AWWA	AMERICAN WATER WORKS ASSOCIATION
BC	BOX CULVERT
BCR	BEARING COOLING RETURN
BE	BEVEL END
BF	BLIND FLANGE
BL	BED LEVEL
BOP	BOTTOM OF PIPE
BOTT.EL	BOTTOM ELEVATION(CABLE DUCT ETC)
CBD	CLOSE BLOW DOWN
CI	CAST IRON
C/C	CENTRE TO CENTRE
℄	CENTRE LINE
CONC.RED	CONCENTRIC REDUCER
CONC	CONCRETE
CPLG	COUPLING
CS	CARBON STEEL
CONN	CONNECTION
CONT	CONTINUATION
CRWS	CONTAMINATED RAIN WATER SEWER
CW	CONSTRUCTION WATER/CARRIAGE WAY
CWPH	COOLING WATER PUMP HOUSE
CWS	CAUSTIC WASTE SEWER
COL	COLUMN
DIA	DIAMETER
DWG	DRAWING
DISCH.	DISCHARGE
ETP	EFFLUENT TREATMENT PLANT
ECC	ECCENTRIC
EL	ELEVATION
ERC	ELECTRIC CABLE ROAD CROSSING
EWSS	EYE WASH & SAFETY SHOWER
FCR	FOR CONTINUATION REFER
FF	FLAT FACE
FGL	FINISHED GROUND LEVEL
F TO F	FACE TO FACE
FFL	FINISHED FLOOR LEVEL
FLGD.	FLANGED
FDN	FOUNDATION
GLV	GALVANISED
GT	GALVANISED BLACK STEEL TUBE
GR	GROUND/GRADE
HC	HOSE COUPLING
HP	HORSE POWER
HS	HOSE STATION
HPP	HIGH POINT OF PAVEMENT
ID	INSIDE DIAMETER
INST	INSTRUMENT
INV	INVERT
IRC	INSTRUMENT CABLE ROAD CROSSING
MDS	MECHANICAL DATA SHEET
MK	MARK
MR	MATERIAL REQUISITION
MTO	MATERIAL TAKE OFF
MS	MILD STEEL
MH	MANHOLE
NGL	NATURAL GROUND LEVEL
OD	OUTSIDE DIAMETER
OHT	OVERHEAD TANK
OWS	OILY WATER SEWER
PC	PIPE CULVERT
PDS	PROCESS DATA SHEET
PE	PLAIN END
PR	PURCHASE REQUISITION
PWS	PROCESS WASTE SEWER
PWB	PIPE WAY BRIDGE
RCC	REINFORCED CEMENT CONCRETE
R	RADIUS
RF	RAISED FACE
REF	REFERENCE
RW	ROAD WAY
SO	SLIP ON
SOR	SCHEDULE OF RATES
SS	STORM SEWER
STD	STANDARD
SCRC	STREET CABLE ROAD CROSSING
STN	STATION
SWS	SANITARY WASTE SEWER
TEMP	TEMPERATURE
TOS	TOP OF SLEEPER
TYP	TYPICAL
TWDK	TEMPORARY DRINKING WATER
U/G	UNDER GROUND
WCS	COOLING WATER SUPPLY
WCR	COOLING WATER RETURN
WDK	DRINKING WATER
WF	FIRE WATER
WR	RAW WATER
WH	HORTICULTURE WATER
WT	TREATED WATER
WF	FILTERED WATER
WWS	WASTE WATER SYSTEM

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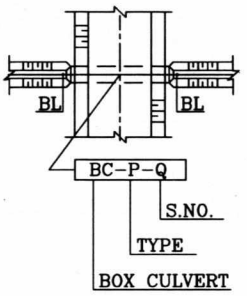
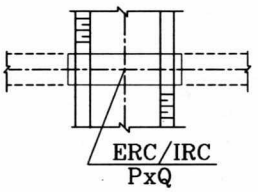
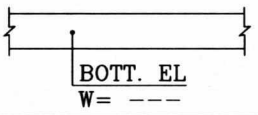
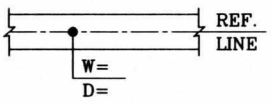
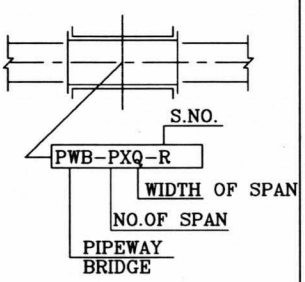
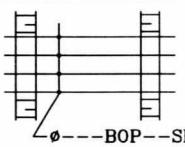
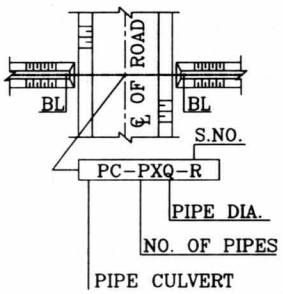
LEGENDS

○	NATURAL GROUND LEVEL		BOX CULVERT REPRESENTATION ON AREA DRAWING
●	FINISHED GROUND LEVEL		
⊖	ROAD TOP LEVEL/ PAVEMENT TOP LEVEL		
⊕	FINISHED FLOOR LEVEL OF BUILDING		
—·—·—	CENTRE LINE		
— — —	LAND ACQUISTION LIMIT		ERC–ELELCTRIC CABLE PxQ ROAD CROSSING NO.OF PIPE IN EACH LAYER NO. OF LAYERS
▬▬▬	COMPOUND WALL		
———	BATTERY LIMIT		
—·—·—	MATCHING LINE		R.C.C. CABLE TRENCH
ROAD–A	ROAD–A REPRESENTATION ON LAYOUTS (A=COORDINATE OF ROAD ℄)		
ROAD–A	ROAD–A REPRESENTATION IN AREA DRAWINGS (A=COORDINATE OF ROAD ℄)		BURIED CABLE TRENCH D=DEPTH W=WIDTH
HIGHER EDGE / LOWER EDGE	SIDE SLOPE		PIPEWAY BRIDGE
BL	TRAPEZOIDAL DITCH REPRESENTATION ON AREA DRAWING		
BL TYPE---	RECTANGULAR DITCH REPRESENTATION ON AREA DRAWING		
BL	TRAPEZOIDAL DITCH REPRESENTATION ON LAYOUT DRAWING		
BL TYPE---	RECTANGULAR DITCH REPRESENTATION ON LAYOUT DRG.		PIPE SLEEVES
BL BL PC/BC---	PIPE CULVERT BOX CULVERT REPRESENTATION ON LAYOUT DRG.		
	PIPE CULVERT REPRESENTATION ON AREA DRAWING	ø--- -CW-PIPE CLASS---	CONSTRUCTION WATER PIPE LINE
		ø--- -WT-PIPE CLASS---	TREATED WATER PIPE LINE
		ø--- -TWDK-PIPE CLASS---	TEMPORARY DRINKING WATER PIPE LINE
		ø--- -WDK-PIPE CLASS---	DRINKING WATER PIPE LINE

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14.03.2024	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN

Approved by

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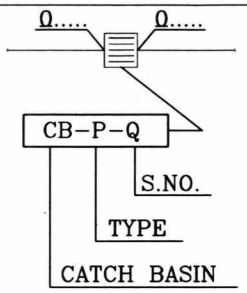
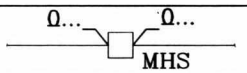
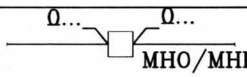
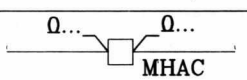
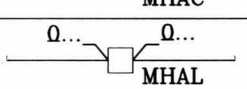
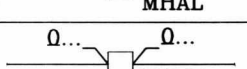
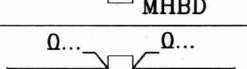
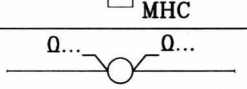
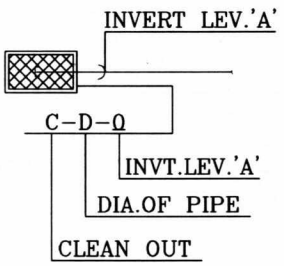
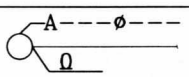
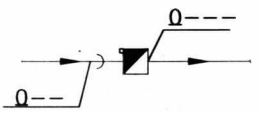
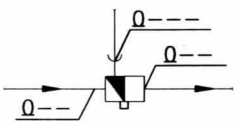
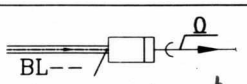
ø--- -WCS-PIPE CLASS---	COOLING WATER SUPPLY PIPE		45° BEND (TURNED DOWN)
ø--- -WCR-PIPE CLASS---	COOLING WATER RETURN PIPE		CATCH BASIN
ø--- -WF-PIPE CLASS---	FIRE WATER PIPE LINE		
ø--- -WH-PIPE CLASS---	HORTICULTURE WATER PIPE LINE		
ø--- -WS-PIPE CLASS---	SERVICE WATER PIPE LINE		
ø--- -SS-PIPE CLASS---	STORM SEWER		PIPE INVERT LEVEL
ø--- -DS-PIPE CLASS---	SANITARY WATER SEWER		SANITARY SEWER MANHOLE
ø---OWS/PWS-PIPE CLASS--	OILY WASTE SEWER/ PROCESS WASTE SEWER		OILY/PROCESS SEWER MANHOLE
ø--- -CTBD-PIPE CLASS--	COOLING TOWER BLOW DOWN		ACIDIC SEWER MANHOLE
ø--- -ACID-PIPE CLASS--	ACIDIC SEWER		ALKALI SEWER MANHOLE
ø---ALKALI-PIPE CLASS--	ALKALI SEWER		CTBD SEWER MANHOLE
ø---SANITARY PUMPING-PIPE CLASS---	SANITARY PUMPING MAIN		CHEMICAL SEWER MANHOLE
	GATE VALVE		CIRCULAR MANHOLE
	GLOBE VALVE		CLEAN OUT
	BUTTERFLY VALVE		
	CHECK VALVE		
	FLOAT VALVE		
	PIPE WITH FLANGED END		FUNNEL FOR STORAGE TANK DRAIN
	BLIND FLANGED END		RECTANGULAR SEALED MANHOLE (SINGLE COMPARTMENT)
TYPE	VALVE PIT IN PIPE LINE		
	90° BEND (TURNED UP)		RECTANGULAR SEALED MANHOLE (DOUBLE COMPARTMENT)
	90° BEND (TURNED DOWN)		
	45° BEND (TURNED UP)		SAND TRAP

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14.03.2024	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN

Approved by

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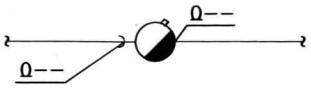
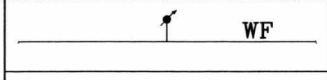
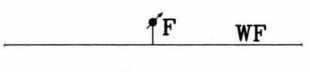
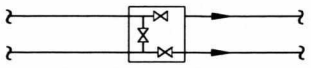
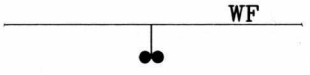
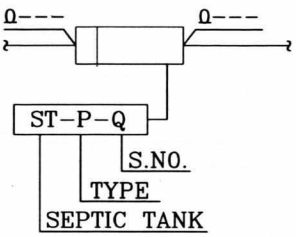
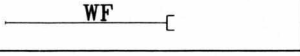
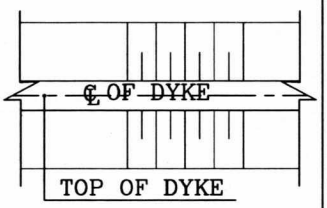
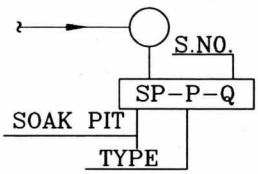
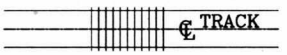
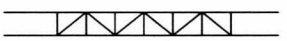
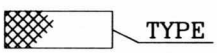
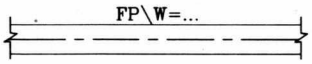
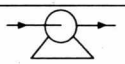
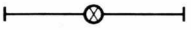
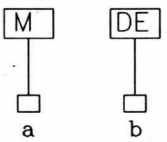
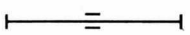
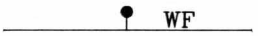
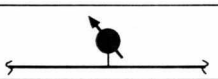
	SEALED MANHOLE (CIRCULAR)		WATER MONITOR FOR FOR FIRE WATER SYST.
			FOAM MONITOR FOR FOR FIRE WATER SYST.
	THREE WAY VALVE PIT (VALVE PITS OUTSIDE TANKFARM AREA FOR DRAINAGE)		DOUBLE HEADED FIRE HYDRANT AWAY FROM HEADER
	SEPTIC TANK		FIRE HOSE COUPLING
			EARTHEN DYKE
	SOAK PIT		RAILWAY TRACK REPRESENTATION ON LAYOUT
			RAILWAY TRACK REPRESENTATION ON AREA DWG.
	GULLY TRAP		PIPE RACK
	GATE		PIPE WAY
	BARBED WIRE FENCING	EQPT. SYMBOLS	
	CHAIN LINK FENCING		HOSE CABINET
	R.C.C. PAVEMENT		HOSE REEL
	FOOTPATH W=WIDTH OF FOOTPATH		DELUGE VALVE ASSEMBLY
	SLIDING SLEEPER		PUMP (HORIZONTAL)
	ANCHOR SLEEPER		PUMP VERTICAL a) ELECT. DRIVE b) DEISEL DRIVE
	GUIDE SLEEPER		
	JUMP OVER SLEEPER		
	FIRE HYDRANT SINGLE HEADED		WATER CUM FOAM MONITOR
	FIRE HYDRANT DOUBLE HEADED		

Rev. No	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
5	14.03.2024	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN

Approved by

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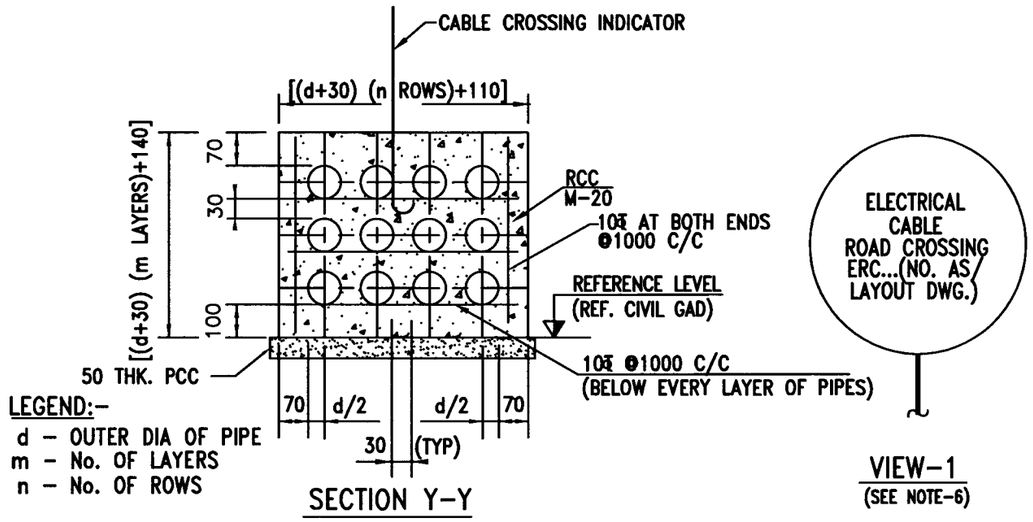
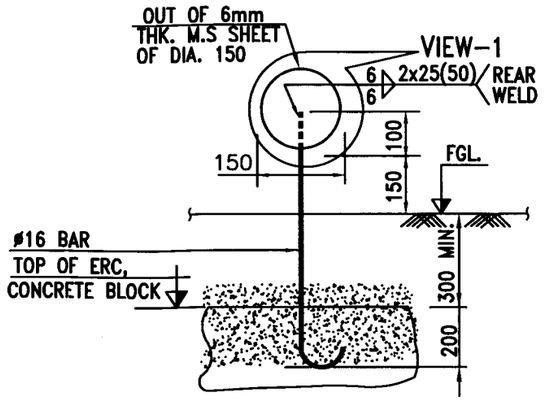


SECTION Y–Y

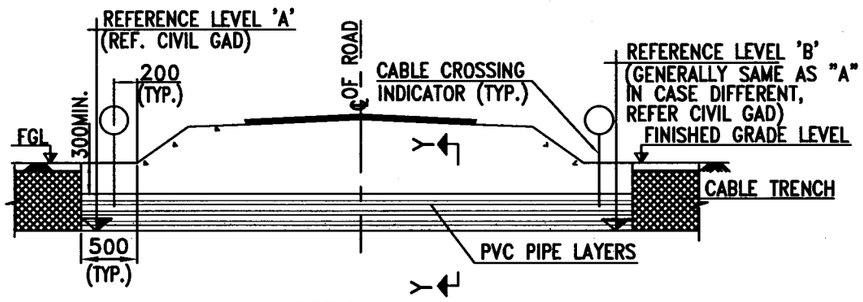
VIEW–1
(SEE NOTE–6)



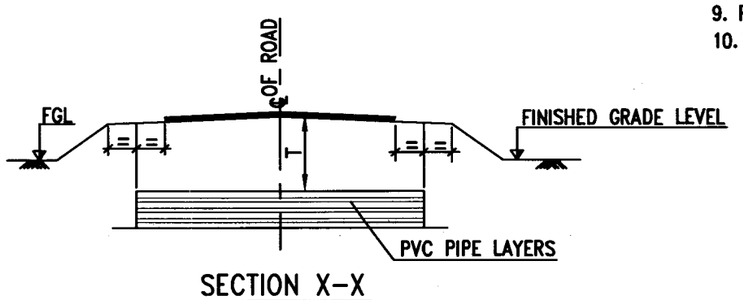
DETAILS OF
CABLE CROSSING INDICATOR

NOTES:–

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. CONDUIT MATERIAL P.V.C. PIPES OF NOM. OUT SIDE PIPE DIA. ϕ110, ϕ160 OR ϕ210 AS PER LAYOUT PLAN.
3. PIPES SHALL CONFIRM TO IS:4985 CLASS–I AND EMBEDDED IN RCC M–20.
4. BACK FILLING OVER ERC/ IRC/ SCRC SHALL BE DONE IN CONFORMATION TO SUB GRADE REQUIREMENT FOR ROADS AS PER 7–65–0011/JOB DRAWING FOR ROAD CROSS SECTION.
5. IN CASE CABLE CROSSING IS REQUIRED TO CROSS THE OPEN DITCHES ON EITHER SIDE, AS SHOWN IN STD.NO.7–51–0322, THE LENGTH AND THE LEVEL OF CABLE CROSSING SHALL BE DECIDED CLEARING THE SERVICES ALONG ROAD SIDE.
6. CABLE CROSSING INDICATOR MADE OF 6mm THICK MILD STEEL PLATE AS PER IS: 2062, ENAMEL PAINTED IN TRAFFIC GREEN (RAL 6024) BACKGROUND ON BOTH SIDES WITH WHITE LETTERING.
7. THE SHAPE OF PVC REMOVABLE TYPE CAP AS SHOWN IS INDICATIVE.
8. PVC PIPES WILL BE TIED WITH SUPPORTING 10 BARS AND 16 SWG BINDING WIRE AT @ 1000C/C.
9. REINFORCEMENT SHALL BE OF GRADE Fe500 TMT BAR CONFIRMING TO IS: 1786.
10. 'T' IS THE THICKNESS OF ROAD CRUST.



