INFO TECH CORPORATION OF GOA LIMITED
(ITG)

3rd Floor, IT Hub, Altinho, Panaji Goa- 403 001

Email: info@infotechgoa.com or md-itg.goa@nic.in

Website: http://www.infotech.goa.gov.in

VOLUME – II: TECHNICAL SPECIFICATIONS

CONSTRUCTION OF GARBAGE BUILDING AT GREENFIELD ELECTRONICS MANUFACTURING CLUSTERS (EMC) IN TUEM VILLAGE OF PERNEM TALUKA

PROJECT MANAGEMENT CONSULTANT

Vijaykumar Sawant Associates

• Feasibility • Design • Engineering • Project Management

AF/UG1, Alcon Regency, Near SBI, NH-17
Alto-Porvorim, Bardez, Goa – 403521
Phone (0832) 2414863
Email: vsagoa@gmail.com

TABLE OF CONTENTS

CHAPTER 1 : GENERAL SPECIFICATIONS

GENERAL INSTRUCTIONS

The specifications contained herein are general in nature and as such only the specifications relating to execution of work shall hold good. The contractor shall bear in mind the instructions given in the Tender Documents while referring these specifications.

1. Abbreviations:

In the Technical Specifications as well as the Schedule of Quantities, the following abbreviations have been used.

The abbreviation	-	Shall mean
Cum / Cu.M	-	Cubic Meters
Sqm / Sq.M	-	Square Meters
Rmtr / Rmt / Rm	-	Running Meters
Nos / Each	-	For Each

2. Terminology:

The terms	-	Shall mean
Approval or approved	-	Approval by the Engineer
As directed	-	As directed by the Engineer

3. Rates:

The percentage quoted, shall be for all works shown on drawings and covered under the battery limit for individual item, irrespective of fact whether they are specifically mentioned or otherwise.
The percentage quoted shall be inclusive of all works whether specified or otherwise and which is required for satisfactory execution of the Item. In case of doubt it should be got clarified before quoting.
In case there are any details of construction or requirement of materials, which have not been reflected to in the specifications, detailed description of items, the Bill of Quantities, or on the drawings, but which are useful or essential in true completion of the work, then the same shall be deemed to have been included in the rate/s quoted by the contractor.
Any claim from contractors on any or all of the above will not be entertained.

4. Site Clearance:

Before starting the work, the site shall be cleared of all shrubs, grass and other vegetation including large and small bushes, all tree stumps, removal of roots, cutting and disposal of trees up to 300mm girth etc. (The girth shall be measured at a height of 1.5 meters above GL). The site if found uneven, up to a height difference of 1.00m, shall be leveled to a plain topography.
The contractor shall make himself familiar with the local rules and regulations pertaining to land clearance environmental aspects including special requirements of forest areas, wherever applicable and the work shall be carried out in strict accordance therewith.
The above shall not be measured and paid for separately.

5. Specific Instructions:

Block levellers: The contractor shall independently survey the entire plot and ascertain the dimensions and levels of the plot and submit and take approval from the Engineer before commencement of actual setting. The Contractor shall carry out the contour / block survey (5m x 5m or closer if so instructed) of the site before setting out the works. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to the established reference/grid lines at 5 m intervals or nearer as determined by Engineer based on ground profile. These shall be checked and verified by the Engineer and thereafter

properly recorded. If any roots or stumps of trees are found during excavation/filling, they shall be burnt or disposed off as directed. ***This shall not be measured and paid for separately.***

The contractor shall maintain and provide on the site at all times, high precision surveying instruments like Dumpy level, thedolite (one or two second thedolite) and total station and carry out the survey of entire plot and setting out of works, building lines & levels, etc., with the help of high precision instruments only.

The contractor shall provide at his own cost all labour, pegs, strings and other materials as may be required for line out and setting out the work.

All levels referred to in connection with these works shall be based on local Benchmarks. The contractor shall protect and preserve all Benchmarks used in setting out the works till the Engineer directs its removal.

The contractor shall be responsible for the accurate setting out of the works in relation to original points, lines and levels of reference given by the Engineer. The checking of any line or level by the Engineer shall not in any way relieve the contractor of his responsibility for the accuracy thereof.

If, at any time during the execution of the works, any error appears in the position, levels, dimensions or alignment of any part of the works on being required so to do by the Engineer, the contractor shall at his own cost rectify such error to the satisfaction of the Engineer.

Test Pits: At least 6 Test pits of 1.5m x 1.5m x 1.5m or as instructed by the Engineer shall be excavated and the strata for resting of the foundations shall be got approved from the Engineer. The Engineer may instruct that the depth of the test pit be deepened in case if sufficiently hard strata is not met with. ***This shall not be measured and paid for separately.***

Relics, Objects Of Antiquity etc.: All gold, silver, oil minerals archaeological and other findings of importance, all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of owner and Contractor shall duly preserve the same to the satisfaction of the owner/employer and from time to time deliver the same to such person or persons, as the Owner may from time to time authorise or appoint to receive the same.

6. Specific Instructions related Bill of Quantities:

GENERAL INSTRUCTIONS / NOTES:

1. The Tenderers are required to visit the site of the work and acquaint themselves with working conditions before quoting for the work.
2. All rates should be mentioned in figures / Numerical, corrections if any shall be initialed.
3. In items where "Equivalent" make is mentioned, Contractor shall take prior approval from Engineer before procurement.
4. Drawing attached in the Tender are indicative drawings.
5. Contractor to provide temporary barrier/curtain to the site with bamboo mundas or props adequately spaced with Corrugated GI sheets with one temporary gate to enter material etc. Material used for fencing to be taken away after the completion of the project by the contractor. The contractor shall visit the site to understand all the works and especially the soil strata before quoting.
6. The Contractor shall take care to ensure that no dust, debris etc.,is created.
7. Cement Used for the construction should be of 43/53 grade and shall be approved by Engineer.
8. Sand to be screened, sieved and washed before use.
9. Aggregate shall be angular and hard, flaky or round aggregate will be rejected.

A EXCAVATION & EARTHWORKS

1. The available boulders/rock shall be broken into 200 x 200 x 200 size or as instructed and stacked in stacks of 3m x 3m x 1.5m high at one place on site. No additional charges shall be paid for the same.
2. All the excess soil/ material shall be taken away from the site for disposal on Engineers/employers approval, after evaluation of requirements if any. Contractor shall be completely responsible for its carting and disposal, away from the site at all leads and lift. The Employer shall not be responsible for the said material and no additional charges shall be paid for the same.
3. The contractor should give at least three working days clear notice to the Engineer before covering up any of the work in foundations or any other that proper measurements may be taken of the work as executed.
4. Identification of site for disposal of any material will be the Contractors responsibility.

CONCRETE WORK

1. Cement Used for the construction should be of 43/53 grade and shall be approved by engineer.
2. Sand to be screened, sieved and washed before use.
3. Aggregate shall be angular and hard, flaky or round aggregate will be rejected.
4. Cover block shall be of fibre reinforced concrete of "Astra" make.
5. a) For shuttering:
   Column / pedestals - plywood
   Beam side shuttering - plywood
   Beam bottom - Timber
   Slab & staircase- New / good condition plywood shutters.
   b) Scaffolding to be of adjustable props, acro spans, pipes for bracing. No timber / bamboo / munda to be used.
6. The contractor shall manufacture concrete on site as per the technical specification & as per standard practice, which shall be approved by engineer. However in the event of non availability of material use of Ready Mix concrete may be permitted under following conditions:-
   a. Contractor shall submit the details of supplier/vendor of RMC to the satisfaction of Consultant/Engineer.
   b. Vendor/supplier shall be approved by engineer.
   c. the cement used for RMC shall be OPC grade 43/53 only.
   d. No slag cement or blended cement shall be permitted.
   e. M25 grade concrete shall be used.
   f. The cost of this additional grade borne by the contractor & no additional payment shall be made towards this.
7. If any construction/cold joint is kept in the RCC structure, Epoxy bonding agent Sikadur 32 / Sika HIBOND/Sikadur 32 LP or equivalent epoxy should be used for bonding of old and new concrete to the satisfaction of the engineer and it should be procured by the contractor. No extra payment will be made for supply and application.
8. All concrete works shall be cured for at least 14 days.

REINFORCEMENT

1. Fiber reinforced concrete cover block of Astra only to be used. Mortar cover blocks or mosaic tile cover blocks not to be used.

2. For Reinforcement steel the laps provided in slabs shall not be considered for payment and the contractor should include the said cost in the item rate and no additional payment shall be made for laps in all items of construction including footing, beams, slabs, retaining walls, etc. except that column laps shall be payable.
3. Type of steel shall be approved by engineer before procurement.

PLASTER

1. Sand to be cleaned, sieved, screened and washed.
2. Mortar to be used in rendering plaster shall be prepared by mechanical mixer.
3. All concrete surface to be roughened (Tacha) immediately after deshuttering, prior to plaster. No additional payment will be done towards roughening (Tacha).
4. All work to be in plumb, level and corners in right angles for all types of surfaces as per specifications
5. No additional payment will be done for coloring material, pigment or using water proofing material.

FLOORING WORK

1. All concrete surfaces/ Floors shall be assured to be in perfect line and level. Any debris shall be cleaned and plaster etc. shall be hacked and cleared. (No additional payment will be done towards this.)
2. In the event the interlocking/cement paving tile color is not uniform in color, the tile shall be painted as approved by Engineer to get required shade, at no additional cost.

STRUCTURAL STEEL WORK

1. All structural members shall be cleaned / scrubbed with wire brush / sanded and cleared of rust before starting the process of painting.
2. The members shall be coated with rust preventer "Steel Guard Nano Coat" and Red oxide primer after fabrication. For application application purpose of rust preventer Steel Guard Nano Coat refer product specification. The rates shall be inclusive of all consumables, anchor fasteners etc.
3. Members shall be coated with 2 coats of Enamel paint of ICI (Dulux) / Berger (Luxol) before erection.
4. Prior to erection the members shall be checked for rust, etc. If found rusty or unclean the area is to be reassembled, sanded, primered and painted as above at no additional cost.
5. Final coat to be applied after erection and entire welding is complete but before laying of sheets.
6. The payment for Structural work shall be done as follows:
    a) Fabricating and applying one coat of red oxide paint - 50 %
    b) Erection and final coat of paint - 50 %

ROOFING

1. Contractor shall quote rate for roof sheeting including laps. Lapping Length shall not be paid separately
2. The Basic Rate of sheet does not consider the lap and the lap component shall be included in the quoted rate.

DOORS, WINDOWS AND ROLLING SHUTTERS

1. Gaps between aluminium section and Jambs if any shall be filled with silicon sealant of matching colour and shade and no additional payment will be done for the same.

PAINTING

1. Preparation of Surface: The surface to be painted shall be cleaned with sand paper.
2. The base coat / primer in the number of coats as recommended by the manufacturer shall be applied.
3. The painting shall be done in a minimum of three coats or until the desired shade and finish is achieved.
4. The consecutive coats of paint shall be done after a minimum of 4 hours at temperature of 250.
5. No strainers or colourants shall be used.
6. The paint shall not be over thinned or the brush over extended.
7. Instructions specified by the Manufacturer are to be strictly followed.
8. Colour from Berger colour bank / Asian paints Apex / ICI colour solution shall be chosen.
9. Nothing extra shall be payable for the above.

WATER PROOFING

1. The Contractor shall give a 10 year guarantee on a stamped paper for good performance of his work and shall undertake to rectify the work at his own cost if any defects are observed during the guarantee period.

PLUMBING / DRAINAGE AND WATER SUPPLY

1. All sanitary fittings / faucets to be fixed with Teflon tape. The Sanitary ware is of Hindustan make and Sanitary Fittings are of Jaquar / Crabtree/Cera make or equivalent. Contractor will include providing and fixing of all other accessories, like extension pieces, fixing devices etc. in the respective item rates for the same in his tender. No extra payment on this account will be admissible under any circumstances.

GENERAL SPECIFICATIONS

These specifications shall be read in conjunction with the particular specifications for various items of work. The Contractor shall carefully acquaint himself with the general specifications, co-ordinate the same with any other specifications forming a part of the Contract Document and determine his contractual obligations for the execution of various items of work in accordance with good engineering practice.

The Contractor shall make available on the Site latest copy of CPWD as well as required all Indian Standard Codes as and when directed by the Engineer. List of the Indian Standard Codes is given as below:

	SAFETY IN CONSTRUCTION	
1	Code of practice for steel tabular scaffolding : Part 2 Safety regulations for scaffolding	4014 (Part 2)
2	Code of safety for protective "barriers in and around buildings	13415
3	Code of safety for excavation- work (first revision)	3764
4	Recommendations for preventive measures against hazards at work places Part 1 Falling material hazards prevention	13416 (Part 1)
5	Recommendations for preventive measures against hazards at work places Part 2 Fall prevention	13416 (Part 2)
6	Safety code for construction involving use of hot bituminous materials	5916
7	Safety code for erection of concrete framed structures	8989
8	Safety code for handling and storage of building materials (with amendment no. 1)	7969
9	Safety code of scaffolds and ladders: Part 1 Scaffolds	3696 (PART 1)
10	Safety requirements for floor and wall openings, railings and toe boards (first revision)	4912
	STRUCTURAL SECTIONS	
1	Aluminum channels(first revision)	3921
	HAND BOOKS	
1	SP-27 - Method of measurement of building works	
2	SP-28 : Hand book on statistical quality control	
3	Handbook on Repair & Rehabilitation of RCC Buildings published by Director General Works , (CPWD), GOI.	

	N.B.: The various items to be used in the FALSE CEILING work shall be of ISI standard. Wherever, the items/products do not have ISI marks/standard, it shall be got tested for its quality etc. at the laboratory and necessary testing charges shall be borne by the contractor.

1. ***Reference to the Standard Codes of Practice :***

1.1 All Standards, tentative specifications, Specifications, Codes of practice referred to shall be the latest editions including all applicable official amendments and revisions. The contractor shall make available at site all relevant Indian Standard Codes of practice as applicable.

1.2 In case of discrepancy between standards, Codes of practice, tentative specifications, specification referred to and this specification shall govern.

SR. NO.	TITLE	IS NUMBER (LATEST EDITION)
	BUILDING CONSTRUCTION PRACTICE	
1.	Code of practice for anti-termite measures in buildings: Part I Constructional measures (first revision).	6313(Part I)
2.	Code of practice for anti-termite measures in buildings: PartII Pro-constructional chemical treatment measures (First revision) (with amendment no. 3)	6313 (Part 2)
3.	Code of Practice for anti-termite measures in buildings : Part II Treatment for Existing buildings (first revision) (with amendment no. 2)	6313 (Part 3)
4.	Code of Practice for brickwork (first revision)	2212
5.	Code of practice for fixing rainwater gutters and down pipes for roof drainage (first revision)	2527
6.	Code of practice for glazing in buildings (first revision)	3548
7.	Code of practice for laying and fixing of sloped roof coverings: part 1	5119(part 1)
8.	Code of practice for patent glazing	10439
9.	Code of practice for preparation and use of masonry mortars (first revision)	2250
10.	Code of practice for roofing with Mangalore tiles (first revision)	2858
11.	Code of practice for setting out of building	11134
12.	General check list of functions of joints in building (ISO 3447-1975)	10958
13.	Glossary of terms for sealants for building purposes (ISO 6972-1981	10566
14.	Method of test for performed filters far expansion joints in concrete paving and structural construction	10566
15.	Specification for performed filters for expansion joint in concrete pavements and structures (Non extruding and resilient type) part 2 CNSL. Arldehyde resin and coconut pith	1838 (part 2)
16.	Specification for equivalent metric units for scales dimensions and quantities in general Construction work (revised) (with amendment No. 2)	965
17.	Specification for hot applied sealing compound for joint in concrete (first revision)	1834
18.	Specification for sand for masonry mortars (first revision)	2116
	CEMENT AND CONCRETE	
1.	Code of practice for bending and fixing of bars concrete reinforcement	2502
2.	Code of practice for concrete structures for the storage of liquids part 1 General requirements(with amendment no.1)	3370 (part 1)
3.	Code of practice for concrete structures for the storage of liquids- Part 2 reinforced concrete structure (with amendment no. 2)	3370 (part 2)
4.	Code of practice for concrete structures for the storage of liquids) part 4*Design	3370(part 3)
5.	Code of practice for extreme weather concreting part recommended – Practice for hot weather concreting (with amendment no. 1)	7861 (part2)
6.	Code practice for extreme weather concreting (with amendment no 1)	786 (part 2)
7.	Code of practice for general construction of plain and reinforced concrete for dame and other massive structures	457
8.	Code of practice for plain and reinforced concrete (third revision) (with amendment no. 1)	456
9.	9 Code of practice for use of immersion vibrators for consolidation concrete (first revision)	3558
10.	Glossary of terms relating to cement concrete:- part 1 Concrete aggregates	6461(part 1)
11.	Glossary of terms relating to cement concrete: part 2 Materials	6461(part 2)
12.	Glossary of terms relating to cement concrete : part 3 concrete reinforcement	6461 (part 3)
13.	Glossary of terms relating to cement concrete : part 5 Formwork for concrete	6461 (part 5)
14.	Glossary of terms relating to cement concrete : part 6 Equipment, tools and plant	6461 (part 6)

SR. NO.	TITLE	IS NUMBER (LATEST EDITION)
15.	Glossary of terms relating to cement concrete : part. 7 mixing, laying, compaction, curing and other construction aspects.	6461 (part 7)
16.	Glossary of terms relating to cement concrete : part 8 properties of concrete	6461 (part 8)
17.	Glossary of terms relating of cement concrete: part 9 Structural aspects	6161 (part 9)
18.	Method of test for permeability of cement and concrete	3085
19.	Methods of test for aggregates for concrete part 1. particle size and and shape (with amendment no. 2)	2386 (part 2)
20.	Methods of test for aggregates for concrete part 2 Estimation. of deleterious materials and organic impurities(with amendment no. 1)	2386 (part 2)
21.	Methods of test for aggregates for concrete part 3 specific gravity, density, voids absorption and bulking.	2386 (part 3)
22.	Method of test for aggregates for concrete : part 8 Petrographic examination>	2386 (part 8)
23.	Recommendations for detailing of reinforcement in reinforced concrete work	5522
24.	Recommended guidelines for concrete mix design	10262
25.	Specification for 43 grade ordinary Portland cement (first revision) (with amendment no. 3)	8112
26.	Specification for integral cement waterproofing compounds (first revision) (with amendment no 1)	2645
27.	Specification for ready mixed concrete (first revision)	926
28	Indian Standard Code of Practice for Constructions of Bored Cast-in-Situ Piles	2911 (Part I) Latest
	CEMENT MATRIX PRODUCTS	
1.	Specification for pre-cast concrete coping blocks (first revision)	5751
2.	Specification for pre cast concrete kerbs (first revision)	5758
3.	Specification for precast concrete manhole covers and frames : part 1 covers (with amendment no 2)	12592 (part1)
4.	Specification for precast concrete manhole covers and frames: part 2 Frames	12592 (part2)
5.	Method of test for burnt clay building bricks : part 1 to 4 (third revision	3495
6.	Specification for burnt clay hollow bricks for walls and partitions (second revision)	3952
7.	Specification for clay roofing tiles, Mangalore pattern (third revision)	654
	CONCRETE REINFORCEMENT	
1.	Specification for high strength deformed steel bars and wires for concrete-reinforcement (third revision) (superseding IS: 1139-1966) (with amendment no 1)	1139-1966
	DOORS, WINDOWS AND SHUTTERS	
1.	Code of practice for selection, Installation and maintenance of timber doors and windows	4913
2.	Method of test for door leaves : part 1. Measurement of dimensions and defects of square ness	13027 (part 1)
3.	Method of test for wooden flush door Type test (First revision)	4020
4.	Specification for Aluminium doors, windows and ventilators (with amendment no. 1)	19487
5.	Specification for collapsible gates	10521
6.	Specification for mental rolling shutters and rolling grills (first revision)	6248
7.	Specification for timber door, window and ventilator frames (seconds revision) (with amendment no 1)	4021
8.	Specification for wooden flush door, shutters (cellular and hollow core type) : part 1 Plywood face panels (Forth revision)	2129 (part 1)
9.	Specification for wooden flush door, shutters (cellular and hollow core type) : part 2 particle board and hardboard face panels (third revision)	2191(part 2)
	FIRE SAFETY	
1.	Code of practice for fire safety of buildings (general) Details of construction (first revision)	1642
2.	Code of practice for fire safety of hotels	13716
3.	Code of practice for fire safety of libraries and archives buildings	11460
4.	Graphic symbols for fire protection plans	12407