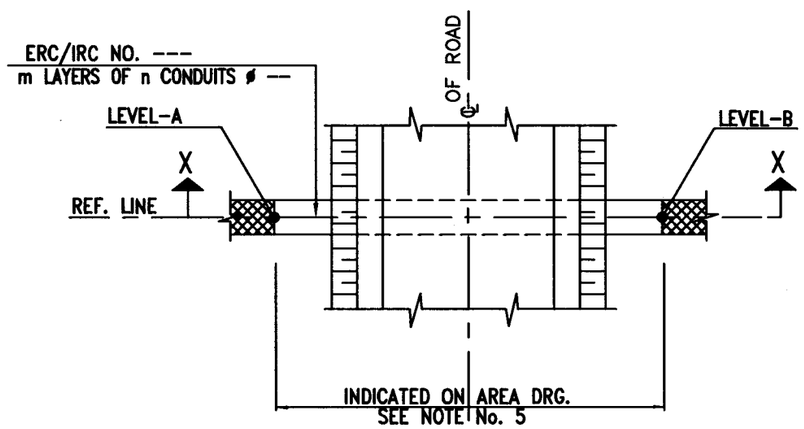
SECTION X–X
(APPLICABLE FOR ERC & IRC)



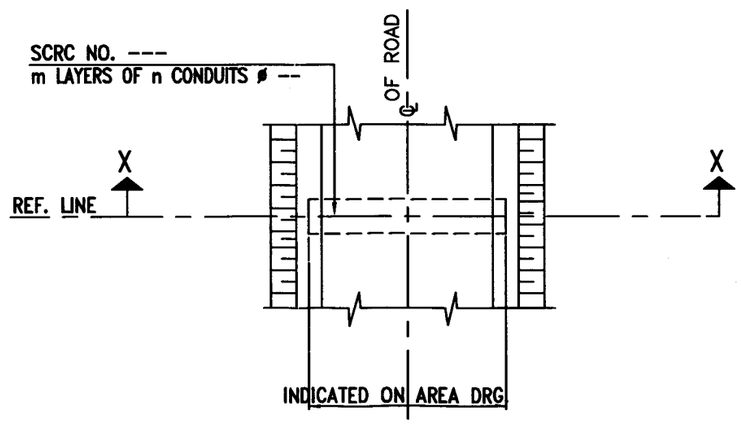
SECTION X–X
(APPLICABLE FOR SCRC)
(REFER SECTION Y–Y FOR CROSS SECTION DETAILS OF SCRC)

LEGENDS:

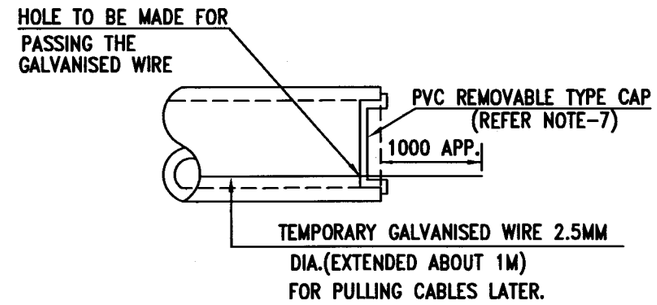
SCRC	STREET CABLE ROAD CROSSING
ERC	ELECTRICAL ROAD CROSSING
IRC	INSTRUMENTATION ROAD CROSSING



PLAN
(REPRESENTATION ON AREA DRG.)



PLAN
(REPRESENTATION ON AREA DRG.)



SLEEVE END PLUGGING DETAIL

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	21.12.20	REVISED AND ISSUED AS STANDARD	ADP	AK	A.SINHA	SM
4	25.07.14	REAFFIRMED AND ISSUED AS STANDARD	HV	RKS	RBB	SC

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

CABLE CROSSING UNDER ROAD (P.V.C. PIPES)

STANDARD No.
7–65–0006 Rev. 5

Format No. 8-00-0001-F5 Rev. 0
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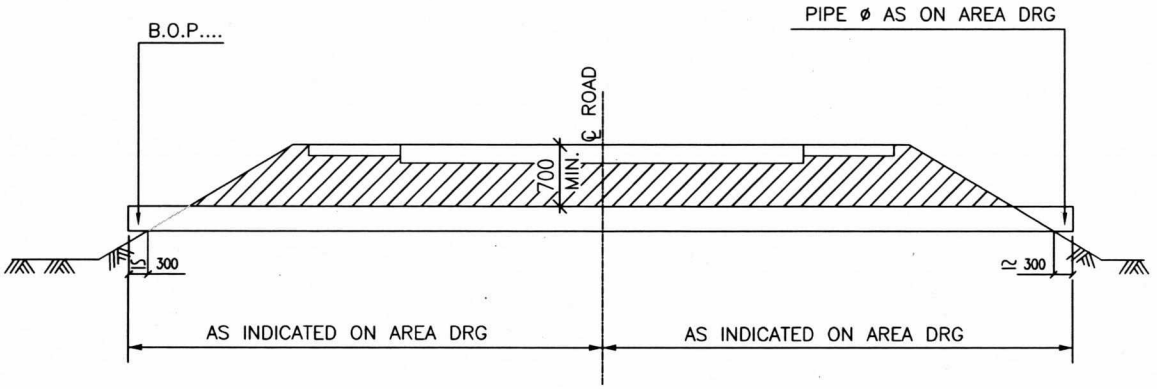
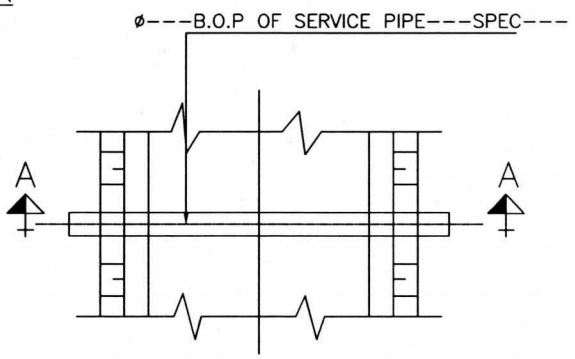


SECTION – A A

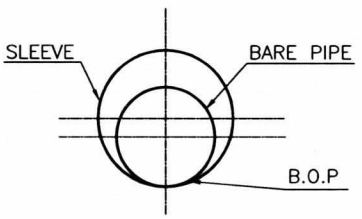


PLAN

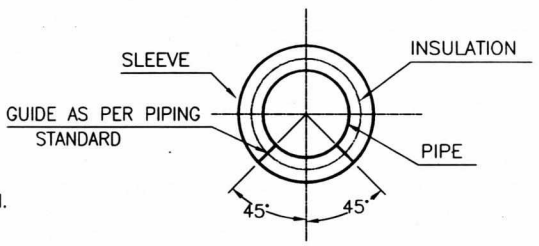
REPRESENTATION ON AREA DRG.

TABLE OF SLEEVE

BARE PIPE SIZE OR OUTER Ø OF INSULATION IN CASE OF INSULATED PIPE	SLEEVE PIPE SIZE
1 1/2"	4"
2"	4"
3"	6"
4"	6"
6"	10"
8"	10"
10"	14"
12"	14"
14"	16"
16"	20"
18"	20"
20"	24"
22"	24"
24"	30"



CASE–I BARE PIPE



CASE – II INSULATED PIPE

NOTES: –

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. MOC FOR PIPE SLEEVES SHALL BE AS PER APPROVED DESIGN BASIS.
3. C.S. PIPE SLEEVES SHALL BE PROVIDED WITH CORROSION PROTECTION COATING AS PER JOB SPECIFICATION.
4. PIPE SLEEVES WITH INADEQUATE CLEAR COVER SHALL BE ENCASED AS PER EIL STD. NO. 7–65–0213.
5. ENDS OF THE PIPE SLEEVES SHALL BE PLUGGED WITH BITUMEN IMPREGNATED MINERAL WOOL.
6. FOR CASE–II (INSULATED PIPE) THE OUTER DIAMETER OF THE SERVICE PIPE TO BE CONSIDERED AS OUTER DIAMETER OF INSULATION

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	
5	14.03.24	REVISED & ISSUED AS STANDARD	MK	AK	SKN	MN
4	08.06.18	REAFFIRMED & ISSUED AS STANDARD	Anil	HV/AK	RS	RKT

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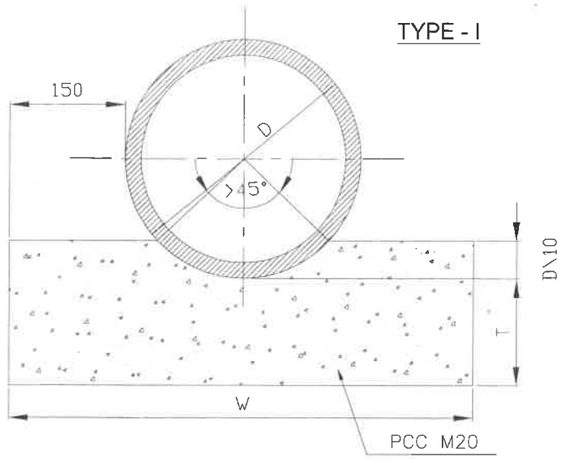
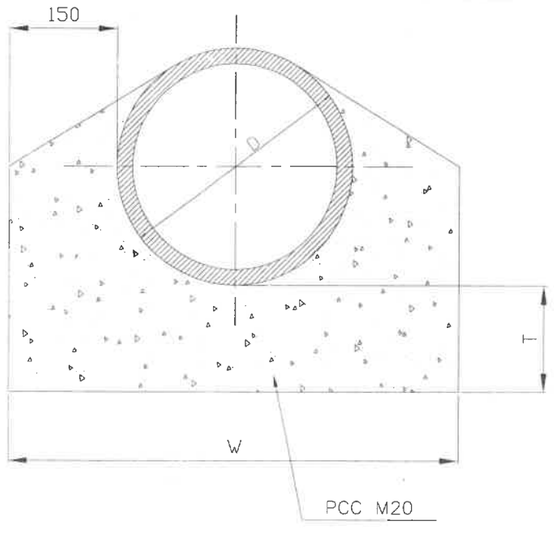
TYPE - I



SECTIONAL ELEVATION BEDDING

(FOR C.S PIPE SEWER WHERE SUPPORT IS REQUIRED)

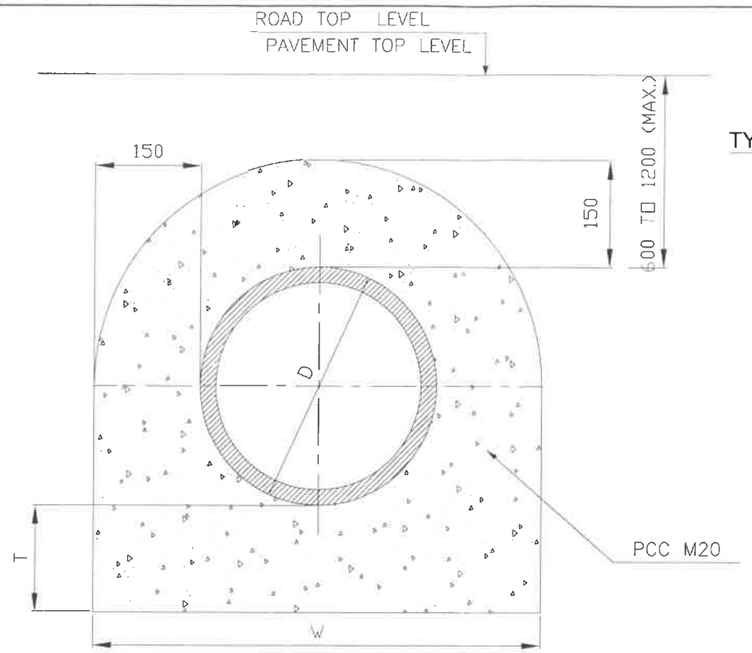
TYPE - II



SECTIONAL ELEVATION HAUNCHING

(FOR HDPE PIPE SEWERS)

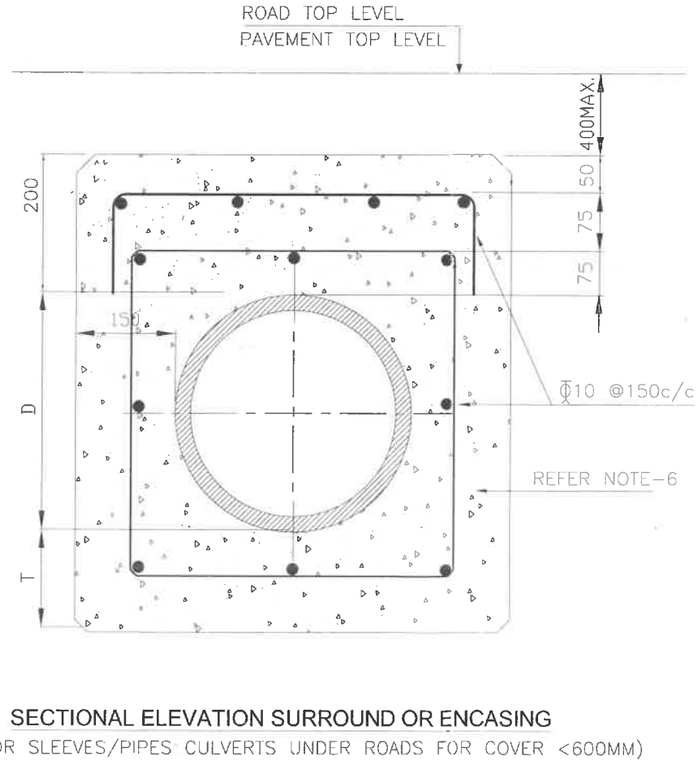
TYPE -IIIA



SECTIONAL ELEVATION SURROUND OR ENCASING

(FOR SEWERS UNDER ROADS)
FOR COVER ≥600

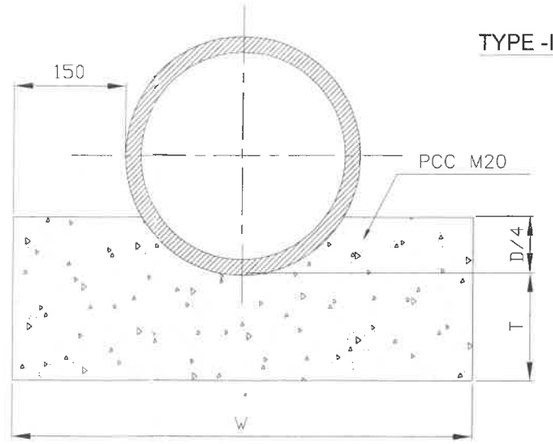
TYPE - IIIB



SECTIONAL ELEVATION SURROUND OR ENCASING

(FOR SLEEVES/PIPES CULVERTS UNDER ROADS FOR COVER <600MM)

TYPE -IV



SECTIONAL ELEVATION
CONCRETE CRADLE BEDDING

(FOR SEWERS – CONC. PIPE)

DIMENSIONS

W= D+300 WHERE D IS EXTERNAL DIA OF PIPE.
T={100 FOR PIPES UNDER 150 (OR 6")NOMINAL ø
T={150 FOR PIPES OF 150 (OR 6")NOMINAL ø AND OVER

NOTES:–

1. BEDDING:–WHERE BEDDING IS USED, THE CONCRETE SHALL BE BROUGHT UP TC ATLEAST TO THE INVERT LEVEL OF THE PIPE TO FORM A CRADLE & TO AVOID LINE CONTACT BETWEEN THE PIPE AND BED.
2. HAUNCHING:–THE FULL WIDTH OF THE BED SHALL BE CARRIED TO THE LEVEL OF THE HORIZONTAL DIAMETER OF THE PIPE AND SPLAYS FROM THIS LEVEL CARRIED ON BOTH SIDES OF THE PIPE TO MEET THE PIPE BARREL TANGENTIALLY
3. SURROUND OR ENCASING TYPE–IIIA:– THE SURROUND OR ENCASING SHALL BE SIMILAR TO HAUNCHING UP TO THE HORIZONTAL DIA OF THE PIPE & THE PORTION OVER THIS SHALL BE FINISHED IN A SEMI–CIRCULAR FORM TO GIVE A UNIFORM ENCASING FOR THE TOP HALF OF THE PIPE.

   TYPE IIIB:– IT IS SIMILAR TO TYPE.IIIA ABOVE EXECEPT THAT THE TOP PORTION OVER THIS SHALL BE FINISHED RECTANGULAR AS SHOWN AND THE SECTION PROVIDED WITH REINFORCEMENT AS PER REQUIREMENTS.
4. CONCRETE CRADLE BEDDING:– IS THE METHOD OF BEDDING PIPES IN WHICH THE LOWER PART OF THE PIPE EXTERIOR IS BEDDED IN A CRADLE CONSTRUCTION OF CONCRETE WITH DIMENSION AS SHOWN.
5. CONCRETE WORK SHALL BE CONFORM TO IS:456
6. REFER STRUCTURAL GENERAL NOTES OF THE PROJECT FOR CONCRETE STRUCTURES FOR FOLLOWING :
   a) GRADE OF CONCRETE
   b) GRADE AND TYPE OF CEMENT
   c) REINFORCEMENT STEEL BARS

इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED
(भारत सरकार का उपक्रम) (A Govt. of India Undertaking)

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6	16.07.24	REAFFIRMED & ISSUED AS STD.	SJ	GYAS	SKN	MN
5	06.06.18	REAFFIRMED & ISSUED AS STD	CS.	AVM	RS	RKT
					Approved by	

CONC. BEDDING AND ENCASEMENT FOR PIPES

STANDARD No.
7-65-0213 Rev.6

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Page 861 of 1204 : C098-TENDER DOC-C098-000-81-41-CD-T-8105 : Rev. A

मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

सामग्री
MATERIALS

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

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Abbreviations:

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

Structural Standards Committee

Convenor: **Mr. Anurag Sinha**

Members:
Mr. Virender Goel
Mr. Deepak Agrawal
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1.0 SCOPE

1.1 This specification establishes and defines the requirements of various materials to be used in Civil and Structural works.