SR. NO.	TITLE	IS NUMBER (LATEST EDITION)
5.	Recommendations for fire precautionary measures in – the construction of temporary structures & pandals (First revision)	8758
	FLOORING, WALL FINISHING AND ROOFING	
1.	Code of practice for external rendered finishes	2402
2.	Code of practice for laying in – situ cement concrete flooring (first revision)	2571
3.	Code of practice for white- washing and colour washing	6278
4.	Definition, classification, characteristics and making of ceramic tiles	13712
5.	Methods of test for ceramic tiles part 1 Determination of dimensions and surface quality	136030 (part1)
6.	Methods of test for ceramic tiles part 2 Determination of water absorption	13630 (part2)
7.	Methods of test for ceramic tiles part 8 Determination of chemical resistance glazed tiles	13630 (Part8)
8.	Methods of test for ceramic tiles part 9 Determination of crazing resistance glazed tiles	13630 (part 9)
9.	Methods of test for ceramic tiles part 11 Determination of resistance to surface abrasion-Glazed tiles	13630 (part 11)
10.	Specification for masons tools for plaster work and pointing work (first revision)	1630
11.	Specification for sand for plaster (second revision)	1542
	FOUNDATION ENGINEERING	
1.	Code of practice of determination of bearing capacity of shallow foundations (first revision) (with amendment no. 1)	6403
2.	Guidelines for selection of ground improvement techniques for foundation in weak soils	13094
3.	Code of practice of pile Foundation	2911(part I, II III, IV)
	METHODS OF MEASUREMENT OF WORKS OF CIVIL ENGINEERING	
1.	Methods of measurement of building and civil engineering works part 1 Earthwork (fourth revision)	1200(part 1)
2.	Method of measurement of building and engineering work part 2 concrete works (third revision with amendment no 2)	1200(part 2)
3.	Method of measurement of buildings and civil engineering works part 3 brick work	1200 (part 3)
4.	Method of measurement of building and civil engineering works part 4 stone Masonry (third revision)	1200 (part 4)
5.	Methods of measurement of building and civil engineering works part 5 form work (third revision) (with amendment no 1)	1200 (part 5)
6.	Methods of measurement of building and civil engineering works part 8 Steel work and iron work (fourth revision)	1200 (Part 8)
7.	Methods of measurement of building and civil engineering works part 9 roof covering (including cladding) (second revision) (with amendment No. 1)	1200(part 9)
8.	Methods of measurement of building and civil engineering works part 10 ceiling and lining (second revision no 2)	1200 (part 10)
9.	Methods of measurement of building and civil engineering works part 11 paving floor Finished dado skirting (third revision) (with amendment No1)	1200(part 11)
10.	Methods of measurement of building and civil engineering works part 12 plastering and pointing (third revision)	1200 (part 12)
11.	Methods of measurement of building and civil engineering works part 13 White Washing, colour washing, distempering and painting of building surfaces (forth revision (with – amendment no. 1)	1200(part 13)
12.	Method of measurement of building and civil engineering works part 15 painting polishing varnishing etc (forth revision)	1200(part 15)
13.	Method of measurement of building and civil engineering works part Methods of measurement of building and civil engineering works part 16 laying water and sewer lines including appurtenant items (third revision)	1200 (part 16)
14.	Methods of measurement of building and civil engineering works part 17 road work including air field pavement (third revision)	1200(part 17)
15.	Methods of measurement of building and civil engineering works part 18 demolition and dismantling (third revision)	1200(part 18)
16.	Methods of measurement of building and civil engineering works part 19 water supply, plumbing and drains (third revision)	1200 (part 19)

SR. NO.	TITLE	IS NUMBER (LATEST EDITION)
17.	Methods of measurement of building and civil engineering works part 21 woods – work and joinery (second revision) With amendment No1)	1200(part 21)
18.	Methods of measurement of building and civil engineering works part 22 materials	1200(part 22)
19.	Methods of measurement of building and civil engineering works part 27 Earth work done by mechanical appliances.	1200 (part 27)
	PAINTING, VARNISHING AND ALLIED FINISHES	
1.	Code of practice for finishing of wood and wood based materials : Part 1 Operations and workmanship	2338 (part 1)
2.	Code of practice of finishing of wood and wood based materials part : 2 schedules	2338 (part 2)
3.	Code of practice for painting concrete, masonry and plaster surfaces : part 1 operation and workmanship	2395 (part 1)
4.	Code of practice for painting, concrete, masonry and plaster surfaces : part 2 Schedule	2395 (part 2)
	SAFETY IN CONSTRUCTION	
1.	Code of practice for steel tabular scaffolding part 2 safety regulations for scaffolding	4014 (part 2)
2.	Code of safety for protective barriers in and around building	13415
3.	Code of safety for excavation – work (first revision)	3764
4.	Recommendations for preventive measures against hazards at work places part 1	13416 (part 1)
5.	Recommendations for preventive measures against hazards at work places part 2 Fall prevention	13416 (part 2)
6.	Safety code for construction involving use of hot bituminous materials	5916
7.	Safety code for erection of concrete framed structures	8989
8.	Safety code for handling and storage of building materials (with amendment no 1)	7969
9.	Safety code of scaffolds and ladders : part 1 Scaffolds	3696 (part 1)
10.	Safety requirements for floor and wall openings, railings and toe boards (first revision)	4912
	SANITARY APPLIANCES AND WATER FITTINGS	
1.	Code of practice for selection, installation and maintenance of sluice valves (first revision)	2658
2.	Code of practice for selection , installation and maintenance of domestic water meters (first revision)	2401
3.	Method for performance testing of water meters (domestic type) (first revision)	6784
4.	Methods of sampling of vitreous and fire clay sanitary appliances (first revision)	9140
5.	Specification for automatic flushing cisterns for urinals (first revision)	2326
6.	Specification for cast iron brackets and supports for wash basins and sinks (second revision)	775
7.	Specification for cast iron gratings for drainage purpose	5961
8.	Specification for cast iron manhole covers and frames (third revision)	1726
9.	Specification for cast iron screw-down stop valves and check valves for water works purpose (first revision)	9338
10.	Specification for cast iron step for manholes specification for chemically resistant glazed stoneware pipes and fittings (first revision)	5455
11.	Specification for chemically resistant glazed stoneware pipes and fittings (first revision)	3006
12.	Specification for flushing cistern for water closets and urinals (with amendment no. 2)	9758
13.	Specification for flush valves and fitting for water closets and urinals (other than plastic cistern) (fourth revision) (with amendment no 3)	774
14.	Specification for foot valve for water works purposes (2nd revision)	4038
15.	Specification for glazed fire –clay sanitary appliances : part 1 general requirements	771 (part 1)
16.	Specification for plastic seats and covers for water closets part 2 Thermo plastic seats and covers (fourth revision) (with amendment no.2)	2548 (part2)
17.	Specification for vitreous sanitary appliances (Vitreous China) : part 4. Specific requirements of wash basin (second revision) (with amendment no.3)	2556(part-4)

SR. NO.	TITLE	IS NUMBER (LATEST EDITION)
18.	Specification for vitreous sanitary appliances (Vitreous China) : part 6 specific requirements of urinals, section 1 bowl type (Third revision) (with amendment no.1)	2556 (part 6 section)
19.	Specification for vitreous sanitary appliances (Vitreous China) : part 6 specific requirements of urinals, section 4 partition slab (second rev.)(with amendment no.2)	2556 (part -6 section 4)
20.	Specification for vitreous sanitary appliances (Vitreous China) : part 11 specific requirements for shower rose (First revision)	2556 (part 11)
21.	Specification for vitreous sanitary appliances (Vitreous China) part 1.2. specific requirements of floor traps (with amendment no 2)	2556 (part 12)
22.	Specification for vitreous sanitary appliances (Vitreous China) : part 15 specific requirements for universal water closets (with amendment no. 2)	2556 (part 15)
23.	Methods of test for soils : part 8 determination of water content-dry density relation using heavy compaction (second revision)	2720 (part 8)
24.	Methods of test for soils: part 28 determination of dry density of soils in place, by the sand replacement method (first revision)	2720 (part 28)
25.	Methods of test for soils: part 29 determination of dry density of soils in place, by the core – cutter method (first revision)	2720 (part 29)
26.	Methods of test for soils part 31 field determination of California bearing ratio (first revision)	2720 (part 31)
27.	Specification of compaction rammer for soil testing (with amendment no. 1)	9198
28.	Specification of laterite stone block for masonry (first revision)	3620
29.	Specification of roofing sate tiles (first revision) with amendment no 1)	6250
30.	Specification of sandstone (slabs and tiles) (first revision)	3622
31.	Code of practice for steel tubular scaffolding part 1 definitions and materials	4014 (part 1)
32.	Code of practice for use of steel tubes in general building construction (first revision) (with amendment)	806
33.	Specification of steel scaffoldings (with amendment no. 3)	270
	STRUCTURAL SECTIONS	
1.	Aluminium channels (first revision)	3921
	TIMBER	
1.	Classification of Indian timbers for door and window shutters and frames	12896
2.	Guiding principles of grading and inspection of timber	6534
3.	Methods of testing of small specimen of timber (part 1 to 18 (with amendment no 1)	1708 (part 1 to 18)
4.	Methods of measurement and evaluation of defects in timber part 1 logs (first revision) (with amendment no. 1)	3364 (part 1)
5.	Methods of measurement and evaluation of defects in timber : part 2 converted timber (first revision) (with amendment no 1)	3364 (part 2)
6.	Methods of presentation of data of physical and mechanical properties of timber	875
	WATER SUPPLY AND SANITATION	
1.	Code of basic requirements for water supply drainage and sanitation (fourth revision)	1172
2.	Code of practice for ancillary structures in sewerage system part 1 Manholes (first revision)	4111 (part 1)
3.	Code of practice for construction and maintenance of road gullies (first revision)	7740
4.	Code of practice for laying of cast iron pipes (first revision)	3114
5.	Code of practice for laying of glazed stoneware pipes (first revision)	4127
6.	Code of practice for laying of welded steel pipes for water supply (first revision)	5822
7.	Code of practice for plumbing in multi storied buildings : part 1 water supply	12183
8.	Code of practice for sanitary pipe work above ground for buildings (first revision)	5329
9.	Code of practice for selection, installation and maintenance for sanitary appliances (second revision)	2064
10.	Code of practice for water supply in buildings (second revision)	2065
	WATERPROOFING AND DAMP- PROOFING	
1.	Code of practice for application of bitumen mastic for waterproofing of roofs	4365
2.	Code of practice for damp proofing using bitumen mastic	7198

SR. NO.	TITLE	IS NUMBER (LATEST EDITION)
3.	Code of practice for general design, details and preparatory work for damp proofing and water- proofing of building	3067
4.	Code of practice for water proofing of underground water reservoir and swimming pool.	6494
5.	Code of practice for application of silicon based water repellent	12054
6.	Glossary of terms relating to bituminous water – proofing and damp – proofing of building	4911
7.	Recommendation for use of polyethylene film for water – proofing of roofs	7290
8.	Recommendation for water – proofing of wet areas in building	13182
9.	Specification for bitumen mastic for use in water – proofing of roof	3037
10.	Specification for bitumen primer for use in water proofing and damp – proofing	3384
11.	Specification for silicon based water repellent	12027
	WOOD PRODUCTS	
1.	Code of practice for the preparation and application of putty for repairing ply wood and other wood based panels	12053
2.	Specification for block board	1659
3.	Specification for plywood for concreting shuttering work	4990
	HAND BOOKS	
1.	SP20 – (S&T) Hand book on masonry design and construction	
2.	SP 23 – Hand book on Concrete mixes (based on Indian Standards)	
3.	SP 25 – Hand Book on causes and * prevention of cracks in building	
4.	SP 27 – Method of measurement of building works	
5.	SP 28 – Hand Book on statistical quality control	
6.	SP 33 – Hand Book on Timber Engineering	
7.	SP 35 – (S & T) Hand Book on water supply and drainage with special emphasis on plumbing	
8.	Handbook on Repair & Rehabilitation of RCC Buildings published by Director General Works , (CPWD), GOI.	

2. ***Contractor to provide :***

The Contractor shall provide and maintain at site throughout the period of works the following at his own cost and without extra charge, the cost being held to be included in the Contract Rates :

2.1 All labour, materials, plant, equipment and temporary works required to complete and maintain the works to the satisfaction of the Engineer.

2.2 Lighting for night work, and also whenever and where ever required by the Engineer.

2.3 Temporary fences, guards, lights and protective work necessary for protection of workmen, supervisors, engineers or any other persons permitted access to the site.

2.4 All equipment, instruments and labour required by the Engineer for measurement of the Works.

2.5 A testing room of not less than 10 m2 equipped with the following, and labour and materials required for carrying out tests therein :

i. Set of standard sieves for testing, grading of sand and a 75 micron sieve for testing silt content.
ii. Sieves with opening respectively of 4.75 mm, 10 mm, 20 mm and 30mm for testing grading of aggregates.
iii. Balance, capacity up to 10 kg, reading to 5 gm.
iv. Electric Thermostat controlled oven and pans for drying of sand and aggregates.
v. Glass measuring flasks of ½, 1, and 2 liter capacity.
vi. Flask for determining moisture content of sand.
vii. Slump cone with rod for slump test.
viii. Minimum 24 steel moulds for 150 mm x 150 mm concrete test cubes. It may be necessary to provide more steel cube moulds depending upon concreting programme.
ix. Vibrator with 25mm, 40mm and 60mm dia needle for compaction of concrete in test cubes and also vibrating table.
x. Work benches, shelves, desks, sinks and any other furniture and lighting as required by the Engineer.
xi. Where concrete cube testing facilities from recognized institute near the site are not available or if the size of the project is large enough or if directed by the Engineer, the contractor should provide at site concrete cube testing machine at his cost.

2.6 If specified in the Bill of Quantities, Contractor shall provide automatic weigh-batching plant of suitable capacity. Contractor shall also provide platform type of weighing machines of a capacity not less than 200 Kg.

2.7 Any of equipment not specifically mentioned above which can reasonably be held necessary for the completion and maintenance of the works to the satisfaction of the Engineer.

2.8 The contractor shall erect and maintain entirely at his own expenses office of 10sq.mt.Each properly lighted, ventilated for the Engineer and for the employers representative and shall consist of executive table 2nos, Plastic moulded chairs 8nos, steel Almirah 1no, ceiling fan 1400mm size 2no, telephone connection, with computer and printer.

2.9 Contractor shall provide all tools & plants like Excavators, Earthmoving Machinery, Drilling equipment with compressors if required for blasting, Mechanical Earth compactors, Wooden/MS Compacting Mallets (Minimum 25 Kgs weight), Pneumatic drills, pickaxe's & shovels etc., all Civil Engineering Survey & levelling instruments like Theodolite, Total Station Survey, Prismatic Compasses, Dumpy Levels, site Laboratory equipment, qualified Technical & supervisory personnel, labour, materials, and temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein, for completion of the Work.

3. ***Dimensions :***

3.1 Figured dimensions on drawings shall supersede measurements by scale and drawings to a large scale shall take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall supersede all others. All dimensions shall be checked on site prior to execution.

3.2 The dimensions where stated do not allow for waste, laps, joints, etc. but the Contractor shall provide at his own cost sufficient labour and materials to cover such waste, laps, joints,etc.

3.3 The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them for himself and also

examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.

4. ***Setting out of Works :***

The Contractor shall set out the Works indicated in the Conditions of Contract. The Contractor shall provide suitable stones with flat tops and build the same in concrete for temporary bench marks. All the pegs for setting out the Works and fixing the levels required for the execution thereof shall, if desired by the Engineer, likewise be built in masonry at such places and in such a manner as the Engineer may direct. The Contractor shall carefully protect and preserve all bench marks and other marks used in setting out the works.

5. ***Materials :***

5.1 Quality :

All materials used in the works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Engineer and shall comply strictly with the tests prescribed hereafter, or where tests are not laid down in the specifications, with the requirements of the latest issues of the relevant Indian Standards and as specified as per manufacturers requirements.

5.2 Copies of orders

The contractor shall supply to the Architect / Engineer, in triplicate, copies of all orders placed by him for the supply of materials. The specialist sub-contractors, if any, also shall supply, through the contractor, four copies of all orders they may place for items of work or materials for fabricating any article or thing for which they may have sub-contracted.

5.3 Sampling and Testing :

All materials used in the works shall be subjected to inspection and test in addition to test certificates. Samples of all materials proposed to be employed in the permanent works shall be submitted to the Engineer for approval before they are brought to the site.

Samples provided to the Engineer for their retention are to be labelled in boxes suitable for storage. Materials or workmanship not corresponding in character and quality with approved samples will be rejected by the Engineer.

Samples required for approval and testing must be supplied sufficiently in advance to allow for testing and approval, due allowance being made for the fact that if the first samples are rejected further samples may be required. Delay to the works arising from the late submission of samples will not be acceptable as a reason for delay in completion of the works.

Materials shall be tested before leaving the manufacturer's premises, quarry or resource, wherever possible. Materials shall also be tested on the site and they may be rejected if not found suitable or in accordance with the specification, notwithstanding the results of the tests at the manufacturer's works or elsewhere or test certificates or any approval given earlier.

The contractor will bear all expenses for sampling and testing, whether at the manufacturer's premises at source, at site or at any testing laboratory or institution as directed by the Engineer. No extra payment shall be made on this account.

5.4 Dispatch of materials :

Materials shall not be dispatched from the manufacturer's works to the site without written authority from the Engineer or prior approval from Engineer.

Test certificates :

All manufacturer's certificates of test, proof sheets, etc showing that the materials have been tested in accordance with the requirement of this specification and of the appropriate Indian Standard are to be supplied free of charge on request to the Engineer.

5.5 Rejection :

Any materials that have not been found to conform to the specifications will be rejected forthwith and shall be removed from the site by the Contractor at his own cost.

The Engineer shall have power to cause the Contractors to purchase and use such materials from any particular source, as may in his opinion be necessary for the proper execution of the work.

6. Storing of Materials at site :

All materials used in the works shall be stored on racks, supports, in bins, under cover etc as appropriate to prevent deterioration or damage from any cause whatsoever to the entire satisfaction of the Engineer.

The storage of materials shall be in accordance with IS 4082 "Recommendation on stacking and storage or construction materials on site" and as per IS 7969 "Safety code for handling and storage of building materials".

The materials shall be stored in a proper manner at places at site approved by the Engineer. Should the place where material is stored by the Contractor be required by the Employer for any other purpose, the Contractor shall forthwith remove the material from that place at his own cost and clear the place for the use of the Employer.

7. Water :

7.1 Water from approved source :

Clean fresh water only shall be used for the works. The water shall be free from any deleterious matter in solution or in suspension and be obtained from an approved source. The quality of water shall conform to prevalent IS 456.

7.2 Storage :

The Contractor shall make his own arrangements for storing water, if necessary, in drums or tanks or cisterns, to the approval of the Engineer. Care shall be exercised to see that water is not contaminated in any way.

8. Workmanship :

8.1 All works shall be true to level, plumb and square and the corners, edges and arises in all cases shall be unbroken and neat.

8.2 Any work not to the satisfaction of the Engineer or his representative will be rejected and the same shall be rectified, or removed and replaced with work of the required standard of workmanship at no extra cost.

9. ***Loading Tests :***

9.1 The Engineer shall during the progress of the works or the period of maintenance, instruct the Contractor that a loading test or tests be made on the works or any part thereof if, in his opinion, such a test or tests be deemed necessary for one or more of the reasons herein below specified :

i. The site made concrete test cubes failing to attain the specified strength;
ii. The shuttering for concrete works being prematurely removed;
iii. Overloading during construction of the Works or part thereof;
iv. Concrete improperly cured;
v. If any portion of the work is carried out without prior approval in writing of the Engineer or his representative to proceed with such work;
vi. If Concrete is honey combed or damaged or in the opinion of the Engineer particularly weak in where weakened concrete will affect the ability of the structure to carry design loads;
vii. Any other circumstances attributed to alleged negligence on the part of the Contractor which, in the opinion of the Engineer, results in the Works or any part thereof being of less than the expected strength;
viii. Any reason other than the foregoing.

9.2 If the loading tests be instructed to be made solely or in part for the reasons I.9.1.1 to 7 the tests shall be made at the Contractor's own cost whether the results of such tests be satisfactory or otherwise. If the tests be instructed to be made for the reasons I.9.1.8 herein before specified, the Contractor shall make the tests and shall be reimbursed for all costs relating thereto irrespective of the result of the tests.

9.3 All the loading tests will be carried out strictly in accordance with the instructions of the Engineer. Load testing will generally follow the procedure set out in Indian Standard Codes of Practice, but the Engineer is not bound to follow the Indian Standard Codes of Practice and in his absolute discretion may issue instructions differing from the procedure set out in the Indian Standard Codes of Practice.

9.4 If in the opinion of the Engineer, the result of the loading tests is not satisfactory the Engineer shall instruct that such parts of the works as he specifies shall be taken down or cut out and reconstructed to comply with the specifications, or other remedial measures shall be taken to make Works secure to the satisfaction of the Engineer. The Contractor shall take down, or cut out and reconstruct the defective work or shall take the remedial measures instructed at his own cost.

10. **Mock-Ups / Prototypes** :

The Contractor shall prepare mock ups for all fixed / loose items as required by the Architect / Engineer based on the Design Drgs. The Architect / Engineer/Employer may require some modifications to be made in order to achieve the desired Design Intent and the same shall be carried out by Contractor at no extra cost. The associated development requirements shall be carried out by the Contractor if required at no extra cost. All Mock-Ups / Prototypes shall be prepared for approval within three weeks from issue of letter of acceptance.

11. **Noise and Dust to be kept to minimum:**

The contractor shall take all necessary precautions in reducing noise of plant of means of mufflers, silencers, screens and the like.

Work liable to create dust shall be segregated or taken care as required before being executed.

12. **Manufacturer's Printed Instructions:**

In case of any difference between the specifications and the manufacturer's printed instructions, the work shall be carried out as per latter at no extra cost.

13. **Design co-ordination:**

All the items of interior work involved in a room or an area shall be well co-ordinated in terms of materials, design detailing, colour and finish to produce an overall integrated interior in accordance with the best intentions of the drawings and specifications.

The Rates quoted for various items included in this tender such as masonry, plaster, concrete, structural work, roof, sheeting's, wooden framework, false ceiling, paneling etc. shall be inclusive of the cost of necessary framework, scaffolding, lifting of materials etc. As the work is proposed to be executed at various heights no extra claim shall be entertained on account of execution of work at various heights/ floor. The measurement of items included in this work shall not be taken and paid separately for different floor levels and varying heights.