1.2 Whenever any reference to BIS Codes is made, the same shall be taken as the latest revision (with all amendments issued thereto) as on the date of submission of the bid.

1.3 Apart from the BIS Codes mentioned in particular in the various clauses of this specification, all other relevant codes related to specific job under consideration regarding quality, tests, testing and/ or inspection procedures shall be applicable. Reference to some of the Codes in the various clauses of this specification does not limit or restrict the scope of applicability of other referred or relevant codes.

1.4 In case of any variation/contradiction between the provision of BIS Codes and this specification, the provision given in this specification shall be followed.

1.5 All materials shall be of standard quality and shall be procured from renowned sources/ manufacturers approved by the Engineer-in-Charge. It shall be the responsibility of the Contractor, to get all materials/ manufacturers approved by the Engineer-in-Charge prior to procurement and placement of order.

1.6 Whenever called for by the Engineer-in-Charge all tests of the materials as specified by the relevant BIS Codes shall be carried out by the Contractor in an approved laboratory and test reports duly authenticated by the laboratory, shall be submitted to the Engineer-in-Charge for his approval. If so desired by the Engineer-in-Charge, tests shall be conducted in the presence of the Engineer-in-Charge or his authorized nominee.

1.7 Quality and acceptability of materials not covered under this specification shall be governed by the relevant BIS Codes. In case BIS code is not available for the particular material, other codes e.g. BS or DIN or API/ ASTM shall be considered. The decision of Engineer-in-Charge, in this regard, shall be final and binding on the Contractor.

1.8 Whenever asked for, the Contractor shall submit representative samples of materials to the Engineer-in-Charge for his inspection and approval. Approval of any sample does not necessarily exempt the Contractor from submitting necessary test reports for the approved material, as per the specification/relevant BIS Codes.

1.9 The Contractor shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendation on storage, application, workmanship etc. for the intended use. Submission of manufacturer's test reports does not restrict the Engineer-in-Charge from asking fresh test results from an approved laboratory of the actual material supplied from an approved manufacturer/ source at any stage of execution of work.

1.10 All costs relating to or arising out of carrying out the tests and submission of test reports and or samples to the Engineer-in-Charge for his approval during the entire tenure of the work shall be borne by the contractor and included in the quoted rates.

1.11 Materials for approval shall be separately stored and marked, as directed by the Engineer-in-Charge and shall not be used in the works till these are approved.

1.12 All rejected materials shall be immediately removed from the site by the Contractor at his own cost.

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2.0 REFERENCES

As mentioned in the respective clauses.

3.0 WATER

3.1 Water used in construction for all civil & structural works shall be clean and free from injurious amount of oil, acids, alkalies, organic matters or other harmful substances which may be deleterious to concrete, masonry or steel. The pH value of water sample shall be not less than 6. Potable water shall be considered satisfactory. Underground water can also be used with the prior approval of Engineer-in-Charge, if it meets all the requirements of IS 456.

3.2 Tests on water samples shall be carried out in accordance with IS 3025 and they shall fulfill all the guidelines and requirements given in IS 456.

3.3 The Engineer-in-Charge may require the Contractor to prove, that the concrete prepared with water, proposed to be used, shall have average 28 days compressive strength not lower than 90% of the strength of concrete prepared with distilled water.

3.4 The Engineer-in-Charge may require the Contractor to get the water tested from an approved laboratory before starting the construction work and in case the water contains any oil/ organic matter or an excess of acid, alkalies or any injurious amount of salts etc., beyond the permissible maximum limits given in IS 456, the Engineer-in-Charge may refuse to permit its use. In case the water is supplied by the owner, contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. In case there is any change in source of water, water samples shall be tested again to meet the specified requirements.

3.5 Water shall be stored in tin barrels, steel tanks or water-tight reservoirs made with bricks / stone or reinforced concrete. Brick/ stone masonry reservoirs shall have RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand and finished with neat cement punning. These reservoirs shall be of sufficient capacity to meet the water requirement, at any stage of construction.

3.6 Water for curing shall be of the same quality as used for concreting and masonry works. Sea water shall not be used for preparation of cement mortar, concrete as well as for curing of plain/reinforced concrete and masonry works. Sea water shall not be used for hydrotesting and checking the leakage of liquid retaining structures also.

4.0 AGGREGATE

4.1 General

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

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

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4.1.2 Source and type of aggregates shall be got approved by the Engineer-in-Charge prior to procurement. Change in source and type of aggregates, at later stage, shall not be generally permitted; but under specific circumstances, Engineer-in-Charge can allow a change in source and type of aggregate. Contractor shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit fresh mix design for approval of the Engineer-in-Charge. Any such change, if permitted by the Engineer-in-Charge, shall be without any time and cost implication to the owner.

4.1.3 Aggregates which may chemically react with alkalies of cement or might cause corrosion of the reinforcement, shall not be used. If so desired by the Engineer-in-Charge, the Contractor shall carry out alkali reactivity tests and submit the results to him for approval.

4.1.4 The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS 2386 - Part II (Methods of Test for aggregates for concrete), shall not exceed the limits defined in IS 383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, the contractor shall submit necessary test results as per IS 383 and IS 2386 to the Engineer-in-Charge prior to his acceptance and approval. The method of Sampling shall be in accordance with the requirements given in IS 2430.

4.1.5 Coarse and fine aggregates shall be batched separately. All-in-aggregate shall be used only where specifically permitted by the Engineer-in-Charge.

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

4.1.6 Whenever required by Engineer-in-Charge, the aggregates (coarse/ fine) shall be washed and/ or sieved by the contractor before use in the works to obtain clean and graded aggregate at no extra cost to the owner.

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

4.2 Coarse Aggregates

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

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

4.2.2 Coarse aggregates may be obtained from

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

b) Crushed gravel or stone which results from crushing of gravel or hard stone

c) Partially crushed gravel or stone which results from blending of (a) and (b) above

d) Manufactured from other than natural sources, by processing materials, using thermal or other processes such as separation, washing, crushing and scrubbing. Manufactured coarse

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

4.3 Fine Aggregates

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

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

4.3.2 Fine aggregates shall consist of

a) Natural Sand : Fine aggregate resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies. This may also be called as uncrushed sand.

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

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

d) Manufactured Fine Aggregate : Fine aggregate manufactured from other than natural sources, by processing materials, using thermal or other processes such as separation, washing, crushing and scrubbing. Manufactured fine aggregate may be RCA processed from C&D waste.

4.4 Sampling and Testing

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

4.5 Storage of Aggregates

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

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

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

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

5.0 SAND

5.1 Sand for Masonry Mortars

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

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

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

5.1.4 **Grading of Sand**

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

GRADING OF SAND FOR USE IN MASONRY MORTARS

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

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

5.1.5 **Sampling and Testing**

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

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

5.2 Sand for Filling

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

6.0 CEMENT

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

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

6.1 Storage at Site

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

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

6.2 Tests after Delivery

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

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

6.3 Rejection

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

7.0 STEEL

7.1 General

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

7.2 Reinforcement Bars

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

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

7.3 Structural Steel

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

Structural steel sections shall conform to following BIS Codes:

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

7.4 Miscellaneous Steel Materials

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

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

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

7.4.1 Anchor Bolts

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

7.5 Storage

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

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

7.6 Tests after Delivery

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

7.7 Rejection

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

8.0 BRICK

8.1 General

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

- Common Burnt Clay Bricks- Specifications IS 1077

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

8.1.1 Common Burnt Clay Bricks

Bricks for masonry works shall conform to IS 1077 - Specification for common burnt clay building bricks and shall be of class 5.0 (with minimum compressive strength of 5.0 N/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.

8.1.2 Pulverized Fuel Ash Cement Bricks

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

8.1.3 Fly Ash Lime Bricks (FALG Bricks)

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

8.1.4 Burnt Clay Fly Ash Bricks

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

8.1.5 Mechanized Autoclave Fly Ash Lime Brick

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

8.2 Tests after Delivery

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

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

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

8.3 Stacking of Bricks

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

8.4 Local Bricks/ Class 3.5 Bricks.

Where shown on drawings, locally available bricks of non modular size (230 mm x 110 mm x 70 mm) in place of bricks of modular size (190 mm x 90 mm x 90 mm) can be used in case the bricks satisfy the other requirements of respective BIS codes. Minimum compressive strength of these bricks shall not be less than 3.5 N/mm^2.

8.5 Concrete Block Masonry

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

9.0 STONE

9.1 General

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

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

9.2 Quality of Stones

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

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

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9.3 Unloading/Stacking

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

10.0 ADMIXTURES

10.1 General Requirements for Admixtures

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

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

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

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

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

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

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

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

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

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

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

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

10.2 Water Proofing Compounds

10.2.1 Water proofing compounds shall be mixed with cement only.

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

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

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

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

11.0 WATER BARS (WATER STOPS)

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

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

12.0 BITUMEN/BITUMINOUS MATERIALS

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

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

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

13.0 PVC PIPES

PVC Pipes shall conform to the requirements of IS 4985.

14.0 WOOD/ TIMBER

14.1 Wood recommended for platforms of cold vessels or below cold vessels/ exchangers shall be hard and shall be of group A, grade I, and shall have safe permissible stress of 7 N/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.

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

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

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

15.0 EPOXY COMPOUNDS

Refer EIL Specification No. 6-68-0056.

16.0 PAINT

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

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17.0 ANTITERMITE COMPOUNDS

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

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

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

18.0 POLYSULPHIDE SEALANTS

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

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मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

सादा एवं प्रबलित सीमेंट कंक्रीट

PLAIN AND REINFORCED CEMENT CONCRETE

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
8	07 DEC 22	UPDATED & REVISED	DK	DA	AS	SM
7	29h JAN 16	UPDATED & REISSUED	AJS	AS	RS	SC
6	15th DEC 14	UPDATED & REISSUED	SP	AS	PKM	SC
5	28th DEC 12	UPDATED & REISSUED	CDS	AJS	PKM SC	DM
4	23rd NOV 07	UPDATED & REISSUED	YPC	PKM	VK	VC
3	APR,01	UPDATED & REISSUED	RPM7097	SCS	SCJ1151	MI

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Abbreviations:

ACI	:	American Concrete Institute
ASTM	:	American Society for Testing and Materials
BS	:	British Standards
GI	:	Galvanized Iron
IS	:	Indian Standard
ISO	:	International Organization for Standardization
PVC	:	PolyVinyl Chloride
RCC	:	Reinforced Cement Concrete
SCC	:	Self Compacting Concrete
SWG	:	Standard Wire Gauge

Structural Standards Committee

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*For Fireproofing Specifications

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1.0 SCOPE

This specification is applicable for Concrete Grade up to M60 and establishes the requirements of materials, mix proportioning, placing, curing, etc. of all types of cast-in-situ and precast concrete (ref. section 1.6) used in foundations, underground and above ground structures, floors, pavements etc. Any special requirements as shown or noted on the drawings shall supersede the provisions of this specification.

1.1 Reference Codes and Specifications

Apart from this specification, construction of plain and reinforced concrete works shall be in accordance with the Indian Standard Code of Practice for "Plain and Reinforced Concrete" IS 456 along with all amendments till date and other relevant codes mentioned therein.

1.2 For Liquid Retaining Structures, EIL Specification No. 6-68-0005 shall be applicable.

1.3 For Structural Steel works, EIL Specification No. 6-68-0006 & 0008 shall be applicable.

1.4 For Bipolar Concrete Penetrating Corrosion Inhibiting Admixture, EIL Specification No. 6-68-0017 shall be applicable.

1.5 For Self Compacting Concrete, EIL Specification No. 6-68-0019 shall be applicable.

1.6 For precast concrete manufacturing refer EIL Specification No. 6-68-0014.

1.7 In case of conflict between the clauses mentioned in this specification and those in the Bureau of Indian Standards (BIS), this specification shall govern.

2.0 MATERIALS

2.1 Materials for concrete viz cement, Pozzolanas, Fly Ash, Ground Granulated Blast Furnace Slag, Sand, Coarse aggregate, Water, etc. shall be as described in EIL Specification No.6-68-0002.

2.2 Materials for all reinforcements, embedment, inserts, water bars etc. shall conform to EIL Specification 6-68-0002.

2.3 Materials to be used as additive to concrete shall conform to EIL specification 6-68-0002 & 6-68-0017.

3.0 GRADES OF CONCRETE

Characteristic Compressive strength for different grades of concrete shall be as per Table-1.

TABLE – 1
GRADES OF CONCRETE

Group	Grade Designation	Specified Characteristic Compressive Strength of 150 mm cube at 28 days (N/mm^2)
Ordinary Concrete	M10 M 15 M 20	10 15 20

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TABLE – 1 (CONT.)
GRADES OF CONCRETE

Group	Grade Designation	Specified Characteristic Compressive Strength of 150 mm cube at 28 days (N/mm^2)
Standard Concrete	M 25	25
	M 30	30
	M 35	35
	M 40	40
	M 45	45
	M 50	50
	M 55	55
High Strength Concrete	M 60	60

Note: The characteristic strength is defined as the strength of material below which not more than five (5) percent of the test results are expected to fall.

4.0 TYPE OF CONCRETE MIX

4.1 Unless otherwise noted on drawings, all lean/plain concrete shall be of Nominal Mix type and reinforced concrete shall be of Design Mix type.

4.2 Nominal Mix Concrete

This concrete shall be made (without preliminary tests) by adopting nominal concrete mix with proportions of materials as specified in Table 9 of IS 456.

4.3 Design Mix Concrete

The mix shall be designed as per IS: 10262 in an approved laboratory to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in Table-1. The target mean strength of concrete mix shall be equal to the characteristic strength plus 1.65 times the standard deviation.

As long as the quality of materials does not change, a mix design done earlier but not prior to one year may be considered adequate for later work. However, in case the source & quality of materials changes or there is a break in the continuity of construction, the Engineer-In-Charge shall ask for a new design mix.

Irrespective of the grade of concrete required to be produced as per characteristic strength criteria, the minimum cement content and maximum water cement ratio in the design concrete shall be strictly maintained as stipulated in Table 5 of IS 456.

5.0 CONCRETE MIX PROPORTIONING

Proportioning, as used in this specification, shall mean the process of determining the proportions of the various ingredients to be used to produce concrete of the required workability when fresh/green and strength, durability & surface finish, when hardened. The following information shall be collected prior to design of the concrete mix:

a) Grade designation.
b) Type of cement.
c) Maximum nominal size of aggregate.
d) Minimum cement content.
e) Maximum water cement ratio
f) Workability requirements.

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g) Exposure condition as per Table 3 & Table 4 of IS 456
h) Maximum temperature of concrete at the time of placing.
i) Method of Placing.

The Engineer-in-Charge shall verify the strength of the concrete mix, before giving his sanction of its use. However, this does not absolve the Contractor of his responsibility as regards achieving the prescribed strength of the mix. If during the execution of the work, cube tests show lower strengths than required, the Engineer-in-Charge shall order fresh trial mixes to be made by the Contractor. No claim to alter the rates of concrete work shall be entertained due to such changes in mix variations. Any variation in cement consumption shall be taken into consideration for material reconciliation. Preliminary mix designs shall be established well ahead of start of work.

5.1 Maximum Density

Suitable proportions of sand and the different sizes of coarse aggregates for each grade of concrete shall be selected to give as nearly as practicable the maximum density as per clause 10.2.3 of IS 456. This shall be determined by mathematical means, laboratory tests, field trials and suitable changes in aggregate gradation. The contractor shall ensure the same to the satisfaction of Engineer-in-Charge.

5.2 Consistency

The concrete shall have a consistency such that it shall be workable in the required position and when properly vibrated it flows around reinforcing steel, all embedded fixtures, etc.

5.3 Workability

"Workability of Concrete" shall be as per clause 7 of IS 456.

5.4 Durability

For achieving sufficiently durable concrete, strong, dense aggregates, low water-cement ratio and adequate cement content shall always be used. Workability of concrete shall be such that concrete can be completely compacted with the means available. Leak-proof formwork shall be used so as to ensure no loss of cement-slurry during pouring and compaction. Cover to reinforcement shall be uniform. Concrete mix design shall always take into account the type of cement, minimum cement content irrespective of the type of cement and maximum water cement ratio and minimum grade of concrete conforming to environmental exposure conditions (refer Table 3 of IS 456) as given in Table 5 of IS: 456.

Generally, following types of cement shall be used for Plain and Reinforced concrete works:

a) 43/ 53 Grade Ordinary Portland Cement conforming to IS 269.
b) Rapid hardening Portland Cement conforming to IS 8041.
c) Portland Slag Cement conforming to IS 455.
d) Portland Pozzolana Cement(fly ash based) conforming to IS 1489(Part 1)
e) Portland Pozzolana Cement (calcined clay based) conforming to IS 1489(Part-2).
f) Sulphate Resisting Portland Cement conforming to IS 12330

Sulphate Resisting Portland Cement shall be used only for specific requirements depending on environmental and process exposure conditions to which the structures may be subjected to like high Sulphate concentrations, processes involving Sulphur handling etc.

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5.4.1 Water Cement Ratio

Once a mix, including its water cement ratio, has been determined and approved for use by the Engineer-in-Charge, that water cement ratio shall be maintained. The Contractor shall determine the water content of the aggregates frequently as the work progresses, and the amount of mixing water shall be adjusted so as to maintain the approved water cement ratio. Maximum water-cement ratio shall be as per Table 5 of IS 456 for different exposure condition.

The minimum cement content as mentioned in Table 5 of IS 456 shall be adjusted for aggregates other than 20 mm nominal maximum size as defined in Table 6 of IS 456.