The rates for all furniture items shall be inclusive of hardware, iron mongery, fittings, fixtures etc.

CHAPTER 2 : TECHNICAL SPECIFICATIONS

SECTION – A : DISMANTLING AND DEMOLITION WORK

Contractor shall have to submit detailed step by step Method Statement indicating procedure of demolition, what machinery to be used where, machinery / equipment list and its number, technical staff, mechanic for repair the machinery, Location of dumping the debris, Occupational health and safety

GENERAL:

Contractors shall take all precautions to see that the demolition is done in such a sequence and manner as to prevent all avoidable damage to unusable and any damage to nearby property or injury to life. To this effect the Contractor may be required to erect suitable barricades around the works as directed for which no claims for extra payment will be allowed.

A register shall be opened by the contractor on the work site to show a day-to-day account of the turn out of salvaged materials. This register should also show whether dismantled material is properly stacked or wasted. It shall be signed by the representative of the contractor and by the Engineer-in-charge on site.

The structure shall be dismantled carefully, and the materials removed without causing damage to the serviceable materials, and the part of the structure to be retained, and any properties or structure nearby. Any damage to nearby property or structure shall be made good by the contractor without extra claims. The contractor shall be responsible for any injury to the workers or the public. Removal of overlaying adjacent materials if required for dismantling of the structure shall be included in the item.

Before demolishing any part of the structure, the contractor shall provide supports and struts to the existing structure as and when directed by the Consultants. All struts and support shall not be removed by the Contractor until written permission is obtained from the architect or structural engineer. No extra claims for such skirting or supports shall be paid for, it shall be included in the tender under respective items for demolishing. All scaffolding will be in steel and will have rubber ends, so as to not damage any part of the structure.

All the materials obtained from the removal of the structure shall be the property of the owner. Serviceable materials shall be stacked neatly in such a manner as to avoid deterioration and in place directed by the Consultant within a distance of 100 m. Different categories of materials shall be stacked separately. Materials which are to be reused, shall be numbered before dismantling, carefully dismantled to avoid any damages and stacked in an order which facilitates the re-use.

Unless otherwise provided, excavated materials shall be used in back filling the excavation made in removing the structure, in leveling ground or otherwise disposed off, as directed free of cost. Serviceable materials may be issued to the contractor for use in the new work or elsewhere at the rates and as per conditions provided in the tender. No material shall be disposed off by the contractor without the specific instruction of the Consultants.

Serviceable materials may be issued to the contractor for use in the new work or elsewhere at the rates and as per conditions provided in the tender.

No material shall be disposed off by the contractor without the specific instructions of the Consultants.

Extent and Methods of Demolition:

Demolish, remove for salvage, or remove and reinstall as applicable, all, or parts of, as indicated: site work interfering with new construction, masonry, concrete, walls and partitions, floor and roof construction, roofing, parapet construction, doors, frames, finish hardware, plaster, gypsum board, acoustical ceilings, suspension systems, furring, lathing, finished, cabinetry, ventilation items, plumbing fixtures, mechanical and electrical equipment, piping, lighting, and other materials and items as necessary to do the Work under this Contract and, in addition, where removal is indicated.

1. Use methods required to complete Work within limitations of governing regulations.
2. Proceed systematically.
3. Demolish concrete and masonry in small sections.
4. Also demolish or remove walls and partitions in small sections whatever the materials of construction/
5. Remove materials so as to not impose excessive loads to supporting walls, floors, or framing.
6. Where necessary to avoid collapse, install temporary struts, bracing, or shoring; leave in place until new Work provides adequate bracing and support.
7. Remove structural framing members and lower to ground by suitable methods. Do not allow to free-fall.
8. Doors: Completely remove indicated existing doors; deliver to Owner or repair, rework, refinish, and reinstall as indicated.
9. Plaster: Remove only sufficient plaster, lathing, support systems, and other materials and items as is necessary to permit the Work under this Contract.
10. Floors:
    a. Where existing equipment, cabinets, lockers, etc., having concrete curbs or bases are removed, also remove the concrete curbs and bases to a depth not less than 1/4 inch below the top of the adjacent concrete left in place.
    b. When removing existing walls and partitions resting on the structural slab, also remove traces of mortar and other materials to expose structural slab beneath the location of partition or wall.
    c. Except where Contract documents permit leaving existing flooring in place completely remove existing finish flooring from locations where new finished are scheduled. Leave top of exposed substrate completely free from materials.
    d. Except where otherwise indicated, completely remove existing ceramic tile from locations where new finishes are scheduled. Leave top of exposed substrate completely free from materials that would interfere with bond or patching, topping, or finish material and not less than ¼ inch below adjacent concrete left in place.
    e. Also remove toppings where necessary to install structural unit covered bases and other products. In such cases, remove topping sufficiently to properly accommodate new and reused products.
    f. In addition to other removal of existing topping, also remove such amounts of topping as is necessary to allow finishing of floor surfaces level to a tolerance of 1/8 inch in each 6 feet.
    g. When partly removing existing topping and when removing existing floor finished, completely remove loose materials and damaged substrate materials.
    h. Completely remove existing carpet from areas to receive new floor finishes. Also remove carpet cushions and all traces of adhesives.
    i. Where Contract requires removing existing concrete slabs, also remove reinforcement. When filling openings with concrete, prepare slab edges as shown. Leave 6 inches of reinforcement exposed when filling openings with concrete.
    j. Remove existing wood floors completely.

11. Ceilings:

Where existing ceilings have been removed, whether under this Contract or earlier, existing hangers and hanger attachments may have been left in place. Do not remove such hangers or attachments unless so indicated Where new acoustical panel or gypsum board ceilings are scheduled, remove existing plaster and acoustical ceilings. Where existing hangers and hanger attachments adequate and suitable for support of the new ceilings, leave them in place and use for new ceilings. Reuse is subject to Architect's acceptance but Contractor shall assume sole acceptance, but Contractor shall assume sole responsibility for reuse and for later failure resulting there from.

12. Walls:

a Where indicated, remove existing wall finished and prepare surfaces to receive indicated new finishes. Leave nothing that will affect new finish. Where substrates will be exposed in the completed Work, remove every trace of old finish except paint.

b. Remove supports for existing finishes removed under this Contract or earlier.

13. Other Materials and Items: Remove where shown to be removed or where removal is necessary to permit Work under this Contract. Remove such items and materials only to extent necessary of miscellaneous items and materials, refer to the specifications sections where such item or material is specified.

Pollution Controls:

Use water sprinkling, temporary enclosures, and other suitable methods to limit airborne dust and dirt to lowest practical level. Comply with governing environmental protection regulations.

1. Sprinkling is subject to Owner's approval. Cease immediately upon Owner's approval. Cease immediately upon Owner's objection. Do not use water when it may create hazardous or objectionable conditions such as flooding, or pollution.
2. Clean adjacent facilities to remain of dust, dirt, and debris due to demolition operations: comply with applicable requirements of governing authorities. Except where new Work is to occur, return adjacent areas to condition existing before start of Work.

Satisfactorily and promptly repair damage to existing materials and equipment to remain, or provide new equal approved products at no additional cost.

Remove carefully and protect items indicated to be reused. Store carefully in a safe location until reinstalled. Assume responsibility for safe storage and handling.

Remove carefully and protect materials and items to remain Owner's property. Move and sore in a space in the building designated by Owner.

F. Cutting and Drilling:

1. Cut and drill existing construction to permit the Work under this Contract. Include cutting holes and other openings for plumbing, mechanical, and electrical Work.
2. Cut by hand or with small power tools when possible. Cut holes and slots neatly to size required, with minimum disturbance of adjacent work. Cut round holes in concrete using core drills. Cut square and rectangular holes by line drilling and using chipping hammers to remove material between drill holes. Do not use large air hammers.
3. Do not operate air compressors inside building.

4. Do not drill or cut structural supporting elements without specific approval in each case, unless the element is shown on structural drawings to be drilled or cut. Do not cut existing concrete slab reinforcement.
5. Cover openings temporarily when not in use, and patch as soon as work is installed.

Following points shall form inherent the part of offer

1) Insurance
Demolition Contractor should arrange suitable insurance before commencement of work and the copy shall be issued to the Employer.

2) Services
The demolition contractor shall be responsible for arranging disconnection of all water, and electricity service prior to work commencing.
The demolition contractor shall give at least forty-eight hours notice of intention to remove, disconnect drain in or under the building to be demolished.
At least twenty four hours notice must be given before making good the surface of the ground disturbed by the removal or sealing of any sewer or drain under this section.

3) Hoardings and Scaffolding
Suitable hoarding may be required to be erected to enclose the site during demolition and
Scaffold erected along the frontage abutting the road (up to 4-5 mt high) and residential building (up to second floor roof of the residential building) and other such places as may be required.
When required by notice any variation must be sanctioned in writing by the PMC prior to commencement of demolition works.

4) Dangerous Practices
Overloading of any part of the building by debris or materials should be avoided.

5) Fire Risk
All precautions should be taken to prevent the risk of fire or explosion caused by gas or
vapour. Oxygen, acetylene and liquefied petroleum gas containers should be handled with care and stored and used away from source of heat.

6) Open drain crossing the Site
Protective measures are to be taken to protect open drain from damage. Any demolition, debris must be removed to the satisfaction of the PMC
The demolition contractor shall give at least forty-eight hours notice of intention to remove, disconnect drain in or under the building to be demolished.
At least twenty four hours notice must be given before making good the surface of the ground disturbed by the removal of drain under this section

7) Explosives
Use of explosive shall not be allowed.

8) Safety
A person carrying on demolition operations should make sure that any building which is Partly demolished (and the site thereof) is so far as is reasonably practicable, properly Secured or closed against entry at all

times when demolition operations are not in progress and that the building or structure is left in a safe condition at the close of each days work.
(If this clause is not complied with, action may be taken by PMC as per the Contract clause)

9) Dust
The demolition works should be periodically sprayed with water to reduce the amount of dust and the contractor shall take all reasonable steps to prevent any nuisance occurring.

10) Noise
Noise should be minimized as far as possible by the fitting and use of devices wherever practicable. The stated hours of working and use of equipment may also be determined and got approved

11) Fire and Smoke
No burning will be permitted on site

12) Storage
Gas cylinders and similar containers, whether empty, in use, or spare, should be stored in a safe place since if they become involved in a fire any resulting explosion may cause injury to persons and damage property.

13) Maintenance of Access
Regard should be had to the need to maintain convenient and safe access to the adjacent properties.
Accessible public road should be maintain clean and tidy by regular brooming and cleaning by water

14) Demolition Ball
The use of the demolition ball is prohibited.

15) Notice of Commencement
Twenty four hours notice of actual commencement or re-commencement should be given to PMC.

16) Completion of Work and Site Treatment
On completion of demolition, the site shall be cleared, levelled (fenced when necessary)
to the satisfaction of PMC

17) Trees;
Existing trees shall be protected as per the instruction.

18) Working Hours: Working hours shall be 8.00 am to 6 pm. However, working hours shall be approved considering site constraint. The Contractor shall ensure that noise is not generated outside approved working hours.

19) Foundation
Where grubbing out foundations or reducing to new levels adjacent to existing buildings not being demolished, care must be taken to ensure that the support to the remaining foundations or land is not disturbed.

20) Operatives and Supervisor

All operatives engaged in demolition and supervision should be technically competent and adequately trained and familiar with the guidance and Code of Practice for demolition and their responsibilities under the Health and Safety at Work Act 1974.

21) Site Plan

Site Plan showing location and the extent of work of demolition shall be provided. Work shall be carried out in accordance with the drawings.

22) Disposal

Rate quoted by the contractor cover handling, transportation and disposal of entire debris generated by demolition work. All debris removed and drive out from the Site premises shall be the property of the Contractor.

23) Joinery & Fixtures: The Contractor shall stack in proper order at indicated area, all joinery, fixtures and useable material removed from the buildings to be demolished. The rate quoted for demolition shall cover this work and no separate payment shall be made for such work.

SECTION – B : EARTHWORK

1 Excavation for all works and of materials required for filling shall be to the exact width, length and depth shown on the drawings or as directed by the Engineer. If excavation is carried out to greater width, length, depth than required, the Contractor shall make good, at his own cost, the extra depth by sound masonry or concrete filling and extra length or width filled in by well consolidated earth or if the Engineer thinks it necessary for the stability of the work, by masonry or concrete as he may direct.

2 Excavation material required for filling shall be stacked or dumped where indicated by the Engineer. Excavated material not required for filling and any surplus material shall be removed and spread on the site anywhere within the premises and as directed by the Engineer or carted away from the site as directed by the Engineer. Dumping of this surplus material shall be in an orderly manner and according to the levels/grades as indicated by the Engineer. The cost of such removal and spreading shall be borne by the Contractor and held to be included in the Contract Rates.

3 The Contractor shall, at the contract rates make provision for all shoring, pumping, dredging, bailing out or draining water whether subsoil or rain or other water and the excavation shall be kept free of water while the masonry work or concrete work is in progress and until the Engineer considers the work well set (Refer IS:3764 Safety Code for Excavation Work). The sides of trenches shall be kept vertical and the bottom horizontal and shall be run level throughout or properly stepped and the Contractor should note that the rates of the respective items is inclusive of works to be carried out in water / marshy strata for items such as excavation, rubble packing, PCC, RCC, etc. However, no extra claim shall be entertained.

The Contractor shall erect and maintain during progress of works temporary fences around dangerous excavations.

4 Excavation in ordinary soil means excavation in ordinary hard soil including stiff heavy clay, hard shale, or compact soil or any material, which can be removed by the ordinary application of spades, shovels, picks and pick axes. This shall also include removal of isolated boulders each having a volume not more than 0.50 cu.m.

5 Excavation in soft rock includes limestone, sandstone, laterite, etc. or other rock which can be quarried or by mechanical equipment like JCB, Poclain, or compressed air equipment like breaker, etc. This shall also include excavation of tarred pavements, masonry work and rock boulders each having a volume of not more than 0.75 cu.m.

6 Excavation in hard rock includes any rock bound in ledges or masses in its original form or cement concrete, excavation of which in the opinion of the Engineer requires the use of compressed air, equipment, chiseling sledge hammer and blasting or any other method. Blasting shall be carried out through authorized agencies and all statutory laws, regulations shall be observed.

7 Excavation in marshy soil include soils like soft clays and peats excavated below the original ground level of marshes and swamps and soils excavated from other areas requiring continuous pumping or bailing out of water.

8 In case of any difficulty concerning the interpretation of Clauses A.4, A.5, A.6 and A.7 above, the Engineer shall decide whether the excavation in a particular material is in ordinary soil, soft rock or

hard rock and his decision in this matter shall be final and binding on the Contractor and without appeal. Merely the use of higher category equipment on explosive in excavation will not be considered as a reason for higher classification unless same are clearly necessary in the opinion of the Engineer.

9 The foundation trenches shall be inspected and passed by the Engineer before concrete or masonry work is commenced and the Contractor shall hold an order in writing to this effect, otherwise the Contractor shall be liable to have this work removed for inspection.

10 The earth for backfilling in foundation and plinth shall be got approved by the Engineer. In the foundation the backfilling shall be done in layers not more than 200mm thick and shall be thoroughly watered and consolidated by approved method. The rate for backfilling in foundation is deemed to have been included in the excavation rate.

11 The backfilling in plinth and other places which are required for leveling shall be done in layers not more than 300 mm thick except minimum of top three layers shall be done in layers not more than 150 mm thick. Each layer shall be watered and thoroughly consolidated by power driven roller/pan vibrator/vibratory roller of approved capacity. The process shall be repeated till the required level is achieved. After the backfilling is completed the surface shall be uniformly dressed and leveled.

For large area or for deep filling or instructed by Engineer, the degree of compaction for filling will be measured as follows :

Top layer of filling	98% modified Proctor Dry density at OMC
Lower two layers below top layer	95% modified
Below above mentioned three layers	90% modified

12 **<u>Backfilling for subsurface drains (Filter drains) :</u>**

Backfilling materials for subsurface drains shall conform to one of the following grades as specified:

Sieve Designation	**Percent by weight passing the sieve**		
	Class I	**Class II**	**Class III**
50mm	–	–	100
40mm	–	–	95 - 100
25mm	–	100	–
20mm	–	90 – 100	50 - 100
10mm	100	40 – 100	15 – 55
4.75mm	90 – 100	25 – 40	0 – 25
2.36mm	80 – 100	18 – 33	0 – 5
1.18mm	50 – 95	–	–
600 micron	30 – 75	5 – 15	–
300 micron	10 – 30	0 – 7	–
150 micron	0 – 10	–	–
75 micron	0 – 3	0 – 3	0 – 3

The filter material shall be deposited in layers not exceeding 200mm

13 Metal Packing :

Unless otherwise specified, stones for metal packing shall consist of crushed or broken stone. It shall be hard, durable and free from disintegrated particles, excessive dust and other objectionable matter.

Grading of aggregates shall conform to one of the grading given in the following tables :

Grading No	Size range	Sieve desig-nation (IS:460) in mm	% by weight passing the sieve	Remarks
1	90mm	100mm	100	Suitable for 100mm consolidated thickness
	to 40mm	80mm	65-85	
		63mm	25–60	
		40mm	0–15	
		20mm	0–5	
2	63mm	80mm	100	Suitable for 75mm consolidated thickness
	to 40mm	63mm	90-100	
		50mm	35–70	
		40mm	0–15	
		20mm	0–5	
3	50mm	63mm	100	Suitable or 65mm consolidated thickness
	to 20mm	50mm	95-100	
		40mm	35–70	
		20mm	0–10	
		10mm	0–5	

Screening to fill the voids shall consist of same material as coarse aggregates and shall conform to the grading given below :

Classification	Size of screening	Sieve desig-nation	% by weight Passing the sieve
A	12.5mm	12.5mm	100
		10.0mm	90–100
		4.75mm	10–30
		150 micron	0–8
B	10.0mm	10.00mm	100
		4.75mm	85–100
		150 micron	10–30

The metal packing shall be done in layers not more than 100mm compacted thickness. For 150mm compacted thickness, it shall be done in two layers each of 75mm compacted thickness.

After laying, each layer shall be compacted thoroughly either by rollers or small vibratory roller, as specified or by other equivalent method approved by the Engineer. Slight sprinkling of water shall be done at the time of rolling.

After rolling has been completed, screening shall be applied uniformly and gradually to fill the interstices and the surface shall be dry rolled. In no case shall the screenings be dumped in a heap on the rolled surfaces. Rolling shall be accompanied with brooming.

After application of screening and rolling, the surface shall be copiously sprinkled with water and rolled. If necessary additional screenings applied to fill the voids if any. Rolling shall be continued

until the coarse aggregates are well bonded. Care shall be taken that the base or subgrade does not get damaged due to addition of excessive quantities of water during the construction.

14 Measurements :

Measurements of excavation shall be solid measurements or actual volume of the materials prior to its removal. Measurements shall be of the exact length, width as indicated in the drawings and depth, measured vertically according to the Engineer's drawing or his instruction.

The measurement for backfilling shall be based on actual difference of levels before filling and after leveling.

The rate for metal packing shall be based on final compacted thickness and shall include all labour, materials and the cost of rolling with road roller or other equivalent method to obtain full compaction, application of screening, watering etc. complete. It shall be measured in square meters.

TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT

1. Treatment of Column pits, Wall trenches and Basement excavations. Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (up to a height of 300 mm) for column pits, wall trenches and basements shall be treated with chemicals at the rate of 5 liters / M2 of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 liters / M2 of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose.

2. Treatment of Soil Surrounding Pipes , Waste and Conduits Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 liters / M2 of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces.

3. Treatment of Soil Surrounding Pipes , Waste and Conduits Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building.

SECTION – C : MASONRY WORK

BRICKWORK :

1 Bricks:

1 All bricks used on the works shall be burnt clay building bricks of first class quality having minimum crushing strength of 35 kg/cm2 and shall conform to IS:1077 latest. The size required for the works is 225x115x70mm. All bricks shall be uniform in quality and size. The bricks shall be got tested as per IS:3495 latest at the contractor's cost.

2 Bricks shall be unloaded by hand and carefully stacked and all broken bricks shall be removed from site.

2 All bricks shall be subject to inspection on the site and shall be to the approval of the Engineer who may reject such consignments as are considered by him to be inferior to the quality specified.

2. Fly Ash Bricks

1. Eco friendly bricks made from fly ash, stone dust and cement.
2. The sizes available 230 X 110 X 80mm, 225 X 150 X 80mm & 200 X 95 X 95mm.
3. The minimum strength 5.5N/$mm^{2.}$
4. Water absorption 8-13%.
5. Density 1800 – 1900 Kg/m^3

2 Mortar:

1 All mortar shall be prepared in accordance with IS: 2250 latest. The sand used shall conform to IS:2116 latest and the water shall conform to relevant clauses of Section B (Concrete) of this specification. Restamping of set mortar will not be permitted.

2 Unless otherwise specified in the Schedule of Quantities, the cement mortar proportion shall be as follows:

(i) 115 mm thk brickwork 1:4
(ii) 230 mm thk brickwork 1:6
(i) 230 mm thk flyash brick blocks in CM 1:4

3 Construction:

1 All masonry work shall comply with the requirements of IS:2212 latest. It shall be of English bond. All closure bricks, etc necessary to comply with the requirements of the bond specified or to break joints effectively shall be procured by the Contractor and used for the work.