For maximum cement content refer Cl.8.2.4.2 of IS 456.

5.4.2 Where specified, Bipolar concrete penetrating corrosion inhibiting Admixture in reinforced concrete as per EIL specification No. 6-68-0017 shall be used for protecting the reinforcement from corrosion.

5.5 Limits to Deleterious Constituents

Careful selection of the mix and the constituent materials shall be made to limit the presence of deleterious constituents in concrete. The total acid soluble chloride content calculated from the mix proportion and the measured chloride content of each of the constituents shall not exceed 0.6 kg/m^3 at the time of placing of concrete. The total water soluble Sulphate content of the concrete mix shall not exceed 4 percent by mass of the cement in the mix.

6.0 BATCHING

Refer clause 10.2 of IS 456.

7.0 CONCRETE MIXING

7.1 Ready Mixed Concrete supplied by Ready Mixed Concrete Plants or from on/off-site batching plants (IS 4926) shall be used for structural concrete.

All records and charts for the batching and mixing operations shall be prepared and maintained by the contractor in accordance with IS 4926 or as per the instructions of Engineer-in-Charge.

In case Ready Mixed Concrete is not available, the mixing of concrete shall be strictly carried out in an approved type of mechanical concrete mixer. The mixer shall be fitted with water measuring devices. The mixing shall be continued until there is a uniform distribution of the material and the mass is uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete shall be remixed.

7.2 Mixer

7.2.1 Mechanical Mixers shall comply with IS 1791 and 12119 and shall be maintained in satisfactory operating condition. These shall be used only for producing lean/ plain concrete and/ or nominal mix concrete wherever permitted.

7.2.2 Mixing Time

Mixing time shall be as indicated in the following Table-2. Excessive mixing requiring additions of water shall not be permitted. Time shall start when all solid materials are poured in the revolving mixer drum, provided that all of the mixing water shall be introduced before one-fourth of the mixing time has elapsed. The Engineer-in-Charge may, however, direct a change in the mixing time, if he considers such a change necessary.

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TABLE-2

MINIMUM MIXING TIME FOR MIXERS

Capacity of mixer	Minimum mixing time
2 m^3 or less	2 minutes
Above 2 m^3	3 minutes or as recommended by the mixer manufacturer.

7.3 Hand Mixing

Hand mixing of concrete shall not be permitted. However, for non-critical applications namely foundations for crossovers, isolated operating platforms etc., using concrete upto grade M20 and located at far away isolated places, this may be permitted by the Engineer-in-charge as a special case. Mixing shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. No extra payment shall be made to the Contractor for mixing by hand or for using extra cement due to hand mixing.

7.4 Additives

Additive in concrete shall be used only with the prior approval of the Engineer-in-Charge and shall comply with Cl. 5.5 of IS 456. Any additive used for obtaining proper workability or leak proofness of concrete or repair/rendering works of concrete due to non-conformance to the specifications, shall not be measured and paid for. All costs relating to such usage shall be borne by the Contractor.

8.0 TRANSPORTATION, PLACING AND COMPACTION

8.1 General

The entire concrete placing programme including transportation arrangements, deployment of equipment, layout, proposed procedures and methods, shall be submitted to the Engineer-in-Charge 24 hours prior to concreting for approval. No concreting shall be placed until his approval has been received. Approval of the Engineer-in-Charge for pouring concrete shall be taken as 'conveyed', when the concrete pour card is signed by him.

8.1.1 Chuting

The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization from the Engineer-in-Charge. In case an inferior quality of concrete is produced by the use of such conveyors, the Engineer-in-Charge may order discontinuance of their use and the substitution of a satisfactory method of placing the concrete. Open troughs and chutes shall be equipped with baffles and be in short lengths to avoid segregation. Chutes shall be designed so that the concrete is, to some extent, remixed at the lower end by passing down through a funnel shaped pipe or drop chute. Alternatively, they shall discharge into a storage hopper from which the concrete shall be transported to the point of placing by wheel barrows or other means. Where drop chutes are used, a sufficient number of these must be provided, so that the concrete discharged from the chute is not required to flow laterally more than 1.0 metre. Where a drop chute is swung from the vertical, the bottom two sections must be maintained in a vertical position to avoid segregation. The addition of water at any point in the system of transportation, to facilitate the movement of concrete shall not be permitted. All chutes, troughs and pipes, shall be kept clean and free from coatings of hardened concrete by thoroughly flushing them with water after each run; water used for flushing shall be discharged clear of the structure.

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8.1.2 Vibrators

8.1.2.1 Concrete shall be compacted with mechanical vibrating equipment supplemented, if necessary to obtain consolidation, by hand spreading, rodding and tamping. The vibrators shall be of immersion type with operational frequency ranging between 8,000 to 12,000 vibrations per minute. All vibrators shall comply with IS 2505. Screed board concrete vibrators or concreting vibrating tables or form vibrators conforming to IS 2506, 2514 and 4656 respectively shall be used where specifically required and directed by Engineer-in-Charge.

8.1.2.2 Immersion type vibrators shall be inserted in a vertical position at intervals of about 600 mm, depending upon the mix, the equipment used, and experience on work. The vibrators shall be withdrawn slowly. The spacing shall provide some overlapping of the area vibrated at each insertion. In no case shall vibrators be used to transport concrete inside the forms. Over vibration or under vibration shall not be permitted as both are harmful. Hand tamping in some cases may be allowed subject to the approval of the Engineer-in-Charge.

8.1.2.3 In placing concrete in layers which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, bonding and moulding of the concrete between the succeeding batches.

8.1.2.4 The vibrator shall penetrate the layer being placed and also penetrate the layer below while the under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

8.1.2.5 Care shall be taken to prevent contact of vibrators against all embedded reinforcing steel or inserts. Vibrators shall not be allowed to come in contact with forms.

8.1.2.6 The use of form vibrators shall not be permitted for compaction of in-situ concrete without specific authorization of the Engineer-in-Charge.

8.1.2.7 The use of surface vibrators of screed board type shall not be permitted for consolidation of concrete under ordinary conditions. However, for thin slabs (of thickness less than 200 mm) surface vibration by such vibrators may be permitted, upon approval of the Engineer-in-Charge.

8.1.2.8 Whenever vibration has to be applied externally, the design of formwork and the disposition of vibrators shall be carefully planned to ensure efficient compaction and to avoid surface blemishes.

8.2 Transportation

8.2.1 All concrete shall be conveyed from the mixer to the place of final deposit such as formwork as rapidly as possible using suitable buckets, dumpers, pumps, transit mixers containers or conveyors which shall be mortar leak tight. Care shall be taken to prevent the segregation or loss of the ingredients and maintaining the required workability. For structural concrete produced from Ready Mixed Concrete/ Batching Plants, concrete shall be transported from the plants to the sites only by transit mixers and Delivery Ticket for each delivery of concrete shall be maintained by the contractor.

8.2.2 During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted. All equipment used for transporting and placing of concrete shall be maintained in clean condition. All buckets, hoppers, chutes, dumpers and other equipment shall be thoroughly cleaned after each use.

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8.3 Placing and Compaction

8.3.1 Before placing concrete, all soil surfaces upon which or against which concrete is to be placed shall be well compacted and free from standing water, mud or debris. Soft or yielding soil shall be removed and replaced, with lean concrete or with selected soils/sand and compacted to the density as directed by Engineer-in-Charge. The surface of absorptive soil (against which concrete is to be placed) shall be moistened thoroughly so that moisture is not drawn from the freshly placed concrete. Similarly, for concrete to be placed on formworks, all chippings, shavings and sawdust etc. shall be removed from the interior of the forms before the concrete is placed.

8.3.2 Concrete shall not be placed until the formwork, the placement of reinforcing steel, embedded parts; pockets etc. have been inspected and approved by the Engineer- in-Charge. Any accumulated water on the surface of the bedding layer shall be removed by suitable means before start of placement. No concrete shall be placed on a water covered surface.

8.3.3 Concrete shall be discharged by vertical drop only and the drop height shall not normally exceed 1.5 metre throughout all stages of delivery until the concrete comes to rest in forms. However, drop height can be relaxed by the Engineer-in-Charge as per the provisions given under Cl. 8.1.1. For continuous concreting operation windows of suitable size shall be kept in the formwork or chutes shall be used to avoid segregation of concrete.

8.3.4 Concrete shall be deposited as near as practicable in its final position to avoid rehandling. Concrete shall be placed in successive horizontal layers. The bucket loads, or other units of deposit, shall be placed progressively along the face of the layer with such over-lap as will facilitate spreading the layer of uniform depth and texture with a minimum of hand shoveling. Any tendency to segregation shall be corrected by shovelling coarse aggregates into mortar rather than mortar on the coarse aggregates. Such a tendency for segregation shall be corrected by redesign of mix, change in process or other means, as directed by the Engineer-in-Charge.

8.3.5 All struts, stays and braces (serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete at their locations) shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These shall not be buried in the concrete. Concrete shall be thoroughly compacted with vibrators and fully worked around the reinforcement, embedded fixtures and into corners of formwork before setting commences and shall not be subsequently disturbed. Methods of placing shall be such as to preclude segregation and avoid displacement of reinforcement or formwork. The formation of stone-pockets or mortar bondage in corners and against face forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for thorough bonding as directed by the Engineer-in-Charge. Care shall be taken to avoid displacement of reinforcement and embedded inserts or movement of formwork.

8.3.6 Unless otherwise approved, concrete shall be placed in single operation to the full thickness of foundation rafts, slabs, beams and similar members. Concrete shall be placed continuously until completion of the part of the work between approved construction joints or as directed by the Engineer-in-Charge.

8.3.7 The method of placing and compaction employed in any particular section of the work shall be to the entire satisfaction of the Engineer-in-Charge.

8.3.8 During hot weather (atmospheric temperature above 40 degree Celsius) or cold weather (atmospheric temperature below 5 degree Celsius, the concreting shall be done as per the procedure set out in IS 7861).

8.3.9 Concrete that has set standing and becomes stiffened shall not be used in the work.

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8.3.10 Continuous Concreting

Where called out on the drawings, continuous concreting shall be done in a single operation as per the requirements of IS 456 and IS 2974. Sufficient "Windows" shall be left in the formwork for pouring & compaction of concrete and inspection. These windows shall be fixed tight once the level of concrete reaches their levels.

8.3.11 Concreting under special conditions

a) Work in extreme weather conditions during hot or cold weather, the concreting shall be done as per procedure set out in IS 7861(Part 1) or IS 7861 (Part2).

b) Under water concreting shall be as per clause 14.2 of IS 456.

8.4 Items Embedded in Concrete

8.4.1 Concreting shall not be started unless the electrical conduits, pipes, fixtures etc., wherever required, are laid by the concerned agency. The Contractor shall afford all the facilities and maintain co-ordination of work with other agencies engaged in electrical and such other works as directed by the Engineer-in-Charge.

8.4.2 Before concreting, the Contractor shall provide, fabricate and lay in proper position all metal inserts, anchor bolts, pipes etc. (which are required to be embedded in concrete members) as per relevant drawings and directions of Engineer-In-Charge.

8.4.3 All embedment, inserts etc. shall be fully held and secured in their respective positions by the concerned agencies to the entire satisfaction of Engineer-in-Charge so as to avoid any dislocation or displacement during the concreting operations. The Contractor shall take all possible care during concreting to maintain these embedment/inserts in their exact locations.

9.0 CONSTRUCTION JOINTS

9.1 Construction joints shall be provided in position as shown or described on the drawings or as directed by the Engineer-in-Charge. Such joints shall be kept to the minimum. These shall be straight and at right angles to the direction of main reinforcement and shall be placed at accessible locations to permit cleaning out of laitance, cement slurry and unsound concrete.

9.2 In a column, the joint shall be formed about 100 mm to 150 mm below the lowest soffit of the beams framing into it. Concrete in a beam and slab shall be placed throughout without a joint but if the provision of a joint is unavoidable, the joint shall be vertical and located within 1/3 to 1/4 of the span, unless otherwise shown on the drawings.

9.3 When stopping the concrete on a vertical plane in slabs and beams, an approved stop board shall be placed with necessary slots for reinforcement bars. The construction joints shall be keyed by providing a triangular or trapezoidal fillet nailed on the stop board. Inclined joints shall not be permitted. Any concrete flowing through the joints of stop board shall be removed soon after the initial set. When concrete is stopped on a horizontal plane, the surface shall be roughened and cleaned after the initial set and a triangular or trapezoidal groove shall be provided for keying with the new concrete later.

9.4 When the work has to be resumed on a surface which has hardened, such surface shall be cleared of any foreign materials and roughened to expose the tips of the coarse aggregate. This may be done by manual chipping of concrete, with a high pressure water jet or by any other appropriate means as per Engineer-in-Charge's directions. It shall then be swept clean and thoroughly washed and wetted before any new concrete is poured. Any set mortar or concrete sticking to the exposed reinforcing rods in and around such joints shall be thoroughly removed. The reinforcements shall be wire brushed and washed just before

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pouring any cement slurry or mortar. For vertical joints neat cement slurry shall be applied on the surface before it is dry. For horizontal joints the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry or mortar shall be freshly mixed and applied immediately before placing new concrete.

9.5 Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of particles of aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry. On this surface layer of concrete not exceeding 150 mm in thickness shall first be placed and shall be well rammed against old work, particular attention being paid to corners and close spots; work thereafter shall proceed in normal way.

10.0 SEPARATION JOINT

10.1 Separation joint shall be obtained by using an approved Alkathene sheet stuck on the surface against which concrete shall be placed. Adequate care shall be taken to cause no damage to the sheet.

11.0 EXPANSION JOINTS/ISOLATION JOINT

11.1 Expansion/ Isolation joints in structures shall be formed in the positions and to the shapes shown in the relevant drawings. Joints shall be filled with joint filling material as stipulated in the drawings/schedule of rates. Isolation joints shall be provided around all equipment foundations, columns, pedestals, trenches etc. on grade.

12.0 WATER STOPS

PVC water stops as per EIL Specification No. 6-68-0002 for materials shall be accurately cut, fitted and integrally joined as per manufacturer's specifications to provide a continuous, watertight diaphragm at all points.

The water stops shall be located and embedded at expansion/contraction/ construction joints as indicated in the drawings or directed by the Engineer-in-Charge.

Adequate provision shall be made for the support and protection of water stops during the progress of the work. Damaged water stops shall be replaced and/or repaired as directed.

13.0 PROTECTION OF FRESHLY LAID CONCRETE

13.1 Newly placed concrete shall be protected, by approved means, from rain, sun and wind. Concrete placed below the ground level shall be protected from falling earth during and after placing. Surface shall be kept free from contact with such ground or with water draining from such ground during placing of concrete for a period of at least 3 days, unless otherwise directed by the Engineer-in-Charge. The ground water around newly poured concrete shall be kept to an approved level by pumping or other approved means of drainage and adequate steps shall be taken to prevent floatation and flooding. Steps shall be taken to protect immature concrete from damage by debris, loading, vibration, abrasion, mixing with deleterious materials that may, in the opinion of the Engineer-in-Charge, impair the strength and/or durability of the concrete.

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14.0 CURING

14.1 Concrete shall be cured by keeping it continuously moist wet for the specified period of time to ensure complete hydration of cement and its hardening. Curing shall be started after 8 hours of placement of concrete in normal weather, and in hot weather after 4 hours. The water used for curing shall be of the same quality as that used for making of concrete.

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances such as hose, sprinklers etc. A layer of sacking, canvas, hessian, or other approved material, which will hold moisture for long periods and prevent loss of moisture from the concrete, shall be used as covering. Type of covering which would stain, disfigure or damage the concrete, during and after the curing period, shall not be used. Only approved covering shall be used for curing.

Exposed surfaces of concrete shall be maintained continuously in a damp or wet condition for at least the first 7 days after placing of concrete.

The Contractor shall have all equipment and materials required for curing on hand and ready to use before concrete is placed.

For curing the concrete in pavements, floors, flat roofs or other level surfaces, the ponding method of curing shall be used. For the first 24 hours after concreting, the concrete shall be cured by use of wet sacking, canvas, hessian etc. The minimum water depth of 25 mm for ponding shall be maintained. The method of containing the ponded water shall be approved by the Engineer-in-Charge. The ponded areas shall be kept continuously filled with water, and leaks, if any, shall be promptly repaired. Areas cured by ponding method shall be cleared of all debris and foreign materials after curing period is over.

Alternatively, membrane curing may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compounds shall be applied to all exposed surfaces of the concrete by spraying or brushing as soon as possible after the concrete has set. Minimum film thickness of such curing compounds shall be as per the recommendation of the manufacturer so as to obtain an efficiency of 90% as specified by BS-8110. This film of curing compound shall be fully removed from the concrete surface after the curing period specified earlier. Engineer-in-Charge may not allow curing by curing compounds for those surfaces where use of curing compound may be detrimental to application of future finishes over the concrete. Impermeable membranes such as polyethylene sheeting closely covering the concrete surface may also be used.

14.2 For concretes containing Portland pozzolana cement or Portland slag cement, the curing period as given in Cl. 14.1 shall be doubled. Curing by ponding shall, however, commence after the first 24 hours of concreting.

15.0 FIELD TESTS

15.1 Materials Testing

15.1.1 Aggregates

Grading test on fine and coarse aggregates shall be carried out as per IS 2386 at intervals specified by the Engineer-in-Charge.

The mandatory tests and their frequencies shall be done as given in Table-3A & 3B below:

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TABLE – 3A
(For Concrete prepared at site by using Mechanical mixers)

MANDATORY TESTS ON SAND & STONE AGGREGATES

S. No	MATERIAL	TEST	FIELD / LAB TEST	MIN. QTY OF MATERIAL/ WORK FOR CARRYING OUT TEST	FREQUENCY OF TESTING*
1.	Sand	(a) Bulking of sand	Field Test	20 m^3	Every 20 m^3 or part thereof or more frequently as decided by the Engineer-in-Charge
		(b) Silt content	Field Test	20 m^3	
		(c) Particle size distribution	Field or Lab as decided by the Engineer-in-Charge	40 m^3	1) Every 40 m^3 of fine aggregate/sand required in RCC works only 2) Every 80 m^3 of fine aggregate/ sand required for other items
2.	Stone aggregate	a) Percentage of soft or deleterious materials	General visual inspection, laboratory test where required by Engineer -in-Charge or as specified	As required by Engineer-in-Charge	For all quantities
		b) Particle size distribution	Field or lab. as required by Engineer-in-Charge	45 m^3	For every 45 m^3 or part thereof as decided by Engineer-in-Charge
		c)Ten percent Fine value	Laboratory	45 m^3	Initial test and subsequent test as & when required by Engineer-in-Charge

* Fresh testing is mandatory whenever there is change in Source of materials.

TABLE – 3B
(Refer Cl. 4.4 & 4.6.1 of IS 4926)

(For Ready Mixed Concrete supplied by Ready Mixed Concrete Plants or from on/off-site Batching Plants)

MATERIALS TESTING REQUIREMENTS

S. No	AGGREGATE PROPERTY/ PARAMETER	TYPE OF AGGREGATE	ASSESSMENT OF TYPICAL PROPERTIES AND HIGH TEST RATE*	NORMAL MONITORING AND LOW TEST RATE*	REQUIREMENT FOR NORMAL MONITORING AND LOW TEST RATE
1.	**Grading**	Sand/Fine	Weekly	Monthly	Last 8 results conform to IS 383 or representative values
		Coarse-Single sized/ Graded	Weekly	Monthly	
2.	**Particle density** -Oven Dry -Saturated Surface Dry -Apparent	All Types	Weekly	3 Monthly	Last 4 results ±0.04 percent
3.	**Absorption**	All Types	Weekly	3 Monthly	Last 4 results ±0.04 percent

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S. No	AGGREGATE PROPERTY/ PARAMETER	TYPE OF AGGREGATE	ASSESSMENT OF TYPICAL PROPERTIES AND HIGH TEST RATE*	NORMAL MONITORING AND LOW TEST RATE*	REQUIREMENT FOR NORMAL MONITORING AND LOW TEST RATE
4.	**Bulk Density** - Loose - Compacted	All Types	Monthly	6 Monthly	Last 4 results ± 75kg/m³
5.	**Fines(Silt) Content**	Sand	Weekly	Monthly	Last 10 results <75 percent maximum allowed
		Coarse	Monthly	3 Monthly	
6.	**Aggregate Impact Value**	Coarse	As specified	As specified	-
7.	**10 % Fines**	Coarse	Yearly	Yearly	-
8.	**Flakiness**	Coarse	2 Weekly	6 Monthly	Last 3 results conform to standard
9.	**Chloride Content**	All Types	Weekly	6 Monthly	Last 3 results < 0.01 percent
10.	**Aggregate Abrasion Value** (Los Angeles Method)	Coarse	-	Yearly/ Source Change	-
11.	**Soundness**	Fine and Coarse	-	Yearly/ Source Change	-
12.	**Potential Alkali Aggregate Reactivity Including Petrography**	Fine and Coarse	-	5 Yearly/ Source Change	-
13.	**Petrographic Description** (General)	All Types	-	5 Yearly	-

***Note** : The high or low test rates apply in accordance with the following conditions:

a) High test rate
   i) To establish the typical characteristics of an aggregate, and
   ii) When significant changes in properties occur outside the tolerances for low test rates given.

b) Low test rate
   i) When the typical characteristics of the aggregate have been established, and
   ii) When subsequent tests lie within the tolerances for low test rates given

15.1.2 Water

The minimum testing frequencies shall be as follows:

SOURCE	PARAMETERS	FREQUENCY	REQUIEMENT
Non mains water (Untreated water extracted from wells, ponds, lakes, rivers, underground, etc.)	p^H value, Chloride ion content, Sulphate content and any other parameter in accordance with IS 456	Initially every week for first 6 weeks (average of test results to be taken) and then at 3-monthly interval	Need further investigation in case significant deviation observed in test results of 3-monthly interval samples from the original 6 weeks average
Mains water (Treated water supplied through piped network)	Same as above	Annual basis once all tests for source are satisfactory	In case Chloride content > 0.01%, testing frequency shall be reduced to 3 months

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15.2 Compaction Factor Test /Slump Test of Concrete

15.2.1 For structural quality concrete (excluding pavements, flooring etc.) at least one Slump Test shall be made for every compressive strength test carried out. More frequent tests shall be made if there is a distinct change in working conditions or if required by the Engineer-in-Charge.

In case of Ready Mixed Concrete, provisions of IS 4926 shall be followed.

15.2.2 For structural quality concrete for pavements & floorings, measurement of workability shall be by determination of compacting factor. Value of compacting factor of 0.75 to 0.8 shall generally be acceptable.

15.3 Strength Test of Concrete

15.3.1 Samples from fresh concrete shall be taken as per IS 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS 516.

15.3.2 In order to get a relatively quicker idea of the quality of concrete, optional tests on beams for modulus of rupture at 72±2 hours or at 7 days, or compressive strength tests at 7 days may be carried out in addition to 28 days compressive strength tests. For this purpose, the values shall be arrived at based on actual testing. In all cases, the 28 days compressive strength specified in Table-1 shall alone be the criterion for acceptance or rejection of the concrete in accordance with clause 15.3.9.

15.3.3 Sampling Procedure

A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested that is, the sampling should be spread over the entire period of concreting and cover all mixing units.

15.3.4 Frequency of Sampling

The minimum frequency of sampling of concrete for each grade shall be in accordance with Table-4.

TABLE – 4
(Refer Cl. 15.2.2 of IS 456)

FREQUENCY OF CONCRETE SAMPLING

Quantity of concrete in the work (m^3)	Number of samples
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 plus one additional sample for each additional 50m^3 or part thereof.

At least one sample shall be taken from each shift.

When concrete is produced at continuous production units such as ready mixed concrete/ batching plants, atleast one sample shall be taken for every 50m^3 of concrete or after every 50 batches, whichever occurs at a greater frequency or as decided by the Engineer-in-Charge. Samples shall be avoided from the first and the last cubic metre of concrete mix in a lot.

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15.3.5 Test Specimen

Three test specimens shall be made for each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 days or at the time of striking the formwork or to check the testing error. Additional samples may also be required for testing samples cured by accelerated methods as described in IS 9013. The specimen shall be tested as described in IS 516.

15.3.6 Identification mark on concrete test cubes:

The following numbering system shall be adopted on each 150 mm cube:

First line: ZZ	(Alpha code assigned by the Engineer -in-Charge to the Contractor for a particular contract starting with AA and progressing to AB, AC and so on).
Second line: XXXX	(Unique integer in ascending order starting from 1).
Third line: DD-MM-YY	(Date of casting of cube)

15.3.7 Test Results of Sample

The test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than $\pm$ 15 percent of the average. If more, the test results of the sample shall be considered invalid.

15.3.8 Standard Deviation

Standard deviation for each grade of concrete shall be calculated separately.

Standard deviation based on test results of samples:

a) The total number of test samples required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts shall be made to obtain the 30 samples, as early as possible, when a mix is used for the first time.

b) For design of mix in the first instance, the value of standard deviation given in Table 8 of IS 456, Amendment No. 4 may be assumed.

c) As soon as sufficient results of samples are available, actual calculated standard deviation shall be used and the mix design shall be revised/ updated. However, when adequate past records for a similar grade exist and justify to the designer a value of standard deviation different from that shown in Table 8 of IS 456, Amendment No. 4, it shall be permissible to use that value.

d) For additional requirement on standard deviation refer clause 9.2.4 of IS 456.

15.3.9 Acceptance Criteria

15.3.9.1 Compressive Strength

The concrete shall be deemed to comply with the strength requirement when both the conditions as given in col. 2 & col.3 of Table-5 for that particular grade of concrete are simultaneously met. For working out standard deviation compressive test result of date wise serially logged 30 sample test result shall be used.

15.3.9.2 Flexural Strength

The concrete shall be deemed to comply with flexural strength requirements when both the following conditions are simultaneously met:

a) The mean strength determined from any group of four non-overlapping consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm^2.

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(For non overlapping consecutive compressive test result any one alternate set of four samples shall be used for verification of compliance to clause no. 16.1.a of IS 456)

b) The strength determined from any test result is not less than the specified characteristic strength less 0.3 N/mm^2

Table-5
(Refer Cl. 16.1 & 16.3 of IS 456)

Characteristic Compressive Strength Compliance Requirement

Specified Grade	Mean of the Group of 4 Non-Overlapping Consecutive Test Results in N/mm^2	Individual Test Results in N/mm^2
M15 or above	$\geq f_{ck}$ + 0.825 x established standard deviation (rounded off to nearest 0.5N/mm^2) or $\geq f_{ck}$ + 3 N/mm^2, Whichever is greater	$\geq f_{ck}$ – 3 N/mm^2

NOTE : 1) In the absence of established value of standard deviation, the values given in Table 8 of IS 456, Amendment No. 4, may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

2) For concrete of quantity 30 m^3 (where the number of samples to be taken is less than four as per the frequency of sampling given in cl. 15.3.4, Table 4), the mean of test results of all such samples shall be f_{ck} + 4 N/mm^2, minimum and the requirement of individual test results shall be f_{ck} – 2 N/mm^2, minimum. However, when the number of sample is only one as per Table 4, the requirement shall be f_{ck} + 4 N/mm^2.

15.3.9.3 Quantity of Concrete Represented by Strength Test Results

The quantity of concrete represented by group of four consecutive test results shall include the batches from which first and last samples were taken together with all intervening batches. Acceptance of concrete shall be applicable for serially logged 30 samples. In case serially logged samples are less than 30 then standard deviation of adjoining previous sample sets will be used for establishing acceptance criteria as per clause 16.1.a of IS 456.

For the individual test result requirements given in col. 3 of Table-5 or in item (b) of 15.3.9.2, only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified, the maximum quantity of concrete that four consecutive test results represent shall be limited to 60m^3.

15.3.9.4 If the concrete is deemed not to comply pursuant to Cl. 15.3.9.1 or 15.3.9.2, the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken (Refer Cl. 16.0).

15.3.9.5 Concrete of each grade shall be assessed separately.

15.3.9.6 Concrete is liable to be rejected if it is porous or honey-combed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measures and tests to the fullest satisfaction of the Engineer-in-Charge.

15.3.9.7 Tolerance in leveling of concrete surface at foundation/ pedestal top level where grouting is to be done:

Maximum Plan Dimension	≤ 2m	>2m but ≤4m	> 4m
Tolerance in leveling	+ 10 mm	+ 10 mm	+ 10 mm
	- 10 mm	- 20 mm	- 25 mm

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15.3.9.8 Tolerance in dimensions of pocket:

20 mm overall maximum tolerance on the size of pocket.

For pockets, chemically dissolvable moulds shall be preferred. Smooth removal of moulds without affecting the pocket size shall be ensured.

16.0 INSPECTION AND TESTING OF STRUCTURES

16.1 Inspection

To ensure that the construction complies with the design, an inspection procedure shall be set up by the contractor and duly approved by the Engineer-in Charge covering materials used, receipt of materials, their test results, records, workmanship and construction etc.

Contractor shall ensure that the surface which is to receive the grout is at proper level and so are the openings for pockets as per Cl. 15.3.9.7 & 15.3.9.8.

16.2 Immediately after stripping the formwork, all concrete shall be carefully inspected and any defective work or small defects either removed or made good before concrete has thoroughly hardened.

16.3 Testing

In case of doubt regarding the grade or soundness of concrete used, either due to poor workmanship or based on results of cube strength, compressive strength tests of concrete on the basis of clause 17.4 of IS 456 and/or load test as per clause 17.6 of IS 456 shall be carried out.

The Engineer-in-Charge shall be the final authority for interpreting the results of all tests and shall decide upon the acceptance or otherwise. The decision of the Engineer-in-Charge shall be final and binding on the contractor. In case the results of the tests are unsatisfactory, the Engineer-in-Charge may instruct the contractor to demolish and reconstruct the structure or part thereof without any extra cost to the Owner.

16.4 Members other than Flexural Members

Members other than flexural members like columns etc. shall be referred to the designer to investigate the structural adequacy. The decision of the designer shall be final and binding on the contractor.

16.5 Non-destructive Tests

Non-destructive tests using Ultrasonic Pulse Velocity and Rebound Hammer methods shall be resorted to for checking the soundness of concrete placed and shall be as per the directions of Engineer-in-Charge. The testing shall be based on IS 13311, Part-1. However, the Rebound Hammer test (IS 13311, Part-2) shall only be used in combination with other tests (Destructive or Non-Destructive) for checking the concrete quality.

17.0 FINISHING OF CONCRETE

17.1 On striking the formwork, all surface defects such as bulges, ridges and honey-combing etc. observed shall be brought to the notice of the Engineer-in-Charge. The Engineer-in-Charge may, at his discretion allow rectification by necessary chipping and packing or grouting with concrete or cement mortar. However, if honey-combing or sagging is of such extent as being undesirable, the Engineer-in-Charge may reject the work totally and his decision shall be binding. No extra payment shall be made for rectifying these defects, demolishing and reconstructing the structure. However, quantity of cement actually used for this purpose may

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be considered for reconciliation of materials. All burrs and uneven faces shall be rubbed smooth with the help of carborundum stone.

The surface of non-shuttered faces shall be smoothened with a wooden float to give a finish similar to that of the rubbed down shuttered faces. Concealed concrete faces shall be left as from the formwork except that honey-combed surface shall be made good as specified above. The top faces of slabs not intended to be covered shall be levelled and floated to a smooth finish to the rises or falls shown on the drawings or as directed. The floating shall not be executed to the extent of bringing excess fine materials to the surface. The top faces of slabs intended to be covered with screed, granolithic or similar finishes, shall be left with a rough finish.

17.2 Repair and Replacement of Unsatisfactory Concrete

17.2.1 Repair shall be made as soon as possible after the forms are removed and before the concrete becomes too hard with prior permission from the Engineer-in-Charge, in writing. Stone pockets, segregation patches and damaged areas shall be chipped out and the edges undercut slightly to form a key. All loose material shall be washed out before patching. No excess water shall be left in the cavity, but the concrete shall be damp. A good bond between the patch and parent concrete shall be obtained by sprinkling dry cement on the wet surface or by throwing mortar with force on to the wetted concrete, or by brush in a coat of thick cement grout of about 1:1 (1 cement:1 sand) just before applying the patching material. Before this has dried, the remainder of the patch shall be filled with mortar or concrete, depending on the extent of the repair.

17.2.2 Cement concrete/mortar used in repair of exposed surfaces shall be made with cement from the same source as that used in concrete and blended with sufficient amount of white Portland cement to produce the same colour as in the adjoining concrete. The proportions of ingredients shall be same as those used in parent concrete. The mortar shall be as dry as possible and well compacted into the cavity. All filling shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the filling has been cured and dried.

17.2.3 For larger repairs to hardened concrete, necessary formwork bearing tightly at the edges of the cavity shall be provided. Concrete shall be chipped out to a depth of at least 100 mm and preferably 150 mm. Mortar shall be scrubbed into all surfaces with a wire brush before placing the concrete. Damaged reinforcement shall be adequately spliced with new steel so as to maintain the original strength. Additional reinforcement, if required in the patch, shall be provided as per the instructions of Engineer-in-Charge.

17.2.4 In case, in the opinion of the Engineer-in-Charge, defects in the concrete is excessive or beyond repair, the contractor shall either redo the structure or take other remedial measures as instructed by the Engineer-in-Charge. The decision of the Engineer-in-Charge shall be final and binding to all in this respect.

17.2.5 Approved epoxy formulation for bonding fresh concrete used for repairs with already hardened concrete shall be used by the Contractor if asked by the Engineer-in-Charge. Epoxy shall be applied in strict accordance with EIL Specification 6-68-0056 and the instructions of the manufacturer.

17.2.6 All repair works due to non-conformance or non-adherence to specification, if allowed by the Engineer-in-Charge, shall be carried out free of cost to the owner.

17.3 Curing of Patched Work

Immediately after patching is completed, the patched area shall be covered with an approved non-staining water saturated material which shall be kept wet and protected against sun and wind for a period of 12 hours. Thereafter, the patched area shall be kept continuously wet by a fine spray or sprinkling for not less than 10 days.

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18.0 WATERPROOF CEMENT PAINT

Wherever specified, concrete elements (whether cast-in-situ or precast) exposed to atmosphere shall be provided with three coats of cement based waterproof paint as per IS 5410 provided these surfaces shall not contain any protective coating. Prior to application of the paint, the surface shall be prepared to remove all foreign particles, loose materials, extra deposited concrete lumps, etc. using appropriate mechanical/ manual means.

19.0 FORM WORK

19.1 General

19.1.1 Forms for concrete shall be of plywood conforming to IS 6461 (Part-5) or steel or as directed by the Engineer-in-Charge and shall give smooth and even surface after removal thereof.

19.1.2 If it is desired by Engineer-In-Charge, the Contractor shall prepare, before commencement of actual work, design and drawings for formwork and get them approved by the Engineer-in-Charge. For details regarding design, detailing etc., reference may be made to IS 14687.

19.1.3 Form work and its supports shall maintain their correct position and be to correct shape and profile so that the final concrete structure is within the limits of dimensional tolerances specified below, unless required otherwise, for functional/aesthetic reasons. The decision of the Engineer-in-Charge shall be final and binding in this regard.

(a) Deviation from specified dimensions of cross section of columns and beams. — - 5 mm to +10 mm

(b) Deviation from dimensions of footings (see Note below)

i)	Dimensions in plan	-10 mm to +50 mm
ii)	Eccentricity	0.02 times the width of the footing in the direction of deviation but not more than 50 mm.
iii)	Thickness	-10 mm to +50 mm or $\pm$0.05 times the specified thickness, whichever is less

Note: These 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)

upto 3m	$\pm$6 mm
3m to 4.5m	$\pm$9 mm
4.5m to 6m	$\pm$12 mm
Additional deviation for every subsequent 6m.	$\pm$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.

upto 3m	6 mm
3m to 6m	9 mm
6m to 12m	12 mm
additional for every subsequent 6m.	6 mm

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(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 6 mm. 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 degree, the included angle between check lines shall be varied accordingly.