2 Ordinarily there shall be four courses per 0.3m height or in other words, the horizontal bed joints shall be on average 10mm thick, and the vertical joints 6mm wide. The mortar shall be worked up to all joints and no hollow space shall be left in any portion of the work. All joints shall be laid truly horizontal and all vertical joints shall be truly vertical. Masonry work shall be raised in a uniform manner so that no one portion is being raised more than 1.0m above another portion at one time.

3 For half brickwalls (115mm thk) which exceed 2.0m in height, a reinforced concrete band 75mm thick (concrete band M-15/10) shall be provided at intervals not exceeding 1.5m. The reinforcement in these bands shall consist of 2 Nos 6mm mild steel / tor steel rounders with 6mm binders spaced at 150mm centres and with the hoop iron 25mm x 1.6mm or equivalent reinforcement at every third courses embedded in the cement mortar. Such band shall also be provided at the free edge of all masonry work including window sills and top of free standing walls. This work will not be paid separately.

4 All bricks / flyash brick blocks shall be thoroughly soaked by keeping them under water for at least 12 hours before use; the practice of dipping bricks in water just before use will not be allowed. All necessary water cisterns for this purpose shall be constructed or tubs brought by the contractor to the satisfaction of the Engineer to ensure proper soaking of bricks.

5 No bats or broken bricks are to be used otherwise than as closures. No under burnt or over burnt bricks shall be used.

4 Fixtures:

Fixtures, plugs, frames for doors and windows, etc shall be placed in position while laying the course and not later by removing bricks/blocks already laid.

5 Scaffolding :

Scaffolding consisting of timber ballies, bamboos or steel tubular scaffolding adequately braced to resist all construction loads shall be provided as required by the working stages. Any holes made in the walls for tying the scaffolding shall be made good by filling solidly with M-10/10 grade concrete.

6 Watering :

The brickwork shall be kept wet for a period of at least 14 days after laying. The mortar shall not be allowed to dry at any time. For blockwork the walls shall not be allowed to become excessively wet.

7 Joints :

1 All unfinished work shall be raked back in courses, unless otherwise directed. When new work is to be joined to unfinished work, the surface of the unfinished work shall be cleaned and thoroughly wetted.

2 The finished work shall be true in line and level. All uneven irregular and disturbed brickwork shall be pulled down and rebuilt with fresh brickwork at the contractor's expense.

3 Joints in brickwork shall be well raked out. Raking out of each day's work shall be done on the same day.

4 Masonry work shall not be raised by more than 8 single courses per day.

8 **Tolerances :**

The permissible tolerance in brickwork shall be as follows
TOLERANCES

1	Deviation from position shown on plan of any brickwork more than one storey in height	10mm
2	Deviation from vertical within a storey	5mm per 3m height
3	Deviation from vertical in total height of building	10mm
4	Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	5mm
5	Deviation from line in plan upto 12.0m	5mm
	In any length over 12.0m	10mm total
6	Deviation of bed joint from horizontal	
	In any length upto 12.0m	5mm
	In any length over 12.0m	10mm total

RUBBLE MASONRY & RUBBLE SOLING

9 The Laterite / Stone for the works except where otherwise described shall be of the best quality procurable complying with IS:1805 latest. No stone with flaws, or traversed with seams of perishable materials or quarry faced, or otherwise in any way defective shall be allowed to be used and the Engineer may reject and refuse to permit the use of any stone which, in his opinion, is unfit for the work.

10 Stone masonry, wherever required, shall conform to the requirements of IS:1597 latest and shall be composed generally of large stone weighing about 25 kgs. The face stones to be squared on all joints and beds shall be hammered and chisel dressed, true and square for at least 75mm back from the face, and the joints for at least 40mm (IS:1127 latest and IS:1129). The face of the stone is to be hammer dressed and "bushing" shall not project more than 40mm. The stone shall be clean flat bedded properly selected for their places and carefully laid with a suitable proportion of smaller stones and chips to fill up the interstices. The mortar including the constituents shall conform to the requirements of IS:2250 latest and IS:1625 latest.

11 The whole masonry shall be hand set and solidly bedded in and surrounded with mortar on every side except the face. There shall be no hollows or dry portions in work nor pinning in the face and no joint shall be more than 10mm. The face stone shall be flat bedded, shall tail back and be bound well into the body of the wall and shall not be of a height greater than either the breadth on face or length of the tail. Through stones covering the whole width or thickness of the walls, or 600mm long where the walls are thicker than 600mm, shall be inserted at every 1000mm measured horizontally and vertically. The rate for stone masonry shall include the extra cost of the through stones. The faces of the walls shall be strictly straight. The masonry shall be shaded from the sun, and kept wet for not less than 14 days after completion.

12 All fixtures, plugs, frames shall be placed securely as the work proceeds and not after completion of the masonry. Iron holdfasts shall be given a coating of bitumen to avoid rusting.

13 Scaffolding as described in clause F.17 above shall be provided as required.

LATERITE STONE MASONRY

14 The Laterite Stone should be quite hard and all the four sides of the stones should be chiseled properly before use for construction.

1 Bricks :

1 All Laterite bricks used on the works shall be building bricks of first class quality having minimum crushing strength of 40 kg/cm2 st. The size required for the works is 230x230x150mm. All bricks shall be uniform in quality and size. The bricks shall be got tested at the contractor's cost.

2 Bricks shall be unloaded by hand and carefully stacked and all broken bricks shall be removed from site.

3 All bricks shall be subject to inspection on the site and shall be to the approval of the Engineer who may reject such consignments as are considered by him to be inferior to the quality specified.

2 Mortar :

1 All mortar shall be prepared in accordance with IS:2250 latest. The sand used shall conform to IS:2116 latest and the water shall conform to relevant clauses of Section B (Concrete) of this specification. Restamping of set mortar will not be permitted.

2 Unless otherwise specified in the Schedule of Quantities, the cement mortar proportion shall be as follows :

(i) 230 mm thk brickwork 1:5 for foundation

(ii) 230 mm thk brickwork 1:4 for superstructure

3 Construction :

1 All masonry work shall comply with the requirements of . All closure bricks, etc necessary to comply with the requirements of the bond specified or to break joints effectively shall be procured by the Contractor and used for the work.

2 The horizontal bed joints shall be on average 10mm thick, and the vertical joints 6mm wide. The mortar shall be worked up to all joints and no hollow space shall be left in any portion of the work. All joints shall be laid truly horizontal and all vertical joints shall be truly vertical. Masonry work shall be raised in a uniform manner so that no one portion is being raised more than 1.0m above another portion at one time.

3 No bats or broken bricks are to be used otherwise than as closures. No under burnt or over burnt bricks shall be used.

4 Scaffolding :

Scaffolding consisting of timber ballies, bamboos or steel tubular scaffolding adequately braced to resist all construction loads shall be provided as required by the working stages. Any holes made in the walls for tying the scaffolding shall be made good by filling solidly with M-10/10 grade concrete.

5 Watering :

The brickwork shall be kept wet for a period of at least 14 days after laying. The mortar shall not be allowed to dry at any time. For block work the walls shall not be allowed to become excessively wet.

6 Joints :

1 All unfinished work shall be raked back in courses, unless otherwise directed. When new work is to be joined to unfinished work, the surface of the unfinished work shall be cleaned and thoroughly wetted.

2 The finished work shall be true in line and level. All uneven irregular and disturbed brickwork shall be pulled down and rebuilt with fresh brickwork at the contractor's expense.

3 Joints in brickwork shall be well raked out. Raking out of each day's work shall be done on the same day.

4 Masonry work shall not be raised by more than 8 single courses per day.

7 Tolerances :

The permissible tolerance in brickwork shall be as follows
TOLERANCES

1. Deviation from position shown on plan of any brickwork more than one storey in height 10mm

2.	Deviation from vertical within a storey	5mm per 3m height
3.	Deviation from vertical in total height of building	10mm
4.	Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	5mm
5.	Deviation from line in plan upto 12.0m	5mm
	In any length over 12.0m	10mm total
6.	Deviation of bed joint from horizontal	
	In any length upto 12.0m	5mm
	In any length over 12.0m	10mm total

SECTION - D : PLAIN & REINFORCED CEMENT CONCRETE

1 Cement :

The Cement used shall be any of the following with the prior approval of the Engineer :

1	Ordinary Portland Cement	IS:269
2	Rapid hardening Portland Cement	IS:8041
3	Portland Slag Cement	IS:455
4	Portland Pozzolana	IS:1489
5	High Strength Ordinary Cement (Grade 53)	IS:8112
6	Hydrophobic Cement	IS:8043
7	Ordinary Portland Cement	IS:12269
8	High Sulphate resisting Cement	IS:4027-1980

Use :

Cement shall be used in the order in which it is received. Cement in bags in storage for more than 3 months shall be retested before use.

Testing :

A sample taken once for every 1000 bags shall be tested. Tests shall be carried out for fineness, initial and final setting time, and compressive strength (IS:4031) and the results approved by the Engineer before use of the cement in permanent works. Samples shall be taken immediately on receipt of cement at site. The methods and procedure of sampling shall be in accordance with IS:3535. The Engineer may specify other forms of sampling and tests including chemical analysis, (IS:4032) if in his opinion the cement is of doubtful quality; the costs of such additional tests shall be borne by the Contractor.

2 Fine Aggregates (Sand) :

1 It shall be river or pit sand conforming to IS:383, obtained from sources approved by the Engineer. If permitted by the Engineer, crushed stone sand produced from stones, suitable for concrete aggregates, and manufactured in special sand producing crushers such as impactors, hammer mills and processed through stone on stone, vertical shaft crushers such as Barmac / Svedala for particle shaping and excess fines removed by suitable dust extractors. The particle shape shall be nearly cubical. If crushed stone sand contains high percentage of fines, the sand will be separated in two fractions viz. 0 - 2.36 mm and 2.36 - 4.75 mm size. These two fractions will be suitably blended to obtain desired grading of sand. In case of crushed stone sand the fines i.e. (-) 0.15 mm shall be less than 5 %. The crushed stone sand shall be tested for flow time and voids as per ASTM 1252, and if found suitable shall only will be used.

The sand shall not contain silt more than a total of 2% by weight and shale, clay, silt and other structurally weak particles a total of 5%.

If considered by the Engineer as necessary, the sand shall be washed in screw type mechanical washers in potable water to remove silt, clay and chlorides. This shall be done at least one day before using it in concrete.

The washed sand shall be stored on a sloping concrete platform and in such a manner as to avoid contamination. Such sand washing, storing, etc. shall be at the Contractor's cost.

2. If grading of fine aggregates can be improved by mixing two sands, the Engineer may at his discretion specify such mixing, and may permit the use of crushed sand as one of the two sands forming the mixture. The provision of two types of sand and their mixing in the specified proportions shall be at the Contractor's cost.

3. The sand shall be screened on 4.75 mm size screen to eliminate over size particles. The cost of screening is deemed to be included in Contractor's rates.

4. The aggregate shall e subjected to tests in accordance with IS 2386 as may be ordered by the Engineer.

3 Coarse Aggregates :

1. Coarse aggregates for the Works shall be river gravel or crushed stone conforming to IS:383, obtained from sources approved by the Engineer.

2. Aggregates shall be properly screened and if necessary washed clean before use.

3. Coarse aggregates containing flat or flaky pieces or mica shall be rejected.

4. Coarse aggregates shall be supplied in the following sizes :

Nominal size	Maximum size	Minimum size
10mm	12mm	5mm
0mm	25mm	10mm
40mm	40mm	20mm
80mm	80mm	40mm

5. The grading of coarse aggregate shall be such that not more than 5% shall be larger than the maximum size and not more than 10% shall be smaller than the smallest size. Between these sizes the coarse aggregate shall be well graded.

6. The aggregates shall be subjected to tests in accordance with IS 2386 as may be ordered by the Engineer.

7. Aggregate shall be stored in such a way as to prevent segregation of sizes and avoid contamination with fines.

4 Mixers and Vibrators :

1 If specified in the schedule of items, for all structural concreting work the Contractor shall provide automatic weigh-batching plant of suitable capacity. The plant used shall conform to IS:4925.

2 The Contractor shall provide concrete mixers (IS:1791 - Batch type concrete mixers, IS:2439 - Roller Pan Mixer) and vibrators (IS:2505 - Concrete Vibrators Immersion Type, IS:2506 - Screed board concrete vibrators, IS:4656 - Form Vibrators for Concrete) supplied by recognized manufacturers.

5 Grade of Concrete :

The concrete is designated as follows : Concrete M 30
The letter M refers to the mix
The number 30 represents the characteristic compressive strength of 15cm cubes at 28 days in MPa (Mega Pascals : 1 MPa : 10 kg/cm2 approximately). M 30 concrete thus has a characteristic strength of 300 kg/cm2.

6 Minimum Cement Content :

For all structural concrete work, minimum cement content shall not be less than 320 kg/m3 of concrete for durability considerations.

7 Trial mixes :

1 The Contractor is entirely responsible for the design of the concrete mixes. The design is however to be approved by the Engineer at least 4 weeks before commencing any concreting in the Works, the Contractor shall make trial mixes using samples of coarse aggregates, sand, water and cement, typical of those to be used in the Works, and which have been tested in an approved laboratory. A clean dry mixer shall be used and the first batch discarded.

2 The required average strengths of different grades of concrete at 28 days for which the mixes shall be designed are specified below :

TABLE 1

Grades of Concrete	Characteristic strength (f'ck) at 28 days (Mpa)	Target mean strength (Mpa) at 7 days	f'cm (MPa) at 28 days
M 15	15	18	24
M 20	20	21	29
M 25	25	23	34
M 30	30	26	39
M 35	35	31	44
M 40	40	36	49
M 45	45	40	54

The mixes are designed to yield mean strengths (f'cm) greater than the corresponding specified characteristic strengths (f'ck) as indicated in Table 1. The difference between f'cm and f'ck is called the `Current Margin'. The value of the current margin has been set at 9

MPa for all grades of concrete. The concrete mixes shall be designed on the basis of required strength, desired workability, the maximum size of aggregate and also upon the various grades of cements as specified in IS: 10262-1982, Clause 3.1.1. Accordingly the required cement content shall be ascertained. The contractor may be allowed to use either approved plasticizers or increased cement content to achieve the required strengths at his own cost.

3 For each grade a total of 18 cubes shall be made. Of these 18 cubes made not more than 6 may be made on any day and further, of the 6 cubes made in one day not more than 2 cubes may be made from any single batch. 9 of these cubes, each representing a different batch of concrete shall be tested at the age of 7 days and the remaining 9 cubes shall be tested at the age of 28 days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with Indian Standards IS: 516. The test shall be carried out in a laboratory approved by the Engineer.

4 If the average strength of the concrete cubes falls below the required strength fresh preliminary mixes for that grade shall be made as before, until the trial mixes yield cubes of compressive strength at 28 days greater than the required average strength at that age.

5 Whenever there is a significant change in the quality of any of the ingredients for concrete, the Engineer may at his discretion order the carrying out of fresh trial mixes. All costs for trial mixes and tests shall be to the Contractor's account and held to be included in the contract rates.

6 Before commencing the Works the Contractors shall submit to the Engineer, for approval full details of all preliminary trial mixes and tests.

7 When the proportions of a concrete mix have been approved by the Engineer, the Contractor shall not vary the quality or source of the materials or the mix without the written approval of the Engineer.

8 <u>Concrete Cube Tests :</u> As per IS 456: 2000

9 <u>Permeability Test :</u>

The concrete will be verified for permeability by the following procedure and shall confirm to IS:3085-1965 – 'Permeability of Cement Mortar & Concrete'.

1 The Engineer shall select random batches of concrete for examination without warning the Contractor and sampling will generally be done at the point of discharge from the mixer and at placing point.

2 From the batches thus selected 2 concrete cylinders shall be made in accordance IS:3085.

3 All cylinders shall be made, cured, stored, transported and tested in accordance with IS:3085. The tests shall be carried out in a laboratory approved by the Engineer.

4 At least 2 cylinders shall be made on each day's concreting until 60 cylinders have been made for each grade of concrete. This is in the initial period.

5 After the initial period, subject to the acceptance of the Engineer, the frequency at which the cylinders shall be made may be reduced as follows:-
(1 set = 2 cylinders, representing concrete from a different batch.)
At least 1 set for each day's concreting consisting of :

i) 1 set for every 10 m3 or part thereof concrete for critical structural elements plus 1 set for every 40 m3 or part thereof for all other elements.

ii) If concrete is batched at more than one point simultaneously the above frequency of making cylinders shall be followed at each point of batching.

The cylinders will be tested as per the procedure, given in Clause 6 next.

6 Test Procedure:
The permeability of concrete will be verified by the following procedure :

i) Prepare a cylindrical test specimen 150 mm dia and 160 mm high.

ii) After 28 days of curing, test specimen will be filted in a machine such that the specimen can be placed in water under pressure up to 7 bars.

iii) At first a pressure of one bar is applied for 48 hours, followed by 3 bars for 24 hours and 7 bars for next 24 hours.

iv) After the passage of the above period, the specimen is taken out and split in the middle by compression applied on two round bars on opposite sides above and below.

v) The water penetration in the broken core is measured with scale and the depth of penetration assessed in mm (max permissible limit 75 mm).

10 Acceptability criteria : As per IS 456: 2000

Permeability Test :

The concrete shall pass the permeability test if it is properly compacted and is not considered permeable when tested as per IS 3085:1965, and the water penetration in the broken core is less than 25mm. No extra payment shall be made for this test and cost of the same will be included in his rate for concrete work.

11 Mix Design :

It is the complete responsibility of the Contractor to design the concrete mixes by approved standard methods and to produce the required concrete conforming to the specifications and the strength requirements approved by the Engineer. It is expected that the Contractor will have competent staff to carry out this work.

12 Failure to meet Specified Requirements :

1 If from the cube test results it appears that some portion of the Works has not attained the required strength, the Engineer may order that portion of the structure be subjected to

further testing of any kind whatsoever as desired by the Engineer, including, if so desired by him, full load testing of the suspected as well as adjacent portions; of the structure as specified in the Conditions of Contract. Such testing shall be at the Contractor's cost. The Engineer may also reject the work and order its demolition and reconstruction at the Contractor's cost.

2 If the strength of concrete in any portion of the structure is lower than the required strength, but is considered nevertheless adequate by the Engineer so that demolition is not necessary, the Contractor shall be paid a lower rate for such lower strength concrete as determined by the Engineer.

13 Site Testing :

As frequently as the Engineer may require, testing shall be carried out in the field for:

1 Moisture content, absorption and density of sand and aggregates
2 Silt content of sand
3 Grading of sand and aggregates
4 Slump test of concrete
4 Concrete cube test
6 Permeability test for concrete as per IS:3085-1965
7 Density and pH value of Plasticiser

The Contractor shall provide and maintain at all times, until the Works are completed, equipment and staff required for carrying out these tests. The Contractor shall grant the Engineer or his representative full access to this laboratory at all times and shall produce on demand complete records of all tests carried out on site.

Before concreting commences on any section of the Works the Contractor shall obtain approval of the Engineer or his representative as regards the form and reinforcement conforming to the drawings. He shall also indicate to the Engineer in writing and obtain his approval for positions of construction joints. The Engineer or his representative's approval shall not relieve the Contractor of any of his obligations to comply with the provisions of this specification or contract.

14 Admixtures :

Approved admixtures and air entraining agents may be permitted by the Engineer at his discretion provided that the strength requirements are not affected by their use. Any cement saving due to their use will be to the benefit of the Contractor. The admixture will not be paid for separately.

15 Volume Batching with Weight Control :

Where volume batching with weight control is specified by the Engineer, all measurements of coarse aggregates and water shall be by volume and of cement by the bag, controlled by regular periodic weighings. In order to ensure correct proportioning the following precautions shall be taken :

1 The Contractor shall maintain at site a suitable number of platform balances similar to the balances used for weighing luggage at railway platforms, capable of weighing up to 200 kg

to the nearest 100 grams; the balance shall be used for weighing cement bags and occasional boxes of sand and coarse aggregate as specified below.

2 The Contractor shall provide the mixer operator with standard measures for measuring the water to be used in the mix.

3 The quantity of water to be added to the mix shall be approved by the Engineer or his representative and may be adjusted by them as frequently as necessary in order to allow for the moisture content of the sand or coarse aggregate and workability desired. On no account shall the Contractor allow more water to be added to the mix than that specified by the Engineer or his representative. Concrete containing water in excess of that specified shall be rejected and not allowed for use in the Works.

4 Sand and coarse aggregates shall be measured by volume. The size of measuring boxes or the depth to which they are filled or both shall be adjusted to obtain the correct weight of each material specified by the Engineer for that mix.

5 Every fifth or tenth measuring box of sand or of coarse aggregate shall be weighed on the balance to ensure that filling of boxes is being uniformly done. Adjustment shall be made from time to time in the amount of each box filled to take into account variations in moisture content and consequent bulking of sand.

6 More frequent weighing of boxes, particularly of sand if found to vary considerably in moisture content and bulking, may be required by the Engineer and shall be done by the Contractor without additional cost.

16 <u>Weigh Batching :</u>

All structural concrete shall be weigh batched. All concrete ingredients except shall be batched by weight using a weigh batcher of an approved make (IS: 2722 - Portable swing weigh batchers for concrete). Batching shall be to an accuracy of not less than 1/2 kg and the batcher shall be tested for accuracy of calibration before commencement of the Works and at least once a week thereafter or more frequently if so required by the Engineer.

17 Water shall be batched by weight or by volume measures as approved by the Engineer. The method of batching shall be such as will ensure accuracy to 0.5 litres or better.

18 Placing temperatures :

During extreme hot or cold weather, the concreting shall be done as per procedures set out in IS:7861, Parts I & II.