(f) Deviation in twist 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:

upto 600 mm wide and upto 6m in length	:	6 mm
over 600 mm wide and for any length	:	12 mm

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

(h) Tolerance in leveling of concrete surface at foundation/ pedestal top level where grouting is to be done : As per Cl. 15.3.9.7

19.2 Form Requirement

19.2.1 The formwork shall be true, rigid and adequately braced both horizontally as well as diagonally. The forms shall have smooth and even surface and be sufficiently strong to carry, without deformation, the dead weight of the green concrete, working load, wind load and also the side pressure exerted by the green concrete. As far as practical, clamps shall be used to hold the forms together. Where use of nails is unavoidable minimum number of nails shall be used. Projected part of nail shall not be bent or twisted for easy withdrawal.

19.2.2 Where through tie rods are required to be put to hold the formwork and maintain accurate dimension, they shall always be inserted through a precast concrete block (of same mix proportion as is to be used for concreting) with a through hole of bigger diameter. The Precast block shall tightly fit against in inner faces of formwork. The holes left after the withdrawal of tie rods shall be fully grouted with cement-sand mortar of same proportion as that used for concrete. However, use of such precast block shall in no case impair the desired appearance or durability of the structure. No such tie rods shall be used in any liquid retaining or basement structure.

19.2.3 Tie wires shall be permitted only upon approval of the Engineer-in-Charge and shall be cut off flush with the face of the concrete or counter sunk, filled and finished in the manner specified in clause 17.

19.2.4 Form joints shall not permit any leakage. The formwork shall be strong enough to withstand the effect of vibrations practically without any deflection, bulging, distortion or loosening of its components.

19.2.5 Forms for beams and slabs (span more than 6.0m) shall have camber of 1 in 500 so as to offset the deflection and assume correct shape and line after deposition of concrete. For cantilevers, the camber at free end shall be 1/100th of the projected length. Where architectural considerations and adjunctive work are critical, smaller form cambers shall be adopted as decided by the Engineer-in-Charge.

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19.2.6 All vertical wall forms may be designed and constructed for the following minimum pressure. The pressures listed in Table-6 are intended as guide only and the Contractor shall ensure that the formwork is adequately strong and sturdy.

TABLE - 6
MINIMUM DESIGN PRESSURE FOR WALL FORMWORK

Rate of pour in meter/hour	Pressure in KN/m^2	
	at 10^0 (in Celsius)	at 24^0 (in Celsius)
0.6	36.0	29.0
0.9	40.0	32.0
1.2	44.0	35.0
1.5	46.0	37.0

All horizontal forms shall be designed and constructed to withstand the dead load of the green concrete, reinforcement, equipment, material, embedment and a minimum live load of 2.0 kN/m^2.

19.3 Inspection of Forms

Temporary openings shall be provided at the base of column and wall forms and other places necessary to facilitate cleaning and inspection. Before concrete is placed, all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight, thoroughly cleaned, properly treated and free from foreign material. The complete form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the work shall be stopped until the defects have been rectified as per the instructions of the Engineer-in-Charge.

19.4 Cleaning and Treatment of Formwork

The surfaces of forms that would come in contact with concrete shall be well treated with approved non-staining form release agents such as soft soap, oil, emulsions etc. Release agents shall be applied so as to provide a thin uniform coating to the forms without coating the reinforcement.

19.5 Chamfers and Fillets

All corners and angles shall be formed with 45 degree mouldings to form chamfers or fillets on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise detailed or specified shall be 25x25 mm. For heavier work chamfers or fillets shall be 50x50 mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

19.6 Reuse of forms

Before reuse, all forms shall be thoroughly scrapped, cleaned, examined and when necessary, repaired and retreated, before resetting. Formwork shall not be reused, if declared unfit or un-serviceable by the Engineer-in-Charge.

19.7 Removal of Forms/Stripping Time

In the determination of time for removal of forms, consideration shall be given to the location and character of the structures, the weather and other conditions including the setting and curing of the concrete and material used in the mix.

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Forms and their supports shall not be removed without the approval of the Engineer-in-Charge. Forms shall not be released until the concrete has achieved a strength of at least twice the stress to which the concrete may be subjected at the time of removal. The formwork shall be removed without shock and methods of form removal likely to cause over stressing or damage to the concrete shall not be adopted. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

In normal circumstances when average air temperature exceeds 15 degree Celsius during the period under consideration after pouring of concrete and where ordinary Portland cement is used, forms may generally be removed after expiry of following periods.

(a) Walls, columns and vertical faces of all structural members	16 to 24 hours as may be decided by the Engineer-in-Charge.
(b) Slabs (props left under)	3 days.
(c) Beam Soffits (props left under)	7 days.
(d) Removal of props under slabs:	
Spanning upto 4.5m.	7 days.
Spanning over 4.5m.	14 days.
(e) Removal of props under beams and arches:	
Spanning upto 6m	14 days.
Spanning over 6m	21 days

(f) Cantilever Construction Formwork shall remain till structures for counter acting or bearing down have been erected and have attained sufficient strength (minimum 14 days).

Notes:

i) For other cements, the stripping time recommended for ordinary Portland cement shall be suitably modified as per the instructions of the Engineer- in-Charge.

ii) The number of props left under, their sizes, supporting arrangement, and disposition shall be such as to be able to safely carry the full dead load of the slab, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

iii) Where the shape of the element is such that the formwork has re-entrant angles, the form work shall be removed as soon as possible after the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed.

iv) For rapid hardening cement, 3/7 of the above mentioned periods shall be considered subject to a minimum of 16 hours.

v) For Portland pozzolana or low heat cement, 10/7 of the above mentioned periods shall be considered.

19.8 Staging/Scaffolding

19.8.1 Staging/Scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. The Contractor shall get it reviewed by Engineer-in-Charge before commencement of work. While designing and during erection of scaffolding/staging, the following measures shall be considered:

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(a) Sufficient sills or underpinnings in addition to base plates shall be provided particularly where scaffolding is 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/staging from rocking.

(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 and effort shall not be made to bring it in line with a physical force.

(h) All nuts and bolts shall be properly tightened and care shall be taken that all clamps/couplings are firmly tightened to avoid slippage

(i) Erection work of a scaffolding/staging under no circumstances shall be left totally to semi-skilled or skilled workmen and shall be carried out under the supervision of a technically qualified civil engineer of the Contractor.

19.8.2 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 19.8.1 above.

20.0 EXPOSED/ARCHITECTURAL CONCRETE WORK

20.1 Form Work

Other things remaining same as per clause 19.0, formwork shall be of high quality. Care shall be taken to arrange the forms so that the joints between forms correspond with the pattern indicated in the drawings. The forms shall be butting with each other in straight lines, the corners of the boards being truly at right angles. The joints between the forms shall cross in the two directions at right angles. The size of forms shall be so selected as to exactly match with the pattern of forms impression on the concrete face indicated in the drawings. Maximum care shall be taken to make the form work watertight. Burnt oil shall not be used for treatment of forms. The Contractor shall be permitted reuse of forms brought new on the work place only if forms are properly cared for, stored and treated after each use.

The Engineer-In-Charge may, at his absolute discretion, order removal of any forms considered unsuitable for use in the work.

20.2 Finishing

Repairing to exposed concrete work shall be avoided. Rendering and plastering shall not be done. Minor repairing, if unavoidable shall be done as specified in clause 17.0 with the written permission of the Engineer-in-Charge.

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21.0 REINFORCEMENT

21.1 The Contractor shall develop the bar bending schedule for all RCC structures/ structural parts at no extra cost to the Owner and shall get it reviewed by the Engineer-in-charge. Reinforcement shall be cut and bent to shape as per dimensions shown in the bar bending schedule/ drawings.

If protective fusion bonded epoxy coating is required to be applied on reinforcement bars, the same shall be done as per IS 13620. All repairs to applied protective coating required due to mishandling and/ or bending of reinforcement bars shall also be done as per relevant clauses of IS 13620.

21.2 Straightening, Cutting and Bending

Procedure for cutting and bending shall be as given in IS 2502. Bars shall be bent in a slow and regular movement to avoid fractures by mechanical means only. In case bars are supplied in coils, they shall be smoothly straightened without any kinks.

Cold twisted deformed bars shall be bent cold. Bars larger than 25 mm in size (except cold twisted deformed bars) may be bent hot at cherry red heat to a temperature not exceeding 850^0 Celsius as per the instructions of the Engineer-in-Charge. The bars shall be allowed to cool gradually without quenching.

Bars shall be cut & bend in a Bar Bending Machine. Bars which develops cracks or splits after bending shall be rejected. A second bending of reinforcement bars shall be avoided but when reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is radius of the bend less than 6 times bar diameter for high strength deformed bars. Care shall also be taken when bending back the dowel bars to ensure that concrete around the bars is not damaged. All bars shall be properly tagged for easy identification.

21.3 Placing and Fixing

All reinforcement shall be cleaned to ensure freedom from loose mill scale, loose rust, oil, form releasing agents, grease or any other harmful material before placing them in position. Reinforcement shall not be surrounded by concrete unless it is free from all such materials. Rough handling and dropping of reinforcement from a height shall be avoided.

All reinforcement shall be fixed in the correct position and shall be properly supported to ensure that displacement will not occur when the concrete is placed and compacted.
The uncoated reinforcement bars shall be tied at every intersection by two strands of 16 SWG black soft annealed binding wire. The Epoxy coated reinforcement bars shall be tied with 2 strands of PVC coated GI 18 SWG wire at every intersection. Crossing bars shall not be tack welded for assembly of reinforcement. The reinforcement bars shall be kept in position by using the following methods:

a) In case of beam and slab construction, precast cover blocks (having the same sand contents as the concrete which shall be placed) of size 40 x 40 mm and thickness equal to the specified covers shall be placed firmly in between the bars and forms so as to secure and maintain the specified covers over the reinforcement.

When reinforcement bars are placed in two or more layers in beams, the vertical distance between the horizontal bars shall be maintained by introducing spacer bars at 1 to 1.2m centre to centre.

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b) In case of thick rafts & pile caps having two or multi layers of reinforcement, the vertical distance between the horizontal bars shall be maintained by introducing suitable chairs, spacers, etc.

c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them. The templates shall be removed after the concreting has been done below it.

d) Exposed portions of reinforcement bars shall not be subjected to impact or rough handling and workmen will not be permitted to climb on extending bars until the concrete has attained sufficient strength so that no movement of the bars in the concrete is possible.

21.4 Special requirements for Handling, Stacking, Placing of Epoxy coated Reinforcing bars.

Epoxy coated reinforcing bars shall be carefully handled and it shall be ensured that these do not rub on any hard surface or against another epoxy coated/uncoated reinforcing bar whether during conveying/transportation, stacking or placing.

During transportation and while stacking the epoxy coated reinforcing bars shall be placed on wooden planks not spaced farther than 600 mm. When placed in stacks the epoxy coated reinforcing bars shall be neatly tied in bundles using PVC binding material.

The cut ends of bars shall be touched up with special touch up material of specifications as provided by the coating agency. After cutting of the bar the application of touch up material shall be completed within four hours.

While bending the bars the pins of work bench(s) shall be provided with a PVC or plastic sleeve. Each bending operation on epoxy coated reinforcing bar shall be completed in time not less than 90 seconds.

Epoxy coated reinforcing steel bar shall not be directly exposed to sun rays or rain, and shall be protected with opaque polyethylene sheets or similar means as approved by the Engineer in Charge.

While doing concreting the workmen or machinery shall not rest or move on the epoxy coated reinforcing bars. Wooden planks shall suitably be placed to create proper gang-way.

21.5 Splicing/Overlapping

Only bars of full length shall be used as shown in the drawings. But where this cannot be done, overlapping of bars shall be done as directed by the Engineer-in-Charge. The overlapping bars shall be tied with two strands of 16 SWG black soft annealed binding wire. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending moment is maximum.

21.6 Welded Joints

Welding of reinforcing bars shall not be permitted without the written permission of the Engineer-in- Charge. Where welding of reinforcing bars is permitted, it shall be in accordance with the recommendations of IS 2751 and IS 9417. Welded joints shall be located at suitable staggered positions. Tests shall be made as directed by the Engineer-in-Charge to prove that the joints are of the full strength of the bars. Maximum one welded joint shall be allowed per bar.

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21.7 Mechanical Connections

The mechanical splices in reinforcement by means of couplers, clamps etc. shall be used (as per manufacturer's specifications) with the written approval of the Engineer-in-Charge. Following tests, at the minimum, shall be conducted in advance to prove efficiency of the coupled joint before putting them in actual use. This covers requirements of couplers to be used with bars conforming to grades less than & equal to Fe550D of IS 1786.

Name of the Test	Testing Requirement	Code of conformance
Static Tensile test: 1. Tensile strength	Each connection shall develop at least 125% of the specified yield strength of the reinforcing bar & 100% of the specified tensile strength. Bar break requirement shall be satisfied to avoid splice failure & to develop full tensile strength of the bar.	ASTM A370/ ACI 318/ **AC 133**/ ISO 15835/ IS 16172
Static Tensile test: 2. Percentage elongation (Ductility)	The minimum percentage elongation (at maximum forces), in the reinforcing bar outside the length of the mechanical splice shall be minimum 3% before the failure of the test piece.	ISO 15835 IS 16172
Static compression test	Each connection shall develop atleast 125% of the specified yield strength of the reinforcing bar.	ASTM A370/ ACI 318/ AC 133
Permanent Elongation (Slip)	Permanent elongation across the coupled joint shall be less than 0.1 mm after loading at 60% of the yield strength of the reinforcing bar	BS 8110/ ISO 15835 IS 16172
Cyclic tensile test	Mechanical splice shall withstand 100 cycles of stress variation from 5% to 90% of the yield strength of reinforcing bar & without loss of static tensile strength capacity when compared with like specimen.	IS 16172
Moderate Oligocyclic (Seismic) Test (Cyclic Tension & Compression Test) **(Refer note- 1)**	Deformation across the coupled joint shall be less than 0.3 mm after subjecting the joint to a series of 20 cycles with 95% tension as well as 50% compression of the yield strength of the reinforcing bar & without loss of static tensile strength capacity when compared with like specimen.	ISO 15835/ ASTM A370/ ACI 318/ AC 133
Violent Oligocyclic (Seismic) Test (Cyclic Tension & Compression Test) **(Refer note- 2)**	The joint shall be subjected from zero strain upto twice the yield strain in tension followed by compression stress of 50% of yield strength of reinforcing bar for 4 cycles. Thereafter, from zero strain upto five times the yield strain in tension followed by compression stress of 50% of yield strength of reinforcing bar for 4 cycles. Deformation across the coupled	ISO 15835/ ASTM A370/ ACI 318/ AC 133

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Name of the Test	Testing Requirement	Code of conformance
	joint shall be less than 0.3 mm after 4 cycles & less than 0.6 mm after 8 cycles & without loss of static tensile strength capacity when compared with like specimen.	
Low cycle fatigue test **(Refer note- 3)**	Mechanical splice shall withstand 10,000 cycles of alternating tension & compression load from +173Mpa to -173Mpa & without loss of static tensile strength capacity when compared with like specimen.	IS 16172

Notes-

1) Moderate Oligocyclic (Seismic) test shall be performed for structures in seismic zone II.

2) Violent Oligocyclic (Seismic) test shall be performed for structures in seismic zone III, IV & V.

3) Low cycle fatigue test shall be performed for all structures except for concrete structures which are subjected to high cycle of fatigue like machine foundations etc.. For concrete structures which are subjected to high cycle of fatigue, High cycle fatigue test shall be performed as per IS 16172.

All operations relating to reinforcement coupling shall be done by using manufacturer's patented machine/ equipment in the presence of Engineer-in-Charge. Mechanical connections shall be placed away from points of high stress and shall be staggered.

21.8 Tolerances on Placing of Reinforcement

Unless otherwise directed by the Engineer-in-Charge, reinforcement shall be placed within the following tolerances:

a) For effective depth 200 mm or less $\pm$ 10 mm

b) For effective depth more than 200 mm $\pm$ 15 mm

21.9 Substitution

When indicated diameter of reinforcement bar is not available, the Contractor shall use other diameter of reinforcement bars on written approval of the Engineer-In-Charge.

21.10 Tolerance to Cover

The actual concrete cover shall not deviate from the required nominal cover by + 10 mm measured over the steel reinforcement including links.

22.0 PAYMENT

22.1 Plain and Reinforced Concrete

22.1.1 Payment for plain and reinforced cement concrete shall be made on cubic metre basis of the volume of the actual finished work done or as per approved construction drawings, whichever is less and shall be inclusive of providing pockets, openings, recesses of all sizes, chamfers, fillets, grooves, separation/ expansion/ isolation/ construction/ movement joints, curing by normal moist curing or using curing compound etc. as directed by Engineer-in-Charge etc. The rates shall be deemed to include complete cost of getting the

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respective mix designs approved, making and testing concrete cubes and carrying out other tests including tests of various ingredients, as per specifications and as directed by Engineer-in-Charge. Payment shall, however, be separately made for tests on concrete cubes done by accelerated methods of curing as defined in IS 9013.

22.1.2 No separate payment shall be made for any additive/ admixture/ Plasticizer/ Fibres used by the contractor for accelerating or retarding the strength of concrete or for achieving specified workability. The rate quoted shall be deemed to be inclusive of all costs related to any such additive/admixture/ Plasticizer/ Fibres.

22.1.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves, formwork, water stops and any filler material in expansion/isolation joints.

22.1.4 Where the strength of concrete mix as indicated by tests, lies in between the strengths of any two grades given in Table-1 and it is accepted by the Owner/Engineer-in-Charge, such concrete shall be classified as a grade belonging to the lower of the two grades between which it lies. In case the cube strength shows higher results than those specified for the particular grade of the concrete, it shall not be placed in the higher grade nor shall the Contractor be entitled for any extra payment on such account. The concrete giving lower strength than specified may be accepted at reduced rates after satisfying the safety of the structure by checking it with tests as specified or rejected entirely at the discretion of the Engineer-in- Charge. The rejected concrete shall be dismantled at no extra cost to the owner and no payment or extension of time shall be granted for the concrete so rejected and the formwork and reinforcement used for the same. Cost of any material supplied by the Owner free of cost shall be recovered from the Contractor at double the prevailing market rate. In case the concrete of lower strength can be improved by carrying out some strengthening measures entirely at the discretion of the Engineer-in-Charge, then the said measures including all related tests shall be carried out by Contractor at his own cost. If the Contractor is able to make up the strength to the required grade by such improvement measures to the entire satisfaction of Engineer-in-Charge, payment shall be made for the grade achieved. However, if the strength of concrete is not made up to the strength of required grade, payment shall be made only for the lower strength if such concrete is accepted by the Engineer-in-Charge.