Fine and coarse aggregates for concreting shall be kept shaded and the concrete aggregates sprinkled with water for a sufficient time before concreting in order to ensure that the temperature of these ingredients is as low as possible prior to batching. The mixer and batching equipment shall be also shaded and if necessary painted white in order to keep their temperatures as low as possible. The placing temperature of concrete shall be as low as possible in warm weather and care shall be taken to protect freshly placed concrete from overheating by sunlight in the first few hours

of its laying. The time of day selected for concreting shall also be chosen so as to minimize placing temperatures. In case of concreting in exceptionally hot weather the Engineer may in his discretion specify the use of ice either flaked and used directly in the mix or blocks used for chilling the mixing water. In either case, the Contractor shall be paid only the cost of such ice delivered on site and nothing extra for additional labour involved in weighing and mixing.

19 Transporting, placing, compacting and curing :

Transporting, placing, compacting and curing of concrete shall be in accordance with IS: 456.

1 Transporting :

The mix after discharging from the mixer shall be transported by wheel barrows, buckets, pimps etc. without causing segregation and loss of cement slurry and without altering its desired properties with regard to water cement ratio, slump, air content, cohesion and homogeneity. It should be ensured that the concrete is moved to its final destination before it attains an initial set.

2 Placing :

The height of any single lift of concrete shall not exceed 1.5m for walls or 3.0m for columns. The thickness of horizontal layers shall not exceed 300mm. High velocity discharge of concrete causing segregation of mix shall be avoided. The concrete shall be placed in the forms gently and not dropped from a height exceeding 1.5m except in columns where the maximum allowed will be 2.0m. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall follow each other so closely that the succeeding layer shall be placed and fully compacted before the layer immediately below has taken initial set. The method of placing shall also be such as to prevent segregation.

Concreting of any portion or section of the work shall be carried out in one continuous operation and no interruption of concreting work will be allowed without approval of the Engineer.

3 Compaction :

Internal (needle) and surface (screed board) vibrators of approved make shall be used for compaction of concrete.

Internal vibrators shall be used for compaction of concrete in foundations, columns, buttresses arch section etc. For sections such as slabs, the concrete shall be compacted by surface type vibrators. Depending on the thickness of layer to be compacted, 25 mm, 40 mm, and 60 mm dia internal vibrators will be used. The concrete shall be compacted by use of appropriate diameter vibrator by holding the vibrator in position until:

i) Air bubbles cease to come to surface.
ii) Resumption of steady frequency of vibrator after the initial short period of drop in the frequency, when the vibrator is first inserted.
iii) The tone of the vibrated concrete becomes uniform.
iv) Flattened, glistening surface, with coarse aggregates particles blended into it appears on the surface.

After the compaction is completed, the vibrator should be withdrawn slowly from the concrete so that concrete can flow in to the space previously occupied by the vibrator. To avoid segregation during vibration the vibrator shall not be dragged through the concrete nor used to spread the concrete. The vibrator shall be made to penetrate, into the layer of fresh concrete below if any for a depth of about 150mm. The vibrator shall be made to operate at a regular pattern of spacing. The effective radii of action will overlap approximately half a radius to ensure complete compaction.

v) To secure even and dense surfaces free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic.

vi) A sufficient number of spare vibrators shall be kept readily accessible to the place of deposition of concrete to assure adequate vibration in case of breakdown of those in use.

vii) Form vibrators whenever used shall be clamped to the sides of formwork and shall not be fixed more than 450 mm above the base of the new formwork and concrete shall be filled not higher than 230mm above the vibrator. The formwork must be made specially strong and watertight where this type of vibrator is used.

Care must be taken to guard against over vibration especially where the workability of the concrete mix is high since this will encourage segregation of the concrete.

viii) Plain concrete in foundations shall be placed in direct contact with the bottom of the excavation, the concrete being deposited in such a manner as not to be fixed with the earth. Plain concrete also shall be vibrated to achieve full compaction.

4 Concrete placed below the ground shall be protected from falling earth during and after placing. Concrete placed in ground containing deleterious substances shall be kept free from contact with such ground and with water draining there from during placing and for a period of seven days or as otherwise instructed thereafter. Approved means shall be taken to protect immature concrete from damage by debris, excessive loading, abrasion, vibrations, deleterious ground water, mixing with earth or other materials, and other influences that may impair the strength and durability of the concrete.

20 <u>Construction Joints :</u>

Construction joints in all concrete work shall be made as directed by the Engineer. Where vertical joints are required, these shall be shuttered as directed and not allowed to take the natural slope of the concrete.

Before fresh concrete is placed against a vertical joint, the old concrete shall be chipped, cleaned and moistened. Where required, suitable expansion joints shall also be provided as directed by the Engineer.

No separate payment shall be allowed to the Contractor for forming joints or chipping and cleaning them. When a horizontal construction joint is formed, provision shall be made for interlocking with the succeeding layer by the embedment of saturated wooden blocks or strips bevelled on four sides to facilitate their removal. Prior to the next pour the wooden pieces shall be loosened and removed in such a manner as to avoid injury to the concrete.

Construction joints in concrete walls and slabs for liquid retaining structures shall be prepared in a similar manner to normal construction joints and metal, rubber or plastic water stops shall be cast into joints. For expansion joints in retaining wall 25mm thick Shalitex, boards are to be provided without any extra cost. Measures shall be taken by the Contractor to ensure that no displacement or distortion of water stops takes place during placing of concrete.

21 Cracks :

If cracks, which in the opinion of the Engineer may be detrimental to the strength of the construction, develop in concrete construction, the Contractor at his own expense shall test the slab or other construction as specified in Special Conditions. If under such test loads the cracks develop further, the Contractor shall dismantle the construction, carry away the debris, replace the construction and carry out all consequential work thereto.

If any cracks develop in the concrete construction, which in the opinion of the Engineer, are not detrimental to the stability of the construction, the Contractor at his own expense shall grout the cracks with neat cement grout and also at his own expense and risk shall make good to the satisfaction of the Engineer all other building works such as plaster, moulding, surface finish of floors, roofs, ceilings, etc. which in the opinion of the Engineer have suffered damage either in appearance or stability owing to such cracks. The Engineer's decision as to the extent of the liability of the Contractor in the above matter shall be final and binding.

22 Defective Concrete :

Should any concrete be found honeycombed or in any way defective, such concrete shall on the instruction of the Engineer be cut out by the Contractor and made good at his own expense.

23 Exposed Faces, Holes and Fixtures :

On no account shall concrete surfaces be patched or covered up or damaged concrete rectified or replaced until the Engineer or his representative has inspected the works and issued written instructions for rectification. Failure to observe this procedure will render that portion of the works liable to rejection; in which case it will be treated as rejection which has failed to meet specified strength requirements and dealt with according to Clause B.11.

Holes for foundation or other bolts or for any other purposes shall be moulded, and steel angles, holdfasts or other fixtures shall be embedded, according to the drawing or as instructed by the Engineer.

24 Finishes :

Unless otherwise instructed the face of exposed concrete placed against formwork shall be rubbed down immediately on removal of the formwork to remove irregularities. The face of concrete for which formwork is not provided other than slabs shall be smoothed with a float to give a finish equal to that of the rubbed down face, where formwork is provided. The top face of a slab which is not intended to be covered with other materials shall be levelled and floated to a smooth finish at the levels or falls shown on the drawings or as directed. The floating shall be done so as not to bring an excess of mortar to the surface of the concrete. The top face of a slab intended to be surfaced with other material shall be left with a spaded finish. Faces of concrete intended to be plastered shall be roughened by approved means to form of a key.

25 Concrete for flooring on grade :

Concrete for flooring on grade shall be over well packed stone metalling or on earth as specified with or without reinforcement, placed in alternate bays not exceeding more than 6m x 6m or as specified including hacking the joints or adjacent bays. The water cement ratio shall not exceed 0.4. The stiff mix shall be thoroughly vibrated and finished to receive the floor finish.

26 Other applicable codes of practice for in-situ reinforced construction :

All other requirements not covered by the above clauses shall be governed by relevant clauses of IS 456, IS 3370, IS 2571 and other relevant standards as may be applicable.

27 Grouting of base plates & bolt holes :

i Mixing :

Dry grout should be mixed in a mechanical mixer: the conventional 200/400-litre capacity concrete mixer can be used to mix four bags of dry grout; alternatively, paddle type mortar mixers can be used. The quantity of grout to be mixed at one time should not exceed that amount which can be placed in approximately 10 to 15 minutes.

ii Batching :

Batching of grout by fraction of a bag is not allowed. The quantity of mixing water should be the minimum commensurate with workability, compaction, and filling of the grout in all corners and crevices. Mixing should be done for a minimum of three minutes to obtain a fluid grout of uniform consistency.

iii Cleaning and preparation of the surface :

The base concrete should be clean and strong, and its surface should be properly hacked; all dust should be removed suction or compressed air. The surface should be thoroughly wetted with water for several hours. Before the grout is poured, all free water should be removed and the flat surfaces coated with a thin cement slurry.

iv Restraint :

Heavy back-up blocks of timber or concrete should be fixed on all sided of the base plate to prevent escape of the grout, when poured through the openings provided in the base plate. Adequate

restraint must be ensured on all the sides for a period of 7 days to obtain effective expansion and shrinkage compensation.

v Curing :

The grout should not dry out where external restraint is provided in the form of form-work, the top opening and all stray openings should be covered with wet sack for at least 7 days.

vi Placing and compaction :

The grout should be placed quickly and continuously either through the holes in the base plates or from one side only to ensure complete filling without entrapment of air. Grout should be properly spread and compacted by rodding. Excessive vibration should be avoided.

Below the bed plates the grout should be compacted using long pieces of doubled-over flexible steel strapping or chains. The forward and backward movement of the strap or chain will assist in the flow of the grout into place. Steps must be taken to keep the grout in full contact with the underside of the bed plate until the grout sets; maintaining a small head of fresh grout in the forms.

vii Shrinkage Compensated Grout:

Shrinkage compensated grout of Associated Cement Companies Limited or any other approved manufacturer should be used. The batching shall be as per the manufacturer's specifications, other procedures being as above.

28 Precast Concrete :

The provision in this section shall be considered supplementary to general provisions for reinforced concrete works.

Handling Storage :

The precast units shall be stored as directed by the Engineer. The area intended for the storage of precast units should be surfaced in such a way that no unequal settlement can occur.

To prevent deformation of slender units, they should be provided with supports at fairly close intervals and should also be safeguarded against tilting. Lifting and handling positions should conform to the Engineer's directions and drawings. In addition, location and orientation marks should be put on the members, as and where necessary. During erection the precast units should be protected against damage caused by local crushing and chafing effects of lifting and transport equipment.

Temporary Supports and Connections :

Temporary supports provided during erection should take into account all construction loads likely to be encountered during the completion of joints between any combination of precast and in-situ concrete structural elements. The supports should be arranged in a manner that will permit the proper finishing and curing of any in-situ concreting and grouting associated with the precast member being supported when the gaps of joints have to be filled with concrete or mortar. They should first be cleaned and faces of the joints should be wetted. The mixing, placing and compacting of cement and mortar should be done with special care. Mortar of a dry consistency should be in the proportion of 1 part of cement to 1 1/2 parts of sand and should be placed in stages and packed hard from both sides of the joint.

Tolerances :

The following tolerances apply to finished precast products at the time of placement in the structure. The forms must be constructed to give a casting well within these limits :

1 Overall dimensions of members should not vary more than
+ 6mm per 3m length with a maximum variation of + 20mm.

2 Cross-sectional dimensions should not vary more than the following :
+ 3mm for sections less than 150mm thick
+ 4mm for sections over 150mm & less than 450mm
+ 6mm for sections over 450mm to 1000mm
+ 10mm for sections over 1000mm

3 Deviation from straight line in long sections should not be more than + 6mm up to 3m, + 10mm for 3m to 6m, + 12mm for 6m to 12m.

29 Steam Curing :

Before the concrete products are subjected to any accelerated method of curing, the cement to be used shall be tested in accordance with accepted standards (relevant IS codes) especially for soundness, setting time and suitability for steam curing.

In the case of elements manufactured by accelerated curing methods, concrete admixtures to reduce the water content may be allowed to be used. The normal aeration agents used to increase the workability of concrete shall not be allowed.

The steam curing of concrete products shall take place under hoods, under chambers or in tunnels. Use of insulated tarpaulin may be permitted. The steam shall have a uniform quality throughout the length of the member. The precast elements shall be stacked with sufficient clearance between each other and the bounding enclosure, so as to allow proper circulation of steam.

The surrounding walls, the top cover and the floor of steam curing chamber or tunnel or hood shall be so designed as not to allow more than 1 kcal/m^2/h/ deg C.

The inside face of the steam curing chamber, tunnel or hood shall have a damp-proof layer to maintain the humidity of steam. Moreover, proper slope shall be given to the floor and the roof to allow the condensed water to be easily drained away. At first, when steam is let into the curing chambers, the air inside shall be allowed to go out through openings provided in the hoods or side walls which shall be closed soon after moist steam is seen jetting out.

Preferably, steam should be let in at the top of the chamber through perforated pipelines to allow uniform entry of steam throughout the chamber. In no case shall steam impinge directly on concrete products.

The fresh concrete in the moulds shall be allowed to get the initial set before allowing the concrete to come into contact with steam. The regular heating up of fresh concrete product from 20 °C to 35 °C

shall start only after a waiting period ranging from 2 to 5 hours depending on the setting time of cement used.

The second stage in steam curing process shall be to heat up the concrete elements, moulds and the surroundings in the chamber. The air-space around the member shall be heated up to a temperature of 75°C to 80°C at a gradual rate, not faster than 30° per hour.

This process shall continue 1 1/2 to 2 1/2 hours depending upon the outside temperature.

The third stage of steam curing shall be to maintain the uniform temperature and pressure for a duration depending upon thickness of the section. This may vary from 3 to 5 1/2 hours.

The fourth stage of steam curing shall be the gradual cooling down of concrete products and surroundings in the chamber and normalization of the pressure to bring it at par with the outside air. The maximum cooling rate, which is dependent on the thickness of the member, shall not exceed 30° per hour.

In all these cases, the difference between the temperature of the concrete product and the outside temperature shall not be more than 60°C for concrete up to M 30 and 75°C for concrete greater than M 45. In the case of light weight concrete, the difference in temperature shall not be more than 60°C for concrete less than M 25. For concrete greater than M 50, the temperature differences may go up to 75°C.

After the steam curing is completed, the elements shall be further water cured for about 3 to 7 days.

30 Ready Mix Concrete and Pumping :

1 Ready-mixed concrete may be manufactured in a central automatic weigh Batching plant and transported to the job in agitating transit mixers.

The maximum size of coarse aggregate shall be limited to one-third of the smallest inside diameter of the hose or pipe used for pumping. Provision shall be made for elimination of over-sized particles by screening or by careful selection of aggregates. To obtain proper gradation it may be necessary to combine and blend certain fractional sizes of aggregates. Uniformity of gradation throughout the entire job shall be maintained.

The quantity of coarse aggregate shall be such that the concrete can be pumped, compacted and finished without difficulty.

2 Fine aggregates :

The gradation of fine aggregate shall be such that 15 to 30 percent should pass the 0.30 mm screen and 5 to 10 percent should pass 0.15 mm screen so as to obtain a pumpable concrete. Sands which are deficient in either of these two sizes should be blended with selected finer sands to produce these desired percentages. With this gradation, sands having a fineness modulus between 2.4 and 2.8 are

generally satisfactory. However, for uniformity, the fineness modulus of the sand should not vary more than 0.2 from the average value used in proportioning.

3 Water, Admixtures and slump :

The amount of water required for proper concrete consistency shall take into account the rate of mixing, length of haul, time of unloading, and ambient temperature conditions.

Additions of water to compensate for slump loss should not be resorted to nor should the design maximum water-cement ratio be exceeded. Additional dose of be retarder be used to compensate the loss of slump at contractor's cost. Retempering water shall not be allowed to be added to mixed batches to obtain desired slump.

4 Transportation :

The method of transportation used should efficiently deliver the concrete to the point of placement without significantly altering its desired properties with regard to water-cement ratio, slump, and homogeneity.

The revolving-drum truck bodies of approved make shall be used for transporting the concrete. The number of revolutions at mixing speed, during transportation, and prior to discharge shall be specified and agreed upon. Reliable counters shall be used on revolving-drum truck units. Standard mixer uniformity tests, conforming to ASTM standards C 94-69 "Standard Specifications for Ready Mix Concrete", shall be carried out to determine whether mixing is being accomplished satisfactorily.

5 Pumping of concrete :

Only approved pumping equipment, in good working condition, shall be used for pumping of concrete. Concrete shall be pumped through a combination of rigid pipe and heavy-duty flexible hose of approved size and make. The couplings used to connect both rigid and flexible pipe sections shall be adequate in strength to withstand handling loads during erection of pipe system, misalignment, and poor support along the lines. They should be nominally rated for at least 3.5 MPa pressure and greater for rising runs over 30 m. Couplings should be designed to allow replacement of any section without moving other pipe sections, and should provide full cross section with no construction or crevices to disrupt the smooth flow of concrete.

All necessary accessories such as curved sections of rigid pipe, swivel joints and rotary distributors, pin and gate valves to prevent backflow in the pipe line, switch valves to direct the flow into another pipe line, connection devices to fill forms from the bottom up, extra strong couplings for vertical runs, transitions for connecting different sizes of pipe, air vents for downhill pumping, clean-out equipment etc, shall be provided as and where required. Suitable power controlled booms or specialized crane shall be used for supporting the pipe line.

6 Field control :

Sampling at both truck discharge and point of final placement shall be employed to determine if any changes in the slump and other significant mix characteristics

occur. However, for determining strength of concrete, cubes shall be taken from the placement end of line.

7 Planning :

Proper planning of concrete supply, pump locations, line layout, placing sequence, and the entire pumping operation shall be made and got approved. The pump should be as near the placing area as practicable, and the entire surrounding area shall have adequate bearing strength to support concrete delivery pipes. Lines from pump to the placing area should be laid out with a minimum of bends. For large placing areas , alternate lines should be installed for rapid connection when required. Standby power and pumping equipment should be provided to replace initial equipment, should breakdown occur.

The placing rate should be estimated so that concrete can be ordered at an appropriate delivery rate.

As a final check, the pump should be started and operated without concrete to be certain that all moving parts are operating properly. A grout mortar should be pumped in to the lines to provide lubrication for the concrete, but this mortar shall not be used in the placement. When the form is nearly full, and there is enough concrete in the line to complete the placement, the pump shall be stopped and a go-devil inserted and shall be forced through the line by water under pressure to clean it out. The go-devil should be stopped at a safe distance from the end of the line so that the water in the line will not spill into the placement area. At the end of placing operation, the line shall be cleaned in the reverse direction.

31 Measurement :

Concrete, formwork and reinforcement shall be paid separately unless otherwise specified.

The volume of concrete measured shall include that occupied by:

1 Reinforcement and other metal sections.

2 Cast in components each less than 0.01 m3 in volume.

3 Rebates fillets or internal splays each less than 0.005 m2 in cross sectional area.

4 Pockets and holes not exceeding 0.01 m3 in volume.

5 For M-10 concrete no payment shall be made for any shuttering used.

6 For concrete for flooring on grade or for roadwork no payment shall be made for any shuttering used. Stone metalling however shall be paid separately.

7 Rates for precast concrete shall include demoulding, handling, storing, transporting and erecting at site, including all clamping, bracing that may be required during erection including erection equipment.

32 Bored Cast in Situ piles

Construction of Bored Cast in situ Piles shall be in accordance with the procedure laid down in IS 2911 (Part I)- Latest editions. Bored Cast in situ piles using minimum 3 no of piling sets to meet the interim milestone of completion of piling work in 100 days

33 Ferrocement Works

The ferrocement consists of armature reinforcement, several meshes, high performance mortar placed in situ,

REINFORCEMENT:
a) Armature Reinforcement
The reinforcement specification is as follows:
Main Reinforcement: This is to be in the form of 8 mm dia TMT steel Fe 500, 6 mm dia Mild Steel round bars and 4 mm dia MS annealed wires.

The reinforcement is to be placed at min 300 mm c/c both ways on the entire skin and even closer at specific locations where more stiffening is required. This will be given in sketches from time to time.

b) Skeletal Mesh Reinforcement:
1) Welded wire mesh of 100mm x 100 mm mesh size and thickness of wire 10 SWG – GI in suitable widths- To be used in single layer
2) Woven Wire Mesh ½" x ½" x 19 G GI in suitable widths- To be used in single layer
3) Galvanised Iron (GI) hexagonal mesh of 12 mm mesh size with wires of 24 gauge, to be used in double layer on the outer face and single layer on the inner face

c) Binding wire : GI binding wire of 24 Gauge

MORTAR:

Mortar Constituent:
A) CEMENT: OPC Conforming to IS 269-1976 – Preferably 43 grade or PPC cement of ACC Suraksha or equivalent. (53 grade cement is not to be used)
B) SAND: Conforming to IS 383-1970 with following grading (as per zone II) The sand should be made by crushing the natural stone such as basalt. The fines & dust (less than 150 microns) in the crushed sand should be removed . In case river sand is used then it should be free of dust and organic matter. Silt content in natural river sand should not exceed 2% by volume. River sand should be invariably washed using a drum or brick enclosure with fine wire mesh at the drain hole.
C) ADMIXTURE: Fiber reinforced Polymer may be added if required
Mortar Mix:
Recommended mortar mix is as follows:
50 kg cement
90 kg crushed/ river sand
10 kg Fly ash
17.5 to 20 kg water

PROCEDURE OF CASTING
1. Prepare the reinforcement cage of main steel and weld mesh + woven mesh + hexagonal mesh as per the detail sketch.
2. The profile of the cage is to be checked by the Architects before any mortaring is undertaken.
3. Provide 12 mm plywood backing plank and ballies held temporarily into the structural framing ribs to prevent any deflection during casting. Prepare holes in the rib beams at top by separating out the

mesh reinforcement. These openings should be at about 600 mm c/c along the ribs to facilitate pouring of concrete in ribs.