22.1.5 Deductions for openings, pockets etc. shall be as specified in relevant parts of IS 1200.

22.1.6 The rate quoted for reinforced cement concrete, also includes single pour concreting wherever specified. The rate shall be inclusive of all extra cost related to labour, shuttering, staging and making all other arrangements for such continuous casting e.g. provisions for adequate movement and storage spaces, special gangways, scaffolding, additional construction equipments, adequate lighting and supervision while the work continues round the clock etc. The rate shall also be inclusive of all costs related to concreting in any thickness, shape and position and at any height or depth so as to avoid any cold joint between specified construction joints.

22.1.7 Form Work

Unless otherwise specified, payment for form work shall be on square metre basis of the actual area in contact with the concrete cast. The rates shall be inclusive of keeping the formwork for the full period as specified in the above clauses and removing the same after the period is over. No extra payment shall be made for providing scaffolding/ staging/ access/ stairways/ ladders etc.

The rates shall be inclusive of any provision to be made or kept in the formwork for providing dowels, inserts etc.

Superior quality formwork for exposed/architectural concrete work shall be measured and paid separately under the relevant item in the schedule of rates.

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22.2 Reinforcement

22.2.1 Payment for plain round mild steel reinforcement bars, high strength deformed steel bars and epoxy coated reinforcing steel bar shall be on the basis of weight of bare steel irrespective of any coating applied in metric tons. The weight of the bar shall be derived from the sizes and corresponding nominal unit weight given in Table-1 of IS 1786. In case actual unit weight of the bars is less than nominal unit weight, but within permissible tolerances, the weight of reinforcement shall be calculated on the basis of actual unit weight. In case actual unit weight of the bars is more than nominal unit weight, the payment shall be made on the basis of nominal unit weight. Standard hook lengths, chairs, spacer bars and authorized laps only shall be included in the weight calculated. Binding wire shall not be weighed nor otherwise measured. Measurements for weight shall not include cutting allowance etc.

22.2.2 Rate quoted for reinforcement shall include cost of supplying, decoiling, straightening, cleaning, cutting, bending, placing, binding, welding (if required) and providing necessary cover blocks of concrete.

22.2.3 Payment for a mechanical threaded coupler/ clamp shall be made by measuring the Lap length of the respective rebar on which coupler/ clamp is used. The rate shall include supply of complete assembly, fixing, testing etc. all complete.

22.3 Water Stops/Water Bars & Expansion/Isolation Joints

22.3.1 Payment for water bars shall be made on running metre (RM) basis of the water stops provided in position. Rate shall include supplying, cutting, fixing, jointing by vulcanising or any other approved method, wastage, etc. complete.

22.3.2 Payment for filler materials in Expansion/Isolation joints shall be made on running metre basis of the joint provided. For boards provided at expansion/isolation joints, the measurement shall be made on square metre basis. Rate shall be inclusive of supply, cutting, fixing, jointing, wastage etc. complete.

22.4 Waterproof Cement Paint

22.4.1 Payment for waterproof cement paint as per Cl. 18.0 shall be made separately on Sqm basis.

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मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

स्वयं जमावदार कंक्रीट
SELF COMPACTING CONCRETE
(SCC)

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
			Approved by			
2	10.03.2025	REAFFIRMED AND REISSUED AS STANDARD SPECIFICATION	AM	AH	AS	MN
1	27.08.2018	REAFFIRMED AND ISSUED AS STANDARD SPECIFICATION	AS	AS	RS	RKT
0	06.06.2013	ISSUED AS STANDARD SPECIFICATION	AJS	RS	PKM	DM

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Abbreviations:

BIS	:	Bureau of Indian Standards
EFNARC	:	European Federation of Specialist Construction Chemicals & Concrete Systems
SCC	:	Self Compacting Concrete

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**

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1.0 SCOPE

This specification defines the specific requirements of Self Compacting Concrete (SCC), both cast-in-situ as well as precast, to be used in foundations, underground and above ground structures, floors, pavements, etc. preferably where there is a dense reinforcement and difficulty in using vibrators. Any special requirements as shown or noted on the drawings shall supersede the provisions of this specification.

1.1 Reference Standards

- EFNARC : Specification & Guidelines for SCC
- The European Guidelines for SCC
- EIL Specification for Materials No. : 6-68-0002
- EIL Specification for Plain and Reinforced Cement Concrete No. : 6-68-0004
- IS 456 : Indian Standard Code of Practice for Plain and Reinforced Concrete.

1.2 Definition:

- Powder/fines: Particles smaller than 0.125mm is considered as fines or powder.
- Paste: The fraction of the concrete comprising powder, water and air, plus admixture (if applicable).
- Mortar: The fraction of the concrete comprising paste plus those aggregates less than 4 mm

1.3 In case of conflict between the clauses mentioned in this specification and those in the Bureau of Indian Standards (BIS)/ International Standards, this specification shall govern.

2.0 MATERIALS

2.1 Materials for concrete viz cement, Pozzolanas, Fly Ash, Ground Granulated Blast Furnace Slag, Sand, Coarse aggregate, Water, etc. shall be as described in EIL Specification No.6-68-0002.

2.2 Additions, Admixtures and Fibers are covered in this specification.

2.3 Materials for all reinforcements, embedment, inserts, water bars etc. shall conform to EIL Specification 6-68-0002.

3.0 CONSTITUENTS OF SCC

Self Compacting Concrete (SCC) is the concrete that is able to flow under its own weight and completely fill the formwork, even in the presence of dense reinforcement, without the need of any vibration, whilst maintaining homogeneity.

A concrete mix can only be classified as Self-compacting Concrete if the requirements for all three characteristics viz. Filling ability, Passing ability and Segregation Resistance are fulfilled.

3.1 Cement

The typical content of cement is 350-450 Kg/m^3. More than 500 Kg/m^3 cement can be dangerous and increase the shrinkage. Less than 350 Kg/m^3 may only be suitable with the

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inclusion of other fine filler, such as fly ash, pozzolana, etc. C_3A content higher than 10% may cause problems of poor workability retention.

3.2 Aggregates

a) Fine Aggregates/ Sand

The amount of fines less than 0.125 mm is to be considered as powder and is very important for the rheology of the SCC. A minimum amount of fines (arising from the binders and the sand) must be achieved to avoid segregation.

The moisture content, water absorption, grading and variations in fines contents should be closely and continuously monitored and shall be taken into account in order to produce SCC of consistent quality.

b) Coarse Aggregates

The normal maximum size is generally 12-20 mm. Consistency of grading is of vital importance. Gap graded aggregates are better than those continuously graded, which might experience greater internal friction and give reduced flow. Spherical shaped aggregates shall be preferred.

3.3 Admixtures

The most important admixtures is the Superplasticizers (High Range Water Reducers), used with a water reduction greater than 20% that provides the necessary workability. The use of a Viscosity Modifying Admixture (VMA) gives more possibilities of controlling segregation when the amount of powder is limited. This admixture helps in providing good homogeneity and reduces the tendency to segregation. Air Entraining Admixtures (AEA) helps to improve freeze-thaw resistance and act as a retarder for concrete mix setting.

3.4 Additions

Due to the special rheological requirements of SCC, following Additions are commonly used to improve and maintain the workability, as well as to regulate the cement content and so reduce the heat of hydration:

a) Mineral Fillers (Stone Powder)

Finely crushed Calcium Carbonate based mineral fillers like limestone, dolomite or granite may be used to increase the amount of powder: the fraction less than 0.125 mm with a passing ability of more than 70% will be most beneficial. However, dolomite may present a durability risk due to alkali-carbonate reaction.

b) Fly Ash

Fly ash is a fine inorganic material with pozzolanic properties, which can be added to SCC to improve its properties. However, high levels of fly ash may produce a paste fraction of cohesive nature that can offer resistance to flow.

c) Silica Fumes

Silica fume gives very good improvement of the rheological as well as the mechanical and chemical properties. Also improves the durability of the concrete. However, high levels of silica fumes can give rise to problems of rapid surface crusting. This can result in cold joints or surface defects if there is any break in concrete delivery.

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d) Ground Granulated Blast Furnace Slag (GGBS)

GGBS is a fine granular mostly latent hydraulic binding material, which can also be added to SCC to improve the rheological properties. A high proportion of GGBS may affect stability of SCC resulting in reduced robustness with problems of consistence control while slower setting can also increase the risk of segregation.

e) Other Additions

Metakaolin, Natural Pozzolana, Ground Glass Filler (GGF), Air Cooled Slag and other fine fillers can also be used. GGF is usually obtained by finely grinding recycled glass. The particle size should be less than 0.1 mm and the specific surface area should be >2500 cm^2/g. Larger particle sizes may cause Alkali-Silica reaction.

f) Pigments

Pigments can be used to achieve required colour density as in conventional concrete.

3.5 Fibres

Commonly used fibres are steel or polymer. Fibres are used to enhance the properties of SCC in the same way as for normal concrete. Steel fibres are used normally to enhance the mechanical characteristics of the concrete such as flexural strength and toughness. Polymer fibres are used to reduce segregation and plastic shrinkage, or to increase the fire resistance. Very fine synthetic fibres may prevent flow and generally the content should not exceed 1 kg/m^3.

4.0 REQUIREMENTS FOR SCC

SCC differs from conventional concrete in that its fresh properties are vital in determining whether or not it can be placed satisfactorily. The various aspects of workability which control its Filling ability, its Passing ability and its Segregation resistance all need to be carefully controlled to ensure that its ability to be placed remains acceptable.

a) Workability

The level of fluidity of the SCC is governed chiefly by the dosing of the poly-carboxylate based Superplasticizer. However overdosing may lead to the risk of segregation and blockage. Consequently the characteristics of the fresh SCC need to be carefully controlled using preferably atleast two of the different types of tests as mentioned in Table-1.

b) Segregation Resistance

Due to the high fluidity of SCC, the risk of segregation and blocking is very high. Preventing segregation is therefore an important feature of the control regime. The tendency to segregation can be reduced by the use of a sufficient amount of fines (< 0.125 mm), or using a Viscosity Modifying Admixture (VMA).

c) Open Time

The time during which the SCC maintains its desired rheological properties is very important to obtain good results in the concrete placing. This time can be adjusted by choosing the right type of superplasticizers or the combined use of retarding admixtures. Different admixtures have different effects on open time, and they can be used according to the type of cement and the timing of the transport and placing of SCC.

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5.0 INITIAL MIX COMPOSITION

In designing the mix it is most useful to consider the relative proportions of the key components by volume rather than by mass.

To achieve the required combination of properties in fresh SCC mixes:

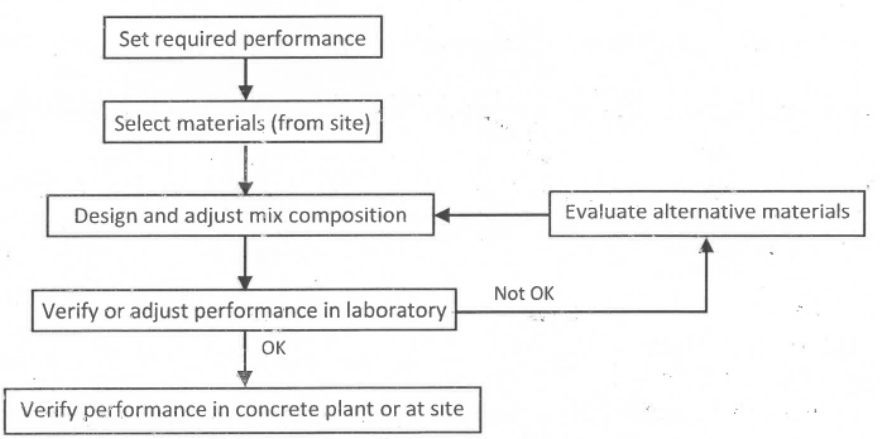
- The fluidity and viscosity of the paste is adjusted and balanced by careful selection and proportioning of the cement and additions, by limiting the water/powder ratio and then by adding a superplasticizer and (optionally) a viscosity modifying admixture. Correctly controlling these components of SCC, their compatibility and interaction is the key to achieving good filling ability, passing ability and resistance to segregation.

- In order to control temperature rise and thermal shrinkage cracking as well as strength, the fine powder content may contain a significant proportion of Additions to keep the cement content at an acceptable level.

- The paste is the vehicle for the transport of the aggregate; therefore the volume of the paste must be greater than the void volume in the aggregate so that all individual aggregate particles are fully coated and lubricated by a layer of paste. This increases fluidity and reduces aggregate friction.

- The coarse to fine aggregate ratio in the mix is reduced so that individual coarse aggregate particles are fully surrounded by a layer of mortar. This reduces aggregate interlock and bridging when the concrete passes through narrow openings or gaps between reinforcement and increases the passing ability of the SCC.

Mix design selection and adjustment can be made according to the procedure shown below:



Indicative typical ranges of proportions and quantities in order to obtain self-compactability are given below. Further modifications will be necessary to meet strength and other performance requirements.

- Water/powder ratio by volume : 0.80 to 1.10
- Total powder content : 160 to 240 litres (400-600 kg) per cubic meter.
- Total paste content: 300-380 litres/m^3

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- Coarse aggregate content normally 28-35% by volume of the mix; 270-360 litres (750-1000Kg) per cubic meter.
- Water/Cement ratio is selected suitably such that water content does not exceed 200 litre/m^3 (usually water content ranges from 150-200 litre/m^3).
- The Fine aggregate (sand) content balances the volume of the other constituents, typically 48-55% of total aggregate weight. Sand should be less than 50% of paste volume.

Generally, it is advisable to design conservatively to ensure that the concrete is capable of maintaining its specified fresh properties despite anticipated variations in raw material quality. Some variation in aggregate moisture content should also be expected and allowed for at mix design stage. Normally, viscosity-modifying admixtures are a useful tool for compensating for the fluctuations due to any variations of the sand grading and the moisture content of the aggregates.

5.1 Adjustment of the mix

Laboratory trials should be used to verify properties of the initial mix composition. If necessary, adjustments to the mix composition should then be made. Once all requirements are fulfilled, the mix should be tested at full scale at the concrete plant or at site.

In the event that satisfactory performance is obtained, then consideration should be given to redesign the mix. Depending on the apparent problem, the following courses of action might be appropriate:

- using additional or different types of fillers, (if available);
- modifying the proportions of the sand or the coarse aggregate;
- using a viscosity modifying agent, if not already included in the mix;
- adjusting the dosage of the superplasticizer and/or the viscosity modifying agent;
- using alternative types of superplasticizer (and/or VMA), more compatible with local materials;
- adjusting the dosage of admixture to modify the water content, and hence the water/powder ratio.

6.0 TEST METHODS

Each mix design should be tested by more than one test method for the different workability parameters. Alternative test methods for the different parameters are listed in Tables 1 and 2 (for details of Test Methods Refer Annexures- A to H):

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TABLE - 1
List of test methods for workability properties of SCC

S.No.	Method	Property
1	Slump-flow by Abrams cone*	Filling ability
2	T_{50cm} slump flow*	Filling ability
3	J-ring	Passing ability
4	V-funnel*	Filling ability
5	V-funnel at $T_{5minutes}$*	Segregation resistance
6	L-box*	Passing ability
7	U-box	Passing ability
8	Fill-box	Passing ability
9	GTM screen stability test or Sieve segregation resistance test*	Segregation resistance
10	Orimet	Filling ability

(*These test methods shall generally be preferred)

For the initial mix design of SCC all three workability parameters need to be assessed to ensure that all aspects are fulfilled. A full-scale test should be used to verify the self-compacting characteristics of the chosen design for a particular application. For site quality control, two test methods are generally sufficient to monitor production quality.

TABLE - 2
Workability properties of SCC and alternative test methods

Property	Test methods		Modification of test according to max. aggregate size
	Lab (mix design)	Field (QC)	
Filling Ability	• Slump flow • T_{50cm} slump flow • V-funnel • Orimet	• Slump flow • T_{50cm} slump flow • V-funnel • Orimet	None (for slump flow) max 20 mm (for V-funnel)
Passing ability	• L-box • U-box • Fill-box	• L-box • J-ring	Different openings in L-box, U-box and J-ring
Segregation resistance	• GTM or Sieve test • V-funnel at $T_{5minutes}$	• GTM or Sieve test • V-funnel at $T_{5minutes}$	None

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6.1 Workability criteria for the fresh SCC

The workability criteria shall be fulfilled at the time of placing of concrete. Likely changes in workability during transport should be taken into account during production. Typical acceptance criteria for Self-compacting Concrete with a maximum aggregate size up to 20 mm are shown in Table- 3:

TABLE - 3
Acceptance criteria for Self-compacting Concrete

S. No.	Method	Unit	Typical Range of Values	
			Minimum	Maximum
1.	Slump flow by Abrams cone	mm	550	850*
2.	T_{50cm} Slump flow	sec	2	6
3.	J-Ring	mm	0	10
4.	V-Funnel	Sec	6	12
5.	Time increase, V-Funnel at $T_{5minutes}$	Sec	0	+3
6.	L-Box	(h2/h1)	0.8	1.0
7.	U-Box	(h2-h1) mm	0	30
8.	Fill-Box	%	90	100
9.	GTM Screen Stability Test or Sieve Segregation Resistance Test(**)	%	0	15(15-20 for SR1)
10.	Orimet	Sec	0	5

(* For 750-850 mm slump value, maximum size of aggregates shall be restricted to 16mm. As per IS:10262 slump flow ranges shall be followed for SF1(550mm -650mm), SF2(660mm-850mm), SF3 (760 mm -850 mm))

(**) For SR1 and SR2

Values outside these ranges may be acceptable if the producer can demonstrate satisfactory performance in the specific conditions, e.g. large spaces between reinforcement, layer thickness less than 500 mm, short distance of flow from point of discharge, very few obstructions to pass in the formwork, very simple design of formwork, etc.

7.0 PRODUCTION AND DELIVERY

SCC can be produced in a site batching plant or in a ready mix concrete plant and delivered to site by Transit mixers. It can then be placed either by pumping or pouring into horizontal or vertical structures. In designing the mix, the size and the form of the structure, the dimension and density of reinforcement and cover should be taken into consideration.