4. Prepare the dry mortar mix (cement + sand + fly ash). Then take water in a container and add powder mix slowly to water while stirring with mortar mixer stirrer. Mixing should be done for a minimum of 5 minutes after water addition. Water content should be so adjusted that the mix is stiff.
5. Place the mortar with trowel on reinforcement cage of the ribs in first operation. The rib skin is to be mortared from inside. and squeeze it. (Mortar should not be splashed against the mesh as is the practice in plastering). The thickness of this first layer of mortar (which will just cover the mesh reinforcement should be 15 (+/- 2) mm. Keep the outer surface of mortar unfinished.
6. After 24 hours of rib mortaring, pour M20 concrete (1:1.5:3), volume batched with max aggregate size of ½", into the ribs and using rods ensure that all the ribs are filled properly. The top skin of the ribs should not be embedded in concrete. It should be free for final mortating from top. Slump of concrete is to be medium (10 cm).
7. Repeat operation 5 above from main ferrocement skin after 24 hour of rib casting. This skin mortaring should be done in 2 or three operations depending upon the contractor's convenience. The main skin cage reinforcement can be mortared first (of about 15 mm thk) followed by finishing from top and bottom of 5-7 mm each. Between each layer a bonding coat of 1 part MONOBOND+ 1 part water + 2 parts cement should be applied. In case it is convenient the operation can be done in two layers. The rib outer face to be finished along with inner side finish of ferrocement skin.
8. Use an orbital sander with a wooden plate to vibrate the mix thoroughly against the backing. No conventional vibrator is suitable for this operation. The casting should be done in a continuous operation as far as possible and afternoon mortaring from 12 to 4 PM should be avoided. The outer surface should be finished to desired profile and then within 2 hours surface laitance should be taken out with nylon brush.

CURING

The ferrocement has to be covered with wet hassian cloth after 3 hours and to be maintained moist by watering periodically. Lay polythene sheet over hessian sheet to help retain the moisture. Curing to be done by spraying water periodically from inside. Curing to continue for 14 days

Design & Guarantee

The work being highly specialized ,the craftsmen/specialized agency is responsible for reinforcement design, stability and undertake the same at their end. They shall be responsible for the same. They should handover liability certificate and guarantee of the works with respect to structural stability, workmanship to main contractor who shall then submit works guarantee to owner, architect & structural consultant.
The agency shall also repair and maintain any cracks/defects arising out for period of defect liability period.
The tenderer is required to take signed letters/undertaking from the specialized agency regarding the above and handover the undertaking on his behalf to Architect ,structural consultant and the client.

Mode of Measurement:

The work shall be measured and paid in Square metres. One side surface exposed to be measured and paid. Incase of curved surface, area along the curved surface to be measured and paid.

SECTION – E : FORM WORK

1 Definition :

The term "Formwork" or "Shuttering" shall include all forms, moulds, sheeting, shuttering planks, walers, poles, posts, shores, struts and strutting, ties, uprights, wallings, steel rods, bolts, wedges and all other temporary supports to the concrete during the process of setting.

2 Materials :

1 All facing formwork to come in contact with concrete in different elements of the structure shall be of such material and size as specified on drawings or as instructed by the Engineer.

2 Timber facing formwork to come in contact with concrete for "Exposed Concrete Surfaces" shall consist of lap-jointed or tongue and grooved planks as directed by the Engineer and no joint shall permit leakage of mortar at all from cast-in-situ concrete.

3 The materials for other backing and supporting formwork and their sizes shall be selected by the Contractor and shall be subject to the approval of the Engineer.

3 Design :

The formwork shall be designed and constructed so that the concrete can be properly placed and thoroughly compacted to obtain the required shape, position and level subject to specified tolerances. It is the responsibility of the Contractor to obtain the results required by the Engineer, whether or not some of the work is sub-contracted. Approval of the proposed formwork by the Engineer will not diminish the Contractor's responsibility for the satisfactory performance of the formwork, nor for the safety and co-ordination of all operations.

4 Formwork for Exposed Concrete Surfaces :

The facing formwork, unless indicated otherwise on drawings, or specifically approved by the Engineer in writing, shall generally be made with materials not less than the thickness mentioned below for different elements of the structure :

1 Plain slab soffits, and sides of beams, girders, joists and ribs and side of walls, fins, parapets, pardis, sun-breakers, etc shall be made with :

a Steel plates not less than 3mm thick of specified sizes stiffened with a suitable structural framework, fabricated true to plane with a tolerance of +/- 2mm within the plate,

b Timber planks of 20mm actual thickness and of specified surface finish, width and reasonable length,

c Plywood plates not less than 12mm thick (IS:4990 - Specification for Plywood for Concrete Shuttering Work) or 3mm thick with a 20mm timber plank backing, of specified sizes stiffened with a suitable timber framework.

2 Bottoms of beams, girders and ribs, sides of columns shall be made with :

a Steel plates not less than 5mm thick of specified sizes stiffened with a suitable structural framework, fabricated true to plane with a tolerance of +/- 2mm within the plate,

b Timber planks of 35mm actual thickness and of specified surface finish, width and reasonable length,

c Plywood plates not less than 12mm thick, of specified sizes stiffened with a suitable timber framework.

5 Erection of Formwork :

The following shall apply to all formwork :

1 To avoid delay and unnecessary rejection of the Contractor shall obtain the approval of the Engineer for the design of forms and the type of material used before fabricating the forms. (ref. ACI 347 Formwork for Concrete or equivalent I.S. Code).

2 All shutter planks and plates shall be adequately backed to the satisfaction of the Engineer by a sufficient number and size of walers or framework to ensure rigidity during concreting. All shutters shall be adequately strutted, braced and propped to the satisfaction of the Engineer to prevent deflection under deadweight of concrete and superimposed live load of workmen, materials and plant, and to withstand vibration. No joints in props shall be allowed.

3 Vertical props shall be supported on wedges or other measures shall be taken where the props can be gently lowered vertically during removal of the formwork. Props for an upper story shall be placed directly over those in the storey immediately below, and the lowest props shall bear on a sufficiently strong area. Care shall be taken that all formwork is set plumb and true to line and level or camber or better where required and as specified by the Engineer.

4 Provision shall be made for adjustment of supporting struts where necessary. When reinforcement passes through the formwork care should be taken to ensure close fitting joints against the steel bars so as to avoid loss of fines during the compaction of concrete.

5 If the formwork is held together by bolts or wires, these shall be so fixed that no iron will be exposed on surfaces against which concrete is to be laid. In any case wires shall not be used with exposed concrete formwork. The Engineer may at his discretion allow the Contractor to use tie-bolts running through the concrete and the Contractor shall decide the location and size of such tie-bolts in consultation with the Engineer. Holes left in the concrete by these tie-bolts shall be filled as specified by the Engineer at no extra cost.

6 Provision shall be made in the shuttering for beams, columns, and walls for a port hole of convenient size so that all extraneous materials that may be collected could be removed just prior to concreting.

7 Formwork shall be so arranged as to permit removal of forms without jarring the concrete. Wedges, clamps and bolts shall be used wherever practicable instead of nails.

The formwork for beams and slabs shall be so erected so that forms on the sides of the beams and the soffit of slabs can be removed without disturbing the beam bottoms or props under beams.

8 Surfaces of forms in contact with concrete shall be oiled with a mould oil of approved quality or clean diesel oil. If required by the Engineer the contractor shall execute different parts of the work with different mould oils to enable the Engineer to select the most suitable. The use of oil which results in blemishes of the surface of the concrete shall not be allowed. Oil shall be applied before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being placed in position. The formwork shall be kept thoroughly wet during concreting and the whole time that it is left in place.

9 Immediately before concreting is commenced, the formwork shall be carefully examined to ensure the following :

a Removal of all dirt, shavings, sawdust and other refuse by brushing and washing.

b The tightness of joints between panels of sheathing and between these and any hardened core.

c The correct location of tie bars, bracing and spacers, and especially connections of bracing.

d That all wedges are secured and firm in position.

e That provision is made for traffic on formwork not to bear directly on reinforcing steel.

10 The Contractor shall obtain the Engineer's approval for dimensional accuracies of the work and for the general arrangement of propping and bracing. (IS:3696 - Safety Code of Scaffolds and Ladders, IS:4014 Steel Tubular Scaffolding I & II) It is imperative that for scaffolding heights of 3.6m and above timber posts or steel scaffolding be used with adequate bracings at several levels in each perpendicular direction connecting each prop. In addition to this diagonal bracing should be provided in elevation ideally at 45 degrees on between 30 and 60 degree. Bracings with bamboos will not be permitted. When timber posts are used the bracings shall consist of minimum 25mm thick wooden planks fixed to each post with at least two nails. The contractor shall be entirely responsible for the adequacy of propping, and for keeping the wedges and other locking arrangements undisturbed through the decentering period. (IS 8989 safety code for erection of concrete framed structures)

11 Formwork shall be continuously watched during the process of concreting. If during concreting any weakness develops and formwork shows any distress the work shall be stopped and remedial action taken.

6 Exposed Concrete Work :

Exposed concrete surfaces shall be smooth and even, originally as stripped without any finishing or rendering. Where directed by the Engineer, the surface shall be rubbed with carborundum stone immediately on striking the forms. The Contractor shall exercise special care and supervision of formwork and concreting to ensure that the cast members are made true to their sizes, shapes and positions and to produce the

surface patterns desired. No honeycombing shall be allowed. Honeycombed parts of the concrete shall be removed by the Contractor as directed by the Engineer and fresh concrete placed without extra cost, as instructed by the Engineer. All materials, sizes and layouts of formwork including the locations for their joints shall have are prior approval of the Engineer or the Architect.

7 Camber :

Forms and false work shall be generally cambered as indicated in the drawings or as instructed by the Engineer. However, for beams up to 5m span and slabs up to 4m span camber is not normally required to be provided.

8 Tolerances :

In accordance with IS:456.

9 Age of Concrete at Removal of Formwork :

In accordance with IS:456.

The Engineer may vary the periods specified in IS:456 if he considers it necessary. Immediately after the forms are removed, they shall be cleaned with a jet of water and a soft brush.

10 Stripping of Formwork :

Formwork shall be removed carefully without jarring the concrete, and curing of the concrete shall be commenced immediately. Concrete surfaces to be exposed shall, where required by the Engineer, be rubbed down with carborundum stone to obtain a smooth and even finish. Where the concrete requires plastering or other finish later the concrete surface shall be immediately hacked lightly all over as directed by the Engineer. No extra charge will be allowed to the Contractor for such work on concrete surfaces after removal of forms.

11 Repropping :

For multistoried buildings the floors may need repropping to support the loads of the upper floors under construction. The extent of such repropping shall be as directed by the Engineer (this does not normally exceed one fourth of the props provided above). Such repropping shall not be paid for separately and the cost of such repropping shall be deemed to have been included in the rates.

12 Reuse of Forms :

The Contractor shall not be permitted reuse of timber facing formwork brought new on the works more than 5 times for exposed concrete formwork and 8 times for ordinary formwork. 5 or 8 uses shall be permitted only if forms are properly cared for, stored and repaired after each use. The Engineer may in his absolute discretion order rejection of any forms he considers unfit for use for a

particular item, and order removal from the site of any forms he considers unfit for use in the Works. Used forms brought on the site will be allowed proportionately fewer uses as decided by the Engineer. Use of different quality boards or the use of old and new boards in the same formwork shall not be allowed.

13 Hacking-Out :

Immediately after removal of forms, the concrete surfaces to be plastered shall be roughened with a bush-hammer or with chisel and hammer as directed by the Engineer to make the surfaces sufficiently coarse and rough to provide a key for plaster.

14 Formwork for Prestressed Concrete :

1 The provisions in this section shall be considered supplementary to the general provisions stated above. Precast concrete members and panels shall be made in accurately constructed moulds, on a properly prepared casting bed. All aspects of the making, curing and erection of precast units shall be subject to the approval of the Engineer.

2 The formwork should be so designed that it does not restrain the shrinkage movements and possible shortening due to prestress of the concrete. The formwork shall be of sturdy construction with special considerations to shutter vibrators when used. At edges and joints the formwork should be designed and sealed (as mentioned above in C.6-7b) so that no cement grout can escape and there is no wedging or keying to the concrete. The effect of curing on the formwork should be given special consideration. Depending on care, curing erection and maintenance after stripping, the following number of uses can be made with different types of formwork.

Plywood with timber
backed formwork - 6 to 10 uses
Steel moulds - 50 to 100 uses

In cases concrete moulds can be satisfactorily provided by the contractor for the Engineer's approval before use.

3 Stripping :

As soon as the precast units have attained sufficient strength, the formwork shall be stripped. The precast unit shall be lifted uniformly out of the formwork without being subjected to tilting or restraint effects.

15 Measurements :

1 Where formwork is paid for separately, measurements shall be of the area of finally exposed surface requiring shuttering including curves, angles, splays, mitres, bevels, etc. for which no special rate shall be allowed. The rates shall be inclusive of all work connected with provision of formwork, its erection and removal and treatment of the concrete surface immediately after removal of the formwork.

2 No extra payment shall be made for holes to be made in formwork for inserting electrical conduits, hooks for fans, for plumbing work.

3 Where boxes or pockets are required to be formed in the concrete, they will be paid for separately at the Contract Rates, but in measuring the area of concrete surfaces shuttered, no deduction will be made for openings up to 0.4m2. For voids larger than 0.4m2 the surface of formwork forming the voids shall be paid at rates of formwork set out in the Schedule and the area of voids deducted from the face area of shuttering.

4 No deductions shall be made from formwork of main beams where the secondary beam intersects it. Formwork to secondary beams shall be measured up to sides of the main beams. No deduction shall be made from the formwork to stanchion or column casings at intersections of beam.

5 No payment shall be made for temporary formwork used in concreting, nor for formwork required for joints or bulkheads, in floors, or elsewhere, whether such joints are to be covered later with concrete or mastic or other material.

SECTION - F : STEEL REINFORCEMENT

1 Steel :

Steel used in the works shall be either rounds conforming to IS:432, hot rolled deformed bars conforming to IS:1139, Cold twisted bars conforming to IS:1566-1977, or rolled steel made from structural steel conforming to IS:226. Any other steel specified for reinforcement shall conform in every respect to the latest relevant Indian Standard Specifications and shall be of tested quality under the ISI Certification Scheme.

All reinforcement work shall be executed in conformity with the drawings supplied and instructions given by the Engineer and shall generally be carried out in accordance with the relevant Indian Standard Specifications (IS:2502).

2 Inspection & Testing :

Every bar shall be inspected before assembling on the works and any defective, brittle, excessively rusted or burnt bars shall be removed. Cracked ends of bars shall be cut out.

Specimens sufficient for three Tensile Tests for each different size of bar for each consignment delivered, or for 10 tonnes of supply of that size, whichever is less shall be sampled and tested by the Contractor. Batches shall be rejected if the average results of each batch are not in accordance with the specifications.

3 Lapping & Welding :

1 As far as possible bars of the maximum length available shall be used. Laps shown on drawings or otherwise specified by the Engineer will be based on the use by the Contractor of bars of maximum length. In case the Contractor wishes to use shorter bars, laps shall be provided at the Contractor's cost in the manner and at the locations approved by the Engineer.

2 As and when necessary welded laps shall be provided as specified by the Engineer.

4 Spacing, Supporting and Cleaning :

1. All reinforcement shall be placed and maintained in the positions shown on the drawings.

2. The Contractor shall provide approved types of supports as specified on the drawings for maintaining the top bars of the slab in position during concreting. All cover blocks shall be of concrete (not sand cement mortar) and of the same strength as that of the surrounding concrete and properly compacted. They shall be circular in shape and not square.

3. Bars must be cleaned before concreting commences of all scale, rust or partially set concrete which may have been deposited there during placing of previous lift of concrete.

   The bars shall be cleaned with dry gunny bags if they are coated lightly with rust or other impurities. On no account shall the bars be oiled or painted nor shall mould oil used on the formwork be allowed to come in contact with the bars. Cement wash to bars shall not be permitted.

5 Welding :

1. Wherever specified all welding shall be carried in accordance with IS:2571. Only qualified welders shall be permitted to carry out such welding.

2. For cold twisted reinforcement welding operations must be controlled to prevent a supply of large amounts of heat larger than that can be dissipated. The extreme non twisted end portion shall be cut off before welding. Electrodes with rutile coating should be used.

3. The welding procedure shall be approved by the Engineer and tests shall be made to prove the soundness of the welded connection.

6 Measurements :

1. The weight of steel to be paid for at the contract rates shall be the weight of bars as mentioned on the drawings or as instructed by the Engineer including stirrups, ties, spacer bars, chairs and any other steel works specified as reinforcement but excluding binding wire and cover blocks. Laps as specified on the drawings shall be paid for. Laps required because of the contractor's use of shorter bars will not be paid for.

2. The weight of any stirrup, tie bar shall be computed from the dimensions given on the drawings or bending schedules. The weight in kg/metre shall be taken as 0.785 kg/metre per 100mm2 of cross section. The rate shall take into account the rolling margin.

STRUCTURAL STEEL WORKS

1 General :

1 Contractor to Provide :

The Contractor will provide all materials and equipment required to complete the works in every respect, whether such materials are required as part of the permanent structures or temporary for fabrication or erection or maintenance including specifically structural steel plates, flats, bars, welding rods, rivets, bolts and nuts, paint, welding sets in the shop and at site, all workshop facilities, derricks, cranes, pulley blocks, wire ropes, hemp or manila ropes, winches, erection cleats and temporary braces or supports and all other materials required to deliver the Works complete in every respect.

All labour required for fabrication and erection for any cleaning, making good, rectifying, hauling, painting and for any other ancillary work required to complete fabrication and erection.

2 The Contractor shall observe all safety requirements for erection of structural steelwork as covered in IS:7205.

2 Drawings :

1 The Engineer will supply to the Contractor profile drawings showing sizes of all structural members and typical connection details.

2 Should there be any discrepancy in the drawings the Contractor is to refer the matter to the Engineer. The Contractor shall further provide a drawing showing the accurate setting out to line and level of all the anchor bolts intended for the work in sufficient time for their inclusion in the work so as to maintain the building programme.

3 The Contractor is to prepare all the necessary fabrication shop drawings and these shall be submitted to the Engineer in duplicate and be approved by him before fabrication is commenced. All such drawings shall show the dimensions of all parts, method of construction, welding and bolting. A further set of all approved fabrication drawings shall be supplied by the Contractor for use of the Engineer as required.

4 Approval by the Engineer of drawings or any other particulars submitted by the Contractor shall not relieve the Contractor of full responsibility for any discrepancies, errors or omissions therein. The Contractor shall at his own expense supply such additional copies of his working drawings as are required for the use of the interested parties.

3 Material :

1 Structural Steel : All structural steel shall be of tested quality and shall conform to one of the following standards:

IS:226 structural steel (Standard Quality)

IS:2062 Structural steel (Fusion welding quality)
IS:961 High Tensile Structural Steel (Ordinary)

The Contractor shall supply to the Engineer copies of the manufacturers certificate that the steel brought to the site for incorporation in the works is of a quality fully complying with the specification. If required by the Engineer, the Contractor shall arrange for testing of the steel samples as per IS:1608 - 1599.

2 Welding Electrodes : Welding electrodes used for the works shall conform to IS:814/latest and shall be supplied by manufacturer approved by the Engineer and shall be of the grade approved by the Engineer. All Electrodes shall be kept under dry conditions. Any electrode which has part of its flux coating broken away or is damaged shall be rejected.

3 Bolts and Nuts : Bolts and nuts used for the works shall unless otherwise specified be black bolts and nuts supplied by manufacturer approved by the Engineer and shall conform to IS:1367.

4 For all other material required for the works, the approval of the Engineer shall be obtained by the Contractor prior to the use of the material in the works.

4 <u>Workmanship and Fabrication :</u>

1 For all the works, workmanship shall be of first class quality, throughout, in conformity with IS:800-latest, and true to line, level and dimension as shown in the drawings or instructed by the Engineer.

2 All parts assembled for bolting shall be in close contract over the whole surface and all bearing stiffeners shall bear tightly at top and bottom without being drawn or caulked. The component parts shall be so assembled that they are neither twisted not otherwise damaged as specified cambers if any shall be provided. Drilling done during assembling shall not distort the metal or enlarge holes. The butting surfaces at all joints shall be so cut and milled so as to butt in close contact throughout the finished joints.

3 Hand flame cutting will not be permitted.

4 Punching of holes will not be permitted.

5 All welding for the works shall be carried out by first class welders and shall be in accordance with IS:816, IS:819, IS:1024, IS:1261, IS:1323 and IS:9595. The Engineer may at his discretion order periodic tests of the welder and/or of the welds produced by them. All such tests, shall be carried out by the Contractor at his cost.

3 As much work as possible shall be welded in shops. The pieces shall be manipulated to ensure down hand welding for all shop joints as far as possible. All parts to be welded shall be arranged so as to fit properly on assembly. After assembly and before the general welding is to commence the parts are to be tack welded with small fillet or butt welds as the case may be. The tack welding must be strong enough to hold the parts together but small enough to be covered by the general welding. The welding procedure shall be so arranged

that the distortion and shrinkage stresses are reduce to a minimum.

7 All joints required in structure to facilitate transport or erection shall be shown on the drawings or as specified by the Engineer. Should the Contractor need to provide joints in locations other than those specified by the Engineer he shall submit his proposals and obtain the prior sanction of the Engineer for such joints. The lengths of structural shall be the maximum normally available in the market jointing of shorter length in order to make up lengths required shall not be permitted.

8 Each piece of steel work shall be marked distinctly before delivery, indicating the position and direction in which it is to be fixed. Three copies of a complete marking plan are to be supplied to the Engineer before erection commences.

9 In the case of welded fabrication any distortion remaining in the member after welding operations are completed shall be rectified by and/or at the expense of the Contractor to the approval of the Engineer.

10 All members of trusses and lattice girders shall be straight throughout their length, unless shown otherwise on the drawings, and shall be accurately set to the lines shown on the drawings. Sheared edges of gussets or other members to be straightened and dressed where necessary.

11 Templates and jigs used throughout the work shall be all steel. In cases where actual materials have been used as templates for drilling similar pieces, the Engineer shall decide whether they are fit to be used as parts of the finished structure.

5 Testing of Welds :

Crane Girders :

Butt welds in top flanges and webs - 100% radiographic testing (IS:2595) of first six welds and 10% thereafter.

Welding of stiffeners, cover plates to flanges, etc. - Ultrasonic testing (IS:4260) of 1 in 5 positions initially, decreased to 1 in 10 position if failures are less than 1 in 10.

Column, Roof elements, Bracing :

Butt welds - Radiographic testing of 5% of welds.

Fillet welds - Ultrasonic testing of 1 in 20 positions decreased to 1 in 50 if failures are less than 1 in 10.

6 Protection of Steel Works (IS:8629) :

1 Sand blasting where specified shall be carried out in accordance with IS:1477.

2 Painting work shall be carried out in accordance with IS:8629 (Parts I to III).

3 The steel work, prior to delivery, shall be cleaned form scale, rust, dirt and grease etc., but means of chipping, scraping and wire brushing using skilled operators as described in the

painting systems below. The cleaning shall proceed each day over the extent of surfaces which can be painted on that day.

4 Site weld locations shall be left free from paint within 50mm of the weld position, and contact surfaces in connection using High Strength Friction Grip Bolts shall not be painted. Immediately after completion of erection all damaged paint shall be scraped off and made good to the approval of the Engineer.

The Steelwork specialist shall also clean down and apply one coat of primer to all site bolts, site bolted connections and site weld locations and the paint work generally shall be left in sound condition for any subsequent painting.

5 All paints and primers shall be of best quality conforming to the relevant Indian Standards and shall be procured directly from the manufacturers. All paint to be used shall be stored under cover in such conditions as will preserve it from extreme of temperature and the paint shall be used and applied strictly in accordance with the manufacturer's instructions.

6 The painting systems to be used shall be as under :

I	**PAINTING SYSTEM NO : I**	:	Zinc phosphate primer with synthetic enamel finish
	System for application on	:	Structures in the interior parts of the country.
	Service conditions under which painting system shall be used	:	1. Inland characteristics with neither coastal effects nor chlorine pollutants
		:	2. No chlorine industries like petrochemicals, fertilizers, H_2S0_4, etc.
	Surface preparation	:	Manual cleaning to Swedish Std. St-2 by using mechanical tools and wire brushes

Coating System	Specification	D.F.T in Micron	Colour
Primer - Coat 1	High build synthetic medium pigmented with zinc Phosphate primer	50	grey
Primer – Coat 2	– do –	50	grey
Finish – Coat 1	High glass synthetic enamel	25–30	as per shade card
Finish – Coat 2	– do –	25–30	– do –
TOTAL COATS - 2	TOTAL	150 min	

Minimum Expected Life Of The System : 4 Years

II	**PAINTING SYSTEM NO : II**	:	Epoxy primer with chlorinated rubber finish
	System for application on	:	Structures in the coastal areas.
	Service conditions under which painting system shall be used		Highly saline atmosphere High humidity, Average beyond 60%
	Surface preparation	:	Sandblasting to Swedish Std Sa 2 1/2 or manual cleaning to Swedish Std St-2.

Coating System	Specification	D.F.T in Micron	Colour
Primer - Coat 1	Epoxy Resin & Zinc Phosphate	25	brown

Finish – Coat 1	High build Chlorinated Rubber medium with Micaceous Iron Oxide	75	grey
Finish – Coat 2	Plastic Chlorinated Rubber medium suitably pigmented	25	as per shade card
Finish – Coat 3	– do –	25	–do–
TOTAL COATS – 4	TOTAL	150 min	

III **PAINTING SYSTEM NO: III** : Ethyl silicate primer with epoxy finish

System for application on : Structures in the coastal cum heavy industrial pollution areas

Service conditions under which painting system shall be used : 1. Highly saline atmosphere
2. Highly polluted atmosphere due to sulphur/fertilizer or petro chemical pollutants

Surface preparation : Sandblasting to Swedish Std Sa 2½ or manual cleaning to Swedish Std St–2.

Coating System	Specification	D.F.T in Micron	Colour
Primer - Coat 1	Ethyl Silicate with Metallic Zinc (high build)	75	green
Intermediate Coat	Epoxy resin pigmented with MIO (high build)	100	grey
Finish – Coat 1	Pigmented epoxy resin with suitable curing agent (high build)	65	as per shade card
Finish – Coat 2	– do –	65	–do–
TOTAL COATS – 4	TOTAL	305 min	

IVa **PAINTING SYSTEM NO: IV a** : Antisaline metallic primer with bitumen finish

System for application on : Chequered plates, walkways and staircases (outside the buildings) for interior parts of the country

Service conditions under : 1. Inland characteristics with which painting system neither coastal effects nor shall be used chlorine pollutants.
: 2. No chlorine industries like petro chemicals, fertilisers, H_2S0_4, etc.

Surface preparation : Manual cleaning to Swedish Std St-2 by using mechanical tools and wire brushes.

Coating System	Specification	D.F.T in Micron	Colour
Primer - Coat 1	Antisaline metallic primer (bituminous medium with leafing aluminium)	25	Metallic aluminium
Primer – Coat 2	– do –	25	– do –
Finish – Coat 1	Reinforced Bituminous Composition (high build)	100	black
Finish – Coat 2	– do –	100	black
TOTAL COATS – 4	TOTAL	250 min	

IVb **PAINTING SYSTEM NO: IV b** : Zinc phosphate primer with synthetic enamel finish

System for application on : Chequered plates, walkways and staircases for interior parts of the country, but for areas where colour coding would be required.

Service conditions under which painting system shall be used : 1. Inland characteristics with neither coastal effects nor chlorine pollutants

: 2. No chlorine industries like petro chemicals, fertilisers, H_2S0_4, etc.

Surface preparation : Manual cleaning to Swedish Std St-2 by using mechanical tools and wire brushes.

Coating System	Specification	D.F.T in Micron	Colour
Primer - Coat 1	Synthetic medium pigmented with Zinc Phosphate (high build)	50	grey
Primer – Coat 2	– do –	50	grey
Intermediate Coat	Chlorinated Rubber Medium with Micaceous Iron Oxide (high build)	75	grey
Finish – Coat 1	Hi Gloss Synthetic Enamel	25–30	as per shade card
Finish – Coat 2	– do –	25–30	– do –
TOTAL COATS – 5	TOTAL	225 min	

Va **PAINTING SYSTEM NO Va** : Epoxy primer with coal tar finish

System for application on : Chequered plates, walkways and staircases (outside the buildings) for coastal and heavy industrial areas.

Service conditions under which painting system shall be used : 1. Highly saline atmosphere

: Highly polluted atmosphere due to sulphur/fertilizer or petro chemical pollutants

Surface preparation : Manual cleaning to Swedish Std St-2.

Coating System	Specification	D.F.T in Micron	Colour
Primer - Coat 1	Epoxy Resin with Zinc Phosphate	25	brown
Intermediate Coat	Epoxy resin with Coal Tar blend (high build)	150	black
Finish – Coat 1	– do –	150	black
TOTAL COATS – 3	TOTAL	325 min	

Vb	**PAINTING SYSTEM NO Vb**	:	Epoxy primer with synthetic enamel
	System for application on	:	Chequered plates, walkways and staircases for coastal and heavy industrial areas but areas where colour coding would be required.
	Service conditions under which painting system shall be used	:	1. Highly saline atmosphere
		:	2. Highly polluted atmosphere due to sulphur/fertilizer or petro chemical pollutants
	Surface preparation	:	Manual cleaning to Swedish Std St-2.

Coating System	Specification	D.F.T in Micron	Colour
Primer - Coat 1	Epoxy Resin with Zinc Phosphate	25	brown
Intermediate Coat	Epoxy resin pigmented with MIO (high build)	100	grey
Finish – Coat 1	Epoxy resin suitably pigmented	25–30	as per shade card
Finish – Coat 2	– do –	25–30	–do –
Finish – Coat 3	Hi Gloss synthetic enamel	25–30	–do –
TOTAL COATS – 5	TOTAL	200 min	

7 In addition the following specification shall apply to the shop painting of contact and inaccessible surfaces:

a) Surfaces to be painted shall be thoroughly cleaned from scale, rust, dirt, grease etc.

b) Surfaces which are to be brought permanently into close contact or made inaccessible either in the shops or upon erection shall, after cleaning, be given two coats of Red Lead Priming Paint. The surfaces shall be brought into contact while the paint is still wet.

c) Contract surfaces in connection using High Strength Friction Grip bolts shall not be painted or oiled and shall be free from dirt, loosed scale, burrs, pits and any other defects which would prevent the solid seating of the parts and would interfere with the development of friction between them.

d) All enclosed surfaces of box members shall be completely sealed by oiling or by coating with an approved bitumen paint and all such members and tubes shall have their ends closed by suitable plates welded in position.

8 The Contractor shall take all precautions to prevent dust and dirt coming in contact with freshly painted surfaces or with surface being painted. The second coat of paint shall only be applied when the first coat has dried.

7 Erection & Site Work :

1 The Contractor shall be responsible for checking the alignment and level of foundation and correctness of foundation bolt centres, well in advance of starting erection work, and shall be responsible for any consequences for non-compliance thereof. Discrepancies if any shall immediately be brought to the notice of the Engineer for his advice.

2 During erection the rough handling of fabricated materials such as bending, straining or pounding with sledges shall be avoided. Any damage to the structure during transportation or erection shall be immediately rectified by the Contractor at his own cost. The straightening of bend edges of plates, angles and other sections shall be done by methods which will not cause fracture.

Following the completion of the straightening, the surface of the member shall carefully be inspected for damage and got approved by the Engineer before further use.

3 The Contractor shall be responsible for accurately positioning, leveling and plumbing of all steelwork and placing of every part of the structure in accordance with the approved drawings and to the satisfaction of the Engineer. All stanchion base, beam and girder bearings etc. shall be securely supported on suitable steel packs. All reference and datum points shall be fixed near the work site for facilitating the erection work.

4 All equipment used by the Contractor shall be sufficient for the purpose and for the erection of the steel work, in the time specified in the contract. Any lifting or erecting machinery shall be to the approval of the Engineer and shall be removed from the site if he considers such appliances dangerous or unsuitable for their functions. The approval of the Engineer shall not relieve the Contractor of the responsibilities for the loads to which the erection equipment shall be called upon to carry. Adequate arrangement shall be made to resist wind loads and lateral forces arising at the time of erection.

5 The Contractor is entirely responsible for the stability of the structure during erection and shall arrange that sufficient tack bolts, braces or guy ropes are used to ensure that work will remain rigid until final bolting, rivetting or welding is completed. The Contractor shall supply and fix, without extra charge, any temporary bracing which may be necessary.

6 All steelwork shall be erected in the exact position as shown on the drawings. All vertical members shall be truly vertical throughout and all horizontal members truly horizontal, fabrication being such that all parts can be accurately assembled and erected. No permanent bolting, welding or grouting shall be done until proper alignment has been obtained.

7 At stanchion splices and at other positions where concrete cover to the steel is liable to be restricted, bolts will be placed with their heads on the outside of the members.

8 All field assembly bolting and welding shall be executed in accordance with the requirements for shop fabrication excepting such as manifestly apply to shop conditions only. Where steel has been delivered painted the paint shall be removed before field welding for a distance of at least 50mm on either side of the joints. The number of washers on permanent bolts shall not be more than two for the nut and one for the bolt head.

8 Rectification of damaged materials :

Any error in shop work which prevents the proper assembly and lifting up of the parts by moderate use of drift pins or reaming or cutting shall be immediately reported to the Engineer and his approval of the method of rectification obtained in writing. Wrongly fabricated material whose erection in the field necessitates extra work shall be the responsibility of the contractor. The entire costs of such operation including the replacement of defective members, if required, shall be borne by the contractor.

9 Inspection :

1 The contractor shall inform the Engineer of the progress in fabrication and as to when individual pieces are ready for inspection. All gauge templates necessary to satisfy the Engineer shall be supplied by the contractor. The Engineer may at his discretion check the results obtained at the contractor's works by independent tests and should the material so tested be found unsatisfactory, the cost of such tests shall be borne by the contractor.

10 Grouting of steel bases :

1 Before grouting of stanchion bases, the contractor shall take the following action :

a Inform the Engineer.
b Clean all holes, openings, recesses and the top of foundations of all dirt, mud, water, oil or other extraneous matter.
c A frame shall be placed in position around the base plate with a provision for placing or injecting grout.
d The contractor shall provide screed bars or mild steel flats and fix them in mortar.
e Holes shall be provided on the stanchion bases for escape of air.

2 Grouting of steel beams, steel stanchions, bases and bearings and encasement of steelwork will be carried out by the contractor after the steelwork has been finally aligned and leveled and approval of the Engineer obtained.

3 The bolt sleeves shall be grouted as a separate operation using neat cement grout of a creamy consistency, which shall be poured in so as to completely fill the holes. "Non-shrink" cements, additives of approved makes shall be used for all grouting operations.

4 The space between the top of the foundations and the underside of the base plate shall be completely filled with a mix 1:2 cement sand mortar and finished flush with edge of the base plate, either :

a Mixed as a stiff mortar well rammed into place from all sides.

b Mixed as thickly as possible consistent with fluidity and poured under a suitable head and tamped until the space has been properly filled.

11 Holding down and Anchor bolts :

1 The holding down and anchor bolts should conform to the requirements laid down in IS:624 or as directed by the Engineer.

2 Installation : Individual bolts in groups of holding down bolts shall be positioned accurately within a tolerance of + 6mm. The bolts shall be set vertically to a tolerance of not more than 1 in 250.

3 During the casting of concrete the contractor shall ensure that space between the bolt and sleeves is kept clean after removal of shuttering. The contractor shall provide and fix timber plugs to maintain this space in a clean condition. The projecting threads of bolts shall be protected by approved wrapping materials.

4 Grouting of bolt tubes shall be carried out after the steelwork or equipment have been aligned, plumbed and leveled.

12 Tolerances :

1 All tolerances shall be in accordance with IS:7215 unless otherwise specified.

2 The maximum deviation for line and level shall be + 3.0mm for any part of the structure including for location of column centres.

3 The maximum deviation from plumb for columns shall be + 3.0mm in 10.0m height subject to a maximum of +6.0mm in a total height of 30.0m.

4 The deviation at the centre of the upper chord member from vertical plan running through the centre of the bottom chord shall not be more than 1/1500 of span but in no case more than 10.0mm. The lateral displacement of top chord at centre of span form vertical plane running through centre of supports shall not be more than 1/250 of the depth of truss but in no case more than 20.0mm.

5 The crane rails shall not deviate from the true location by more than + 2.0mm.

13 Mode of measurement :

1 The pricing must include for all rolling margins, extras for length and size, allowance for waste, complete fabrication, delivery and erection, and caulking the gap between base plate and foundation, and primer coats of paints as specified. The final coats of paints, however, will be measured and paid separately on the basis of tonnage fabricated and erected.

2 Any temporary strutting, tieing or anchor bolts, black bolts, fasteners, welding required to withstand the stresses of erection and carrying of plant are to be included in the price.

3 The payment for the steelwork will be for the weight of the steelwork actually erected, i.e. plates, rolled sections, shear connections, cleats, splice plates.

Dimensions of the steelwork will be taken on site or from the actual shop working drawings as preferred by the Engineer. In calculating the weights of gusset plates, payment will be made for the least enclosing parallelogram or triangle. For structural sections the weight will be calculated on lengths actually used with no deduction for splay cut or mitred end. In case of imported sections, the weights chargeable shall be the weight according to the relative standards of the country of origin. Full weight of the bolts and nuts will be paid for as per Indian Standard Codes weights without any deduction for shanks, etc. No account

shall be taken of the weight of weld in calculating the weight of steelwork. Erection packing plates bedded in mortar and wedges shall not be measured but shall be included in the rates. No deduction shall be made for openings less than 0.1m2 in area measured in plane for bolt holes. The weight of sheet steel, plate, strips and rolled sections shall be taken from relevant Indian Standards.

4 Unless otherwise specified, foundation and anchor bolt assemblies shall be measured separately
including nuts and washers.

SECTION-G

PLASTERING AND PAINTING

1 General :

All plaster work shall comply to IS-1661 (Application of cement and cement lime plaster finishes). The cement shall be ordinary Portland cement conforming to IS:269. The lime shall conform to IS-712 (Building limes). The sand shall conform to IS-1542 (sand for plaster). The sand shall not contain any particle larger than 3mm and shall be washed before use.

2 Preparation Of Surfaces :

1 Concrete surfaces shall be roughened by wire brushing, hacking, or bush hammering or chiseling. If the Engineer is not satisfied with the roughening achieved by these methods he may order other methods such as washing with acid etc.

2 Loose layers of dust etc. on surfaces to be plastered shall be washed. The surface shall be cleaned to remove oil, paint or any other material that might interfere with satisfactory bond and saturated with water so as to be damp when the plaster is applied.

3 To avoid cracks at the junction of concrete with brickwork the plaster shall be reinforced at such junctions by fixing GI Expanded Metal Mesh.

GI expanded metal of approximate size 20mm x 50mm consisting of 2.4mm width and 1.25mm thick strands, weighing approximately 2.35 kg/ sq.m. shall be laid over the joints, formed between concrete and masonry work, after one coat of plaster dash. The metal should be equally distributed on either side of joints and fixed with the help of
GI 3.14 mm U nails with GI washers at 80mm c/c on each sides. Overlapping of atleast 75mm is allowed in the joints of expanded metal. All the expanded metal shall be laid within the thickness of final plaster.

GI expanded metal shall be measured and paid on square metre basis which includes all cost of materials and scaffolding. The cost of plaster dash is included in plastering.

3 Slaking Lime :

1 All impurities, ashes or pieces improperly burnt shall be screened or picked out and then slaked not less than one week nor more than two weeks before use. The slaked lime shall be screened through IS 240 sieve for mortars used for first coat or through IS:120 sieve for mortars used in subsequent coats. The slaked lime shall be stored in a weather proof shed with a impervious floor (IS:712). The lime shall be used when fresh. The lime shall be kept wet for at least six days in a water tank (or drums) before using.

4 Neeru:

"Run" lime shall be allowed to mellow for at least 10 days in a tank or drums. The surplus water on top shall be allowed to run off and the top layer of lime formed into putty shall be skimmed off and well mixed with sand and jute in the proportion of 4 cu.m of lime putty to 1 cu.m of fine washed

sand (passing sieve No 25) and fine chopped jute at the rate of 5 kgs per every cubic metre of mortar, and the mixture properly ground to a paste.

5 Proportioning :

1 The materials used in the preparation of plaster may be measured either by volume using gauge boxes or by weight. The mix proportion of lime, unless otherwise stated generally refers to the volume of putty.

2 Cement and Sand Plaster :
Cement and sand shall be mixed dry in the required proportions to obtain a uniform colour. Water shall then be added to get the required consistency for the plaster.

3 Cement-lime-plaster :
Lime putty and sand shall be mixed dry in the required proportions and kept protected from drying out till the time of use. The required quantity of cement shall then be added and the whole mass thoroughly mixed. Water shall be added if necessary but only to the minimum extent required to give a working consistency for the plaster.

4 Mixing shall be done mechanically in "Mortar Mill". If hand mixing is allowed by the Engineer, mixing shall be carried out on a clean, water tight platform protected from sun and rain.

6 Application:

1 Patches of plaster 150mm x 150mm shall be placed about 3m apart as gauge to ensure even plastering. The mortar shall be firmly applied in a thickness slightly more than the required thickness and well pressed into the joints, rubbed and leveled with a flat wooden rule to required thickness.

2 All plastering shall be made good up to metal or wooden frames, skirtings and around pipes or fittings.

3 For internal plastering, scaffolding shall be erected independent of walls. No members of scaffolding shall be allowed to be housed in the walls being treated with plaster. Scaffolding for external plaster shall also be supported independent of walls as far as possible to avoid patchy appearance.

7 Wetting & Curing :

Surfaces to be plastered shall be profusely watered well in advance before plastering so as to keep the surface damp. Plastered surfaces shall be kept thoroughly wet by sprinkling water for at least 7days as directed by the Engineer.

Surface with craziness or cracks shall be rejected and the contractor shall dismantle such plaster forthwith and apply plaster all over again.