7.1 Testing of Aggregates

Testing frequency of aggregates shall be same as that for conventional concrete (produced at site by using Mechanical Mixers- Refer EIL Specification No. 6-68-0004 for details). However, testing frequency can be increased as per the directions on Engineer-in-Charge in case inconsistent test results of SCC are obtained.

7.2 Mixing

There is no requirement for any specific mixer type. Forced action mixers, including paddle mixers, Free fall mixers, including truck mixers, and other types can be used. The necessary

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mixing time should be determined by practical trials. Generally, mixing time needs to be more than that for conventional mixes (Refer EIL Specification No. 6-68-0004).

Time of addition of admixture is important. If the consistency has to be adjusted after initial mixing, then it should generally be done with the admixtures. If the requirements for specified water/cement ratio are to be maintained, then the water content can be varied to make the necessary modification. Care shall be taken to avoid formation of unmixed "balls" of constituents while using truck mixers.

Admixtures should not be added directly to dry constituent materials but dispensed together with or in the mixing water. When using VMA, a late addition to the mix is preferred. If Air Entraining Admixtures are being used, they are best added before the superplasticizer and while the concrete is at a low consistency.

a) Free-fall Plant and Truck Mounted mixers

Approximately two thirds of the mixing water is added to the mixer. This is followed by the aggregates and cement. When a uniform mix is obtained, the remaining mixing water and the superplasticizer are added. Where VMA is used, this should be added after the superplasticizer and just prior to final consistence adjustment with water.

Truck mixers are likely to require additional mixing time for SCC as they are less efficient than plant mixers. Splitting the load into two or more batches can improve mixing efficiency. The condition of the truck mixer drum and mixing blades are particularly important for SCC and should be regularly inspected. The rotational speed of the drum during the mixing cycle should comply with the manufacturer's recommendations but the mixing speed for SCC will normally be in the range 10-15 rpm.

b) Forced Action mixers

Aggregate is generally added to the mixer first, together with the cement. This is immediately followed by the main mixing water and superplasticizer. Where used, the VMA is added with the final water. The high shear produced by a forced action mixer improves the fluidity and it may be possible to reduce the addition rate of the superplasticizer compared to a free-fall mixer.

Since the quality of freshly mixed concrete may fluctuate at the beginning of production, it is recommended that workability tests should be conducted on every load, until consistent and compliant results are obtained. Subsequently, every delivered batch should be visually checked before transportation to site and routine testing shall be carried out.

7.3 Delivery and Transportation

Depending upon the size of the concrete structure to be cast, production capacity of plant, journey time and placing capability, the SCC mechanism needs a proper balance. Unexpected production stops can result in consistence variations that adversely affect the end result.

SCC should be suitably designed so that workability is maintained to meet the specified requirements. Placing is faster, especially if a pump is used, but it is still essential to make sure that delivery and placing can be completed within the workability-retention (self-compactability) time of the concrete.

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7.4 Sampling

Frequency of sampling shall be same as that for conventional concrete produced with a Mechanical mixer at site (for details refer EIL Specification No. 6-68-0004). However while preparing the cubes with SCC, tamping with rod shall not be permitted.

7.5 Placing

Before placing SCC, it should be confirmed that reinforcement and formwork are arranged as planned. The formwork must be in good condition and special measures shall be taken to prevent grout loss. Formwork design, including support and fixing systems, should be designed for full hydrostatic concrete pressure. This may require modification of the formwork. Particular attention should be paid to both the outer supports and the tie rod system including spacing to ensure that the formwork cannot deform during placing. Formwork release agents should only be used with permeable or semi-permeable formwork in order to ensure a reliable surface finish.

In case pump is used for placing the SCC, pumping from bottom of the formwork through a valve normally gives the best surface finish for any vertical element. It takes less air into concrete and allows faster casting rates than pumping from the top. If this is not possible the casting hose should be kept below the concrete surface at all times. The hopper and pump line must be kept completely full of concrete to ensure that air is not introduced at the bottom.

Though it is easier to place SCC than ordinary concrete, the following limits are advised to minimize the risk of segregation:

- limit the vertical free fall distance to 3 m
- limit the permissible distance of horizontal flow from point of discharge to5 m.

7.6 Curing

SCC tends to dry faster than conventional concrete because there is little or no bleed of water at the surface. Initial curing should therefore be commenced as soon as practicable after placing the concrete to minimize the risk of shrinkage cracking. Curing time shall be as defined in EIL Specification No. 6-68-0004.

8.0 STRENGTH TEST OF CONCRETE AND ACCEPTANCE CRITERIA

Strength test and acceptance criteria shall be as per EIL Specification No. 6-68-0004.

9.0 INSPECTION AND TESTING OF STRUCTURES

For details refer EIL Specification No. 6-68-0004.

10.0 QUALITY CONTROL

The production of self-compacting concrete shall be carried out in plants where the equipment, operation and materials are suitably controlled. Production shall therefore be carried out at ISO 9001 accredited plants or plants with a quality system that conforms to ISO 9001 or equivalent and shall be approved by the Engineer-in-Charge. The production staff involved in the production of self-compacting concrete shall be trained and also have experience in self-compacting concrete.

The Contractor shall ensure that all site acceptance testing (refer Cl. 6.0) is carried out by competent, trained personnel, in a suitable environment – this includes an area protected

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against the weather, suitably maintained and calibrated equipments and level, stable ground for performing the test.

Besides the normal check of delivery ticket, a visual check of the concrete shall also be made.

11.0 PAYMENT

Payment for Self Compacting Concrete shall be made on cubic metre basis in line with EIL Specification No. 6-68-0004 (the rates shall be inclusive of all types of Admixtures, Additions, Fibres, etc.)

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ANNEXURE-A

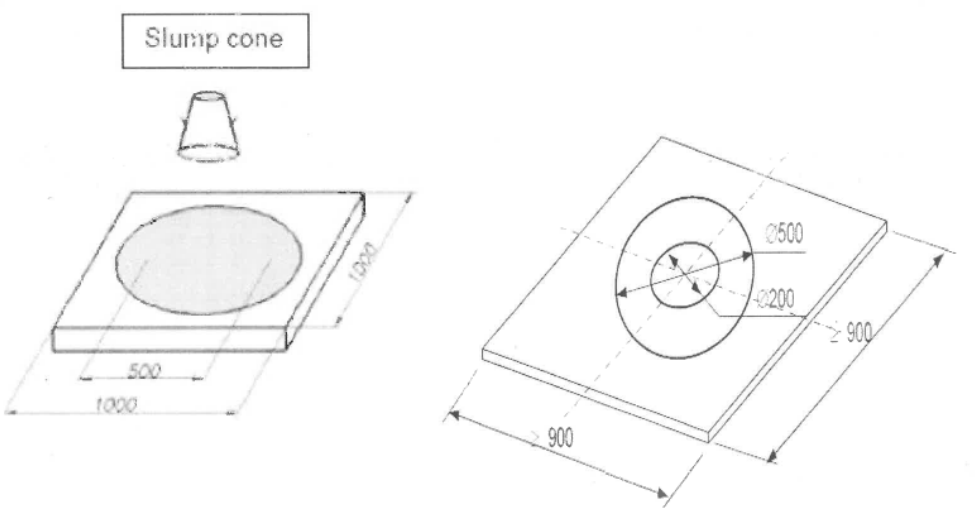
SLUMP FLOW TEST and T $_{50cm}$ TEST

Introduction

The slump flow is used to assess the horizontal free flow of SCC in the absence of obstructions. The test method is based on determining the slump. The diameter of the concrete circle is a measure for the filling ability of the concrete.

Assessment of test

This is a simple, rapid test procedure, though two people are needed if the T_{50} time is also to be measured. It can be used on site, though the size of the base plate is somewhat unwieldy and level ground is essential. It is the most commonly used test and gives a good assessment of filling ability. It gives no indication of the ability of the concrete to pass between reinforcement without blocking, but may give some indication of resistance to segregation.



Equipment

- mould in the shape of a truncated cone with the internal dimensions 200 mm diameter at the base, 100 mm diameter at the top and a height of 300 mm
- base plate of a stiff non absorbing material, at least 900mm square and 2mm thick, marked with a circle marking the central location for the slump cone, and a further concentric circle of 500mm diameter and the deviation from flatness of base plate shall not exceed 3mm at any point when a straight edge is placed between the centres of opposing sides
- trowel
- scoop
- ruler
- stopwatch (optional)

Procedure

- About 6 litres of concrete is needed to perform the test, sampled normally.
- Moisten the base plate and inside of slump cone,
- Place base plate on level stable ground and the slump cone centrally on the base plate and hold down firmly.
- Fill the cone with the scoop. Do not tamp, simply strike off the concrete level with the top of the cone with the trowel.

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- Remove any surplus concrete from around the base of the cone.
- Raise the cone vertically (within 30 second after filling it with concrete) and allow the concrete to flow out freely.
- Simultaneously, start the stopwatch and record the time taken for the concrete to reach the 500mm spread circle (This is the T_{50} time).
- Measure the final diameter of the concrete in two perpendicular directions.
- Calculate the average of the two measured diameters. (This is the slump flow in mm).
- Note any border of mortar or cement paste without coarse aggregate at the edge of the pool of concrete.

Interpretation of result

The higher the slump flow (SF) value, the greater its ability to fill formwork under its own weight. A value of at least 650mm is required for SCC. A tolerance of $\pm$ 50mm can be accepted.

The T_{50} time is a secondary indication of flow. A lower time indicates greater flowability. It is suggested that a time of 3-7 seconds is acceptable for civil engineering applications, and 2-5 seconds for housing applications.

In case of severe segregation most coarse aggregate will remain in the centre of the pool of concrete and mortar along with cement paste at the concrete periphery. In case of minor segregation a border of mortar without coarse aggregate can occur at the edge of the pool of concrete. In both cases test shall be declared as unsatisfactory.

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ANNEXURE-B

J RING TEST

Introduction

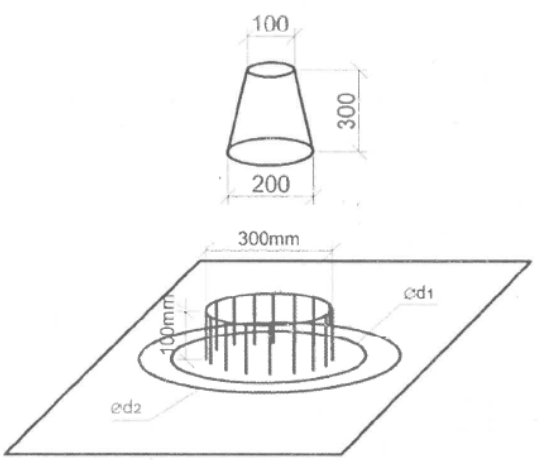
The test is used to determine the passing ability of the concrete. The equipment consists of a rectangular section (30mm x 25mm) open steel ring, drilled vertically with holes to accept threaded sections of reinforcement bar. These sections of bar can be of different diameters and spaced at different intervals: in accordance with normal reinforcement considerations, 3x the maximum aggregate size might be appropriate. The diameter of the ring of vertical bars is 300mm, and the height 100 mm.

The J-Ring can be used in conjunction with the Slump flow, the Orimet test, or eventually even with the V- funnel. These combinations test the flowing ability and (the contribution of the J-Ring) the passing ability of the concrete. The Orimet time and/or slump flow spread are measured as usual to assess flow characteristics. The J-Ring bars can principally be set at any spacing to impose a more or less severe test of the passing ability of the concrete. After the test, the difference in height between the concrete inside and that just outside the J-Ring is measured. This is an indication of passing ability, or the degree to which the passage of concrete through the bars is restricted.

Assessment of test

These combinations of tests are considered to have great potential, though there is no general view on exactly how results should be interpreted. There are a number of options - for instance it may be instructive to compare the slump-flow/J-Ring spread with the unrestricted slump-flow.

Like the slump-flow test, these combinations have the disadvantage of being unconfined, and therefore do not reflect the way concrete is placed and moves in practice. The Orimet option has the advantage of being a dynamic test, also reflecting placement in practice, though it suffers from requiring two operators.



Equipment

- mould, WITHOUT foot pieces, in the shape of a truncated cone with the internal dimensions 200 mm diameter at the base, 100 mm diameter at the top and a height of 300 mm.
- base plate of a stiff non absorbing material, at least 700mm square, marked with a circle showing the central location for the slump cone, and a further concentric circle of 500mm diameter
- trowel
- scoop
- ruler
- JRing a rectangular section (30mm x 25mm) open steel ring, drilled vertically with holes. In

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the holes can be screwed threaded sections of reinforcement bar (length 100mm, diameter 10mm, spacing 48 ± 2mm).

Procedure

- About 6 litre of concrete is needed to perform the test, sampled normally.
- Moisten the base plate and inside of slump cone,
- Place base-plate on level stable ground.
- Place the JRing centrally on the base-plate and the slump-cone centrally inside it and hold down firmly.
- Fill the cone with the scoop. Do not tamp, simply strike off the concrete level with the top of the cone with the trowel.
- Remove any surplus concrete from around the base of the cone.
- Raise the cone vertically and allow the concrete to flow out freely.
- Measure the final diameter of the concrete in two perpendicular directions.
- Calculate the average of the two measured diameters (in mm).
- Measure the difference in height between the concrete just inside the bars and that just outside the bars.
- Calculate the average of the difference in height at four locations (in mm).
- Note any border of mortar or cement paste without coarse aggregate at the edge of the pool of concrete.

IN CONJUNCTION WITH THE ORIMET

Equipment

- Orimet device of a stiff non absorbing material (Refer Annexure-H).
- trowel
- scoop
- stopwatch
- ruler
- JRing a rectangular section (30mm x 25mm) open steel ring, drilled vertically with holes.
- In the holes can be screwed threaded sections of reinforcement bar (length 100mm, diameter 10mm, spacing 48 ± 2mm)

Procedure

- About 8 litres of concrete is needed to perform the test, sampled normally.
- Set the Orimet on firm ground.
- Moisten the inside surfaces of the casting pipe and the orifice.
- Keep the trap door open to allow any surplus water to drain.
- Close the trap door and place a bucket underneath.
- Fill the apparatus completely with concrete without compacting or tapping, simply strike off the concrete level with the top with the trowel.

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- Open the trap door within 10 seconds after filling and allow the concrete to flow out under gravity.
- Simultaneously, start the stopwatch and record the time
- Start the stopwatch when the trap door is opened, and record the time for the discharge to complete (**the flow time**). This is taken to be when light is seen from above through the orifice section.
- Measure the final diameter of the concrete in two perpendicular directions.
- The whole test has to be performed within 5 minutes.
- Calculate the average of the two measured diameters (in mm).
- Measure the difference in height between the concrete just inside the bars and that just outside the bars.
- Calculate the average of the difference in height at four locations (in mm).
- Note any border of mortar or cement paste without coarse aggregate at the edge of the pool of concrete.

Interpretation of result

It should be appreciated that although these combinations of tests measure flow and passing ability, the results are not independent. The measured flow is certainly affected by the degree to which the concrete movement is blocked by the reinforcing bars. The extent of blocking is much less affected by the flow characteristics, and it can be stated that the greater the difference in height, the less the passing ability of the concrete. Blocking and/or segregation can also be detected visually, often more reliably than by calculation.

Note: The results of the J-Ring are influenced by the combination methods selected and results obtained with different combinations may be different.

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ANNEXURE-C

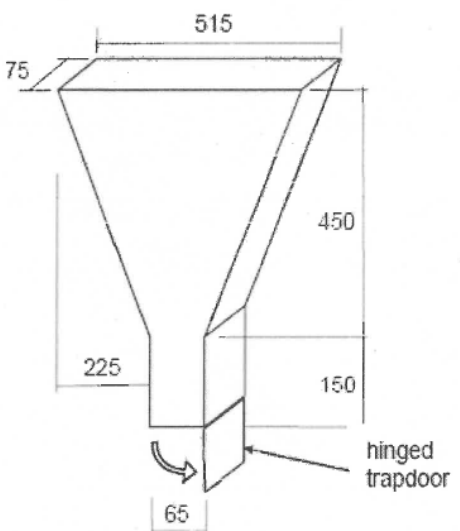
V FUNNEL TEST and V FUNNEL TEST at $T_{5minutes}$

Introduction

The equipment consists of a V-shaped funnel. The V-funnel test is used to determine the filling ability (flowability) of the concrete with a maximum aggregate size of 20mm.

Assessment of test

Though the test is designed to measure flowability, the result is affected by concrete properties other than flow. The inverted cone shape will cause an obstruction to free flow of concrete in case too much coarse aggregates are present. High flow time can also be associated with low deformability due to a high paste viscosity, and with high inter-particle friction. While the apparatus is simple, the effect of the angle of the funnel and the wall effect on the flow of concrete are also not clear.



Equipment

- V-funnel
- bucket (±12 litre)
- trowel
- scoop
- stopwatch

Procedure flow time

- About 12 litre of concrete is needed to perform the test, sampled normally.
- Set the V-funnel on firm ground.
- Moisten the inside surfaces of the funnel.
- Keep the trap door open to allow any surplus water to drain.
- Close the trap door and place a bucket underneath.
- Fill the apparatus completely with concrete without compacting or tamping, simply strike off the concrete level with the top with the trowel.
- Open within 10 sec after filling the trap door and allow the concrete to flow out under gravity.
- Start the stopwatch when the trap door is opened, and record the time for the discharge to complete (**flow time**). This is taken to be when light is seen from above through the funnel.
- The whole test has to be performed within 5 minutes

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Procedure flow time at $T_{5\ minutes}$

- Do NOT clean or moisten the inside surfaces of the funnel again.
- Close the trap door and refill the V-funnel immediately after measuring the flow time.
- Place a bucket underneath.
- Fill the apparatus completely with concrete without compacting or tapping, simply strike off the concrete level with the top with the trowel.
- Open the trap door 5 minutes after the second fill of the funnel and allow the concrete to flow out under gravity.
- Simultaneously start the stopwatch when the trap door is opened, and record the time for the discharge to complete (**the flow time at $T_{5\ minutes}$**). This is taken to be when light is seen from above through the funnel.

Interpretation of result

This test measures the ease of flow of the concrete; shorter flow times indicate greater flowability. For SCC a flow time of 10 seconds is considered appropriate. The inverted cone shape restricts flow, and prolonged flow times may give some indication of the susceptibility of the mix to blocking.

After 5 minutes of settling, segregation of concrete will show a less continuous flow with an increase in flow time.

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