8 Type of Plaster :

1 Neeru finished plaster :

Lime gauged plaster of the proportion 1 cement to 2 lime to 9 sand or cement mortar as specified shall be applied to surfaces to be plastered to a uniform thickness of 18mm and shall be trowelled to a fair and uniform surface without any depressions. Neeru shall then be applied to a uniform thickness of 3mm and thoroughly trowelled. This trowelling process shall continue the succeeding day also to get a smooth surface. The plastered wall shall be kept thoroughly wet by sprinkling water for 7 days when plaster starts drying. One coat of lime wash shall be given on all neeru finished surfaces after 10 days to prevent hair cracks.

2 Sand faced plaster :

The sand faced plaster shall be applied in two coats. The first coat (base coat) shall be of proportion 1:4 and approximately 15mm thick. The base coat shall be trowelled hard so as to ensure a permanent bond. The surface of the base shall be thoroughly combed so that 3mm deep grooves at 12mm apart are formed when the mortar is in the plastic stage. The base coat shall be cured for at least two days.

The second coat shall be applied with the mortar of same proportion but 6mm thickness. The mortar shall contain sand with slightly larger proportion of coarse material. The surface shall be finished with a wooden float, and trowelled to get a uniform surface.

A sponge dipped in cement water shall be used with a circular motion to get the sandy appearance.

3 Cement & Sand Plaster Smooth Finished :

The cement mortar of the proportions 1 cement to 4 sand shall be applied on all the walls brick or concrete surfaces specified to a uniform thickness of about 12mm and shall be trowelled smooth using a wooden float. Use of dry cement to obtain smooth finish will trowelling shall not be permitted. Care should be taken to ensure that the plastered surface does not dry out too quickly and also it is not over trowelled, in order to avoid craze cracks.

4 Rough cast Cement Plaster :

The joints shall be raked out as for plaster. The cement shall be thoroughly mixed dry with sand and gravel to pass through a 6mm mesh but not through 2mm in the proportion of one part of cement, two parts of sand and one part gravel. Water shall be gradually added to make the mixture homogenous. No more mixture shall be prepared than can be used within half an hour. The mixture shall be dashed against the surface to a thickness of 20mm and finished in level.

5 Pebble Dash Cement Plaster :

This shall be same as rough cast cement plaster but gravel shall be replaced with round pebbles to pass through 12mm mesh and the thickness of plaster shall be 25mm.

9 Pointing :

The joints of the masonry either brick or stone to be flat pointed shall be raked to a depth of about 20mm while the mortar in the joint is still fresh and the joints shall be kept well wetted till the pointing is done. The mortar for the pointing shall consist of one part cement and two parts sand and shall be applied to wetted joints uniformly. The joints of the pointed work shall be regular and uniform in breadth. The edges of the pointing shall be cut off parallel so as to leave well defined lines about 200mm apart. The pointing shall be kept well wetted for five days after the pointing is done.

10 Measurement :

The quoted rates shall include the preparation of surfaces, erection and dismantling of scaffolding, materials, labour, curing, all tools and equipment required to complete the plaster work in all respects.

The plastered and pointed surfaces shall be measured and paid on an area basis (m2) for the area actually plastered in accordance with IS:1200. No separate payment shall be made for coving and finishing around skirting, door and window frames.

WHITE WASHING, COLOUR WASHING, DISTEMPERING, PAINTING

1 White Washing and Colour Washing :

1 White washing and colour washing shall in general comply with IS:6278 latest. Only freshly burnt fat lime of good quality from unburnt stone and other foreign matter shall be used, slaking shall be done at site with an excess of water and the lime allowed to remain under water for two days. The mixture of lime and water shall then be drawn off, placed in a suitable receptacle and clean fresh water added to bring it to the consistency of thin cream. The wash so prepared shall be strained through a coarse cloth or fine sieve and mixed with gum water. The quantity of gum to be used shall be at the rate of 2 Kg/m3.

2 The surface to be white or colour washed shall be thoroughly broomed down so as to remove all dust and holes if any shall be stuffed with materials similar to the surface.

3 Three coats of white wash shall be applied with proper fibre brushes. Each coat must be allowed to dry and will be subject to inspection before the next coat is applied.

4 The colour wash shall be prepared by adding a solution of water and lime fast pigment boiled if directed to the lime wash prepared as above which shall be done gradually and stirred until the required tint is obtained.

5 For all colour wash, a sample must first be applied, allowed to dry and approved by the Engineer-in-charge before the work proceeds. Even colour must be obtained. Three coats are to be given. Patchy or streaky work will be rejected and will be re-executed at the contractor's expense.

2 Distempering or Painting with Oil Bound Water Paints etc :

1 Distemper, washable, shall comply with IS:427 or 428 latest. Ready mixed washable distemper of an approved brand shall be used. Preparation of distemper from ingredients by the Contractor shall not be allowed. The tint of distemper shall be as directed by the Engineer-in-charge and a sample application of it shall be made by the contractor if so desired.

2 The surface shall be cleaned and all cracks, holes, irregularities etc shall be repaired to get a smooth and even surface. It shall be completely dry and dust-free before commencement of distempering.

3 Waterproof Cement based Paints IS-5410 :

1 The waterproof cement paint shall be of an approved manufacturer such as Snowcem, Oricem or Super Snowcem, or other equivalent and approved and shall be brought to the site in original airtight containers with seal intact.

Preparatory work :

Surfaces shall be thoroughly cleaned free from dirt, dust, etc by
brushing and washing down with clean water. Any grease, oil paint, varnishes and oil bound washable distemper shall be removed by means of an approved paint remover.

3 Mixing and application :

The dry cement paint shall be thoroughly mixed with clean fresh water so as to produce a paint of required consistency which for normal work shall be of ordinary paints. In mixing and application, the contractor shall conform to manufacturer's instructions.

Paint for application by brush shall be strained through a paint strainer and paint for spraying shall be twice strained.

The paint shall be kept stirred during use and no paint which has been mixed for a period longer than one hour shall be used.
The paint to surface other than rough cast may be applied by means of brushes or spraying with low pressure pot sprayer. Spraying, however, may only be carried out if the Engineer-in-charge approves. The paint applied to roughcast surface shall be by means of spraying.

Absorbent surface shall be thoroughly dampened so as to give even suction. In dry weather freshly painted surfaces shall be kept damp for at least 2 days and protected from the sun.

When more than one coat is ordered, subsequent coats shall not be applied until the preceding coat has thoroughly hardened and is approved.

4 <u>Painting :</u>

Oil Paint, Synthetic Enamel, Acrylic, Plastic Emulsion etc. shall confirm to IS codes of practice and paints of approved manufacturer only shall be used and shall be applied as per specifications of the manufacturer. Paints appropriate for the surface to be painted shall be used.

1 Painting Plastered Surface IS:2395 :

a) **Primer Coat** :
For plastered surfaces to be painted, the same shall be rubbed down with a dry brush to remove loosely adhering matter. One coat of cement for other approved primer shall then be applied to the surface. After 24 hours a second coat of primer shall be applied. All cracks in the surface shall be filled with approved putty. Any uneven surface shall be made good by applying approved putty.

b) **Final Coat :**
The paint shall be constantly stirred and thinned by appropriate thinning agent. It shall be applied uniformly on the surface. The second coat may be applied within three hours of the first coat.

2 Painting old surface :

A surface previously treated with paint or oil bound distemper shall be cleaned properly and rubbed down with sand paper to ensure proper adhesion. No priming coat would be necessary.

Where lime and certain type of dry distemper have been used, the surface shall be washed down with water to remove all traces of alkali. The surface must be allowed to dry for at least 24 hours.

Final cost of paint specified shall then be applied as specified under painting for new plaster work.

3 Painting woodwork :

a) **Preparation of surface** :

The surface shall be rubbed smooth with sand paper, first with coarse grade and then with medium grade. When finished no scratches from the coarse paper should be seen.

b) **Knotting :**

Before priming, all the knots in the woodwork shall be filled with an application of two coats of an approved substance through which the resin cannot exude.

c**) Primer Coat** :

Primer coat shall be the ready mixed prime coat of approved make and shall be applied to
the specifications of the manufacturers.

d) **Final Coats :**

After priming, all small holes, cracks, open joints, etc shall be closed with approved putty consisting of pure whiting mixed with linseed oil to a proper consistency and white lead for hardening. Putty should not be used before application of priming coat.

After applying priming coats the surface shall be lightly rubbed down smooth with sand paper and the subsequent coats of paint of the specified shade and finish approved by the Engineer, shall be applied. It shall be spread as smoothly as possible with approved brush by means of crossing at right angles to the grains and then laying off with the brush in the direction of the grain over the crossing. The final coat shall be very carefully crossed and laid off so that no brush marks are visible. Each coat of paint shall be allowed to dry thoroughly and shall be lightly rubbed down before the application of the next coat. Each coat shall be got approved before the application of the next. The finished surface shall be free from any hair marks, ridges, puddles and other defects.

Unless otherwise specified, three coats of paint exclusive of primer coat shall be applied for all timber work.

If the final coat is not approved, an extra coat of paint shall be applied at no extra cost so as to get the specified finish.

4 Painting Old Woodwork :

The surface shall be cleaned down and rubbed with sand paper or with pumice. All holes and uneven surfaces shall be filled with putty. Two coats of under coating of paint shall be applied, each coat being sand papered before the application of the next coat. The surfaces shall be smooth and dry before applying the final coats.

5 Polishing & Varnishing Woodwork :

French Polishing :

French spirit shall be of an approved make conforming to IS:348. It has to be prepared at site, the polish shall be made by dissolving 0.7kg
base shellac in 4.5 litres of methylated spirit without heating. To
obtain required shade pigment may be added and mixed.

Surface shall be cleaned. All unevenness shall be rubbed down smooth with sandpaper and well dusted. Knots if visible, shall be covered with a preparation of red lead and glue. Resinous or loose knots end gaps shall be filled with seasoned and timber pieces and made level with rest of the surface. Holes and indentations of surface shall be filled with putty made of whiting and linseed oil. Surface shall be given a coat of filler made of 2.25 Kg of whiting in 1.5 litre of methylated spirit. When it dries, surface shall be rubbed down perfectly smooth with sandpaper and wiped clean.

Piece of clean, fine cotton cloth and cotton wool made into shape of pad shall be used to apply polish. The pad shall be moistened with polished and rubbed hard on the surface applying the polish sparingly but uniformity and completely over the entire surface. It shall be allowed to dry and another coat of applied in the same way. To give finishing coat, the pad shall be covered with a fresh piece of clean fine cotton cloth, slightly damped with methylated spirit and rubbed lightly and quickly with a circular motion, till the furnished surface attains uniform texture and high gloss.

Wax Polishing :

Wax polishing shall either be prepared at site or obtained readymade from market. Polish made at the site shall be prepared from a mixture of 2:1.5:1:1/2 by weight. The bees wax and the boiled linseed oil shall be heated over the slow fire. When the wax is completed dissolved, the mixture shall be cooled till be it is just warm, and turpentine oil and varnish added to it in the required proportions and the entire mixture is well stirred. Surface shall be prepared as described under 'French Polishing' except than the final rubbing shall be done with sand paper which has been slightly moistened with linseed oil.

Mixture or polish shall be applied evenly, with a clean cloth pad in such a way that no blank patches are left and rubbed continuously for half an hour. When the surface is quite is quite dry a second coat shall be applied in the same manner and rubbed continuously for an hour or until the surface is dry. Final coat shall then applied and rubbed for two hours or more if necessary until surface has assumed a uniform gloss and is quite dry showing no sign of stickiness when touched. Gloss of the polished depends on the amount of rubbing. Therefore, rubbing must be continuous and with uniform pressure and frequent change in direction.

Varnishing :

Surface shall be prepared as described above. After preparation of surface, two coats of clean boiled linseed oil shall be applied at sufficient intervals of time. After the linseed oil has dried two coats of varnish obtained from approved manufacturer shall be applied without any extra cost.

5 Mode Of Measurement & Payment :

The quoted rate for painting shall include the cost of preparing and cleaning the surface as specified, preparing sample of paints for approval, scaffolding, wherever required, tools and machinery, etc. and after painting has been completed, cleaning the floor surface of all dirt, paint, etc. It shall also include the cost of putty, primer coat, preparation of surface after application of each coat and final coats.

Where painted surfaces are to be paid separately, they shall be paid in square metres and the measurement shall conform to IS:1200 (Part XV) latest.

SECTION – H

FLOORING

1. Stamped Concrete Flooring :

This item shall consist of all work associated with furnishing and installing concrete stamped surfaces in accordance with these specifications, as detailed on the plans or as directed by the Engineer. This shall include all labor, materials, testing, submittals, tools, and equipment necessary to saw cut, excavate, prepare the base and install the stamped concrete surface to the lines and grades shown on the plans including any incidentals thereto. The work in this section includes preparation work and placing, stamping and coloring concrete. The Contractor shall coordinate items of other trades to be furnished and set in place. Such locations of their work as in all or in part embedded, built-in, attached to, or supported by the work shall be executed by them in ample time that progress of the work is not delayed. Any cutting or patching made necessary to comply with this injunction shall be done at the Contractor expenses. The Contractor shall be responsible for the proper installation of all accessories embedded in the concrete and for the provision of holes, sleeves, openings, etc., necessary to the execution of the work of the trades. The Contractor shall furnish one 4'x4'x4" sample of each concrete finish at the job site for approval ofthe Engineer and haul them away after approval. Approved samples shall be standards for finishes in stamped concrete work. The pattern shall be running bond or shall match existing median where applicable.

2. Vacuum Dewatered Flooring

This specification defines the material, mixing, placing, curing, and constructional and other performance requirements for VACUUM DEWATERING CONCRETE SYSTEM for concrete floor slab. Any other special requirements shown or noted on the drawings and directed by the Engineer-in-Charge shall govern over the provision of this specification. Actual work shall be Carrie out in accordance with this specification and in consultation with specialized firm undertaking the job to suit specific requirement at site such as rise and fall of the floor slab, providing dowels for pedestals etc. In case of conflict between clauses mentioned in this specification and those in any Indian Standard, this specification shall grown.

MATERIAL:

All materials of construction like cement, aggregate, sand, water etc.

GRADE OF CONCRETE:

Minimum grade of concrete used shall be M15 conforming to IS-456. Only Design Mix Concrete shall be used. For other details like proportioning, batching, mixing, placing, curing etc.

WATER-CEMENT RATIO:

Water-cement ratio unto 0.65 shall be allowed to obtain better slump & workability. Actual ratio shall be decided with approval of the Engineer-in-charge. Only measured quantity of water shall be used in the mix.

SPECIAL REQUIREMENT:

All works covered by this specification shall be carried out by an experienced agency having sufficient expertise in vacuum dewatering concrete system. Only skilled and experienced operators shall be employed for the purpose. Prior approval of the agency shall be obtained from the Engineer-in-Charge before starting the work. All the equipment shall be of approved and proven types and suitable for the work involved.

CONCRETE LAYING:

Concrete laying pattern shall be decided in consultation with the Engineer-in-Charge and with his approval. The maximum width of a slab strip shall not generally exceed 4 meters and minimum number of construction joints shall be used. Alternate slab strips shall be sequentially laid. Any damage to the already finished top surface shall be avoided. At construction joints no overflow of mortal or slurry on the already hardened surface shall be allowed while concreting the intermediate slab strip. Such construction joints shall be marked with a thread in a straight line while the concrete is still green. Continuity of reinforcement shall be maintained while laying concrete in slab strips. Edges at expansion joints shall be protected and proper arrangement of shear-transfer shall be provided standards.

3. Mastic Asphalt Flooring :

Unless otherwise specified, the thickness of mastic asphalt shall be 25mm.

1 Materials :

The following materials shall be used.

a) Bitumen, should conform to the following requirements :

Characteristic	Requirements	Method of (Ref. to Indian Standard)
Softening point	65-115 °C	IS: 1205-1958
Penetration at 25 °C	3-20 mm	IS: 1203-1958
Ductility at 25 °C	0-5 mm	IS: 1208-1958
Loss on heating percent (max)	0.05-0.10	IS: 1212-1958
Solubility in CS2 percent (min)	99	IS: 1216-1958

Mexphalte 10/20 or Esso Paving Asphalt 10/20 or similar grade bitumen is suitable for the work.

b) Fine Aggregate : This should consist of naturally occurring limestone rock containing not less than 80% calcium carbonate content, and finely ground to the following grading :

Passing through IS Sieve 75 micron 45 to 55 per cent by weight.
Passing through IS Sieve 212 micron and retained on IS Sieve 75 micron 10 to 30 per cent by weight.
Passing through IS Sieve 600 micron and retained on IS Sieve 212 micron 10 to 30 percent by weight.
Passing through IS Sieve 2.36 mm 5 to 20 per cent by weight and retained on IS Sieve 600 micron.

c) Coarse Aggregate : This should consist of crushed siliceous stone (igneous stone or sand-stone), containing not more than 15 per cent by weight of constituents soluble in hydrochloric acid, and graded as follows:

Passing though 10 mm mesh - 100 percent by weight.

Retained on IS Sieve 2.36 mm - 95 percent by weight.

2 **Proportion of Mixing :**

The percentage by weight of the different ingredients shall be:

		Kg/m2
Bitumen	11%	7.6
Fine Aggregate	54%	37
Coarse Aggregate	35%	24

The fine aggregate shall be heated to a temperature of 170 to 205 °C and then the required amount of bitumen heated 180 °C shall be added to it. They shall be mixed and cooked for five to six hours, mixing thoroughly with rotating paddles during the cooking process. The temperature at no time shall exceed 205 °C. After the mastic has been cooked for three to four hours, the requisite percentage of coarse aggregate shall be added and thoroughly incorporated during the manufacturing process. In the alternative, mastic composed only of bitumen and fine aggregate may be cooked and formed into 25 Kg blocks, and remelted at site and incorporated with coarse aggregate.

3 Laying :

The mastic should be as hot as possible (within limits of 175 °C and 200 °C) to be able to hand float it with case. The mastic making plant should be so sited that the distance over which the hot molten mastic has to be carried, is as short as possible.

To prevent the molten material from sticking to the carrying pans, they may be sprinkled inside with a minimum quantity of inert inorganic material, such as limestone dust. Cement, ashes, oil or slaked lime powder shall not be used for the purpose.

Prior to laying the 25mm thick mastic composition on the floor, loose or broken portions of the existing surface should preferably be removed, and voids and depressions should be filled with mastic composition. If the existing surface is not likely to firmly adhere to the mastic composition, better bond between the mastic layer and the existing flooring may be obtained by the application of Mexphalte 10/20 or bitumen of similar grade, heated to about 175 °C and spread at the rate of 0.5 kg/m2.

Mastic asphalt should be laid in bays (made out with wooden battens 25mm deep) generally in one coat. It should be spread by means of hand tools to the specified thickness, gauges being used in conjunction with straight edge and level to ensure accuracy. Any 'blows' which occur, should be stabbed and the area affected carefully made good whilst the mastic is still hot.

The surface should be rolled with approved roller or by other approved means and/or floated to a uniform level with the help of steel floats (warmed up prior to use) to a finish free from roughness, depressions and imperfection due to insufficient working or unsuitable compounding. In floors which are likely to have water spilt on them, a cross fall of not less than 1 in 100 shall be provided towards the outlets.

Junctions between bays should be even and neat. Where skirtings are specified they should be in accordance with details supplied by the Consultants. In such cases, the floor surface be set back from the walls and partitions at a suitable distance by means of gauges, to allow a neat junction to be formed at the base of skirting or cover.

Flooring shall not be subjected to traffic until the mastic asphalt has cooled to the temperature of the surrounding atmosphere.

4 Maintenance and Repairs :

On the finished surface, concrete or mortar shall not be mixed directly. Oil, paint and distemper droppings shall be avoided. The floor shall also be protected from solvent chemicals, hot surfaces and open fires.

It may be necessary to cut into existing mastic asphalt flooring. Considerable damage may result from an attempt to cut away an affected area with a hammer and a chisel or to soften it with a blow lamp. The correct method is to place hot asphalt around and over the area concerned, and after this has had a sufficient softening effect, the area shall be carefully cut away.

When multiple-coat work is being restored or made good, the edge along the perimeter of the area shall be cut back not less than 75mm to half the total thickness of asphalt, to form a lapped joint.

2 Grano M-35/10 and Indian Patent Stone Topping M-25/10 laid separately or cast as Monolith finish integral with base concrete :

1 Preparing base :

The base course, either PCC or RCC slabs shall be brushed with a stiff bristles broom removing all the laitance. The brooming should expose some of the aggregates and roughen the surface adequately to provide a mechanical bond for the topping. The base shall be cleared if any deposition i.e. grease, oil, paint, etc. on its surface which would interfere with the bond and thoroughly cleaned of loose particles and dust with water by scrubbing with a stiff brush. Foreign substances not removed by scrubbing shall be chipped off. After the base is chipped clean, it shall be saturated with water overnight. If specified proprietary brand adhesive solution of approved make shall be applied as per manufacturer's specification to the old concrete surface so as to ensure proper bond between old concrete surface and new in-situ topping.

2 Materials for Grano :

a) Cement or fine aggregate used shall be as specified under 'Concrete' Section.

b) Coarse aggregate shall consist of 10mm single size crushed rock of Granite, or basalt or trap or quartzite and shall conform to IS:383 (latest) and IS:2386 (latest).

3 Mix proportion :

The proportion by weight shall be 1 part of cement to 3 parts of total aggregate for M-35/10 grano floor. For M-25/10 IPS the proportion by weight shall be 1 part of cement to 4 parts of total aggregates. Sand content shall be 40% - 45% of total aggregate. The mix should be weigh batched. Water cement ratio should not exceed 0.45 in both cases.

The size of panels for casting shall be as per drawing. Thickness of grano for monolithic finish shall be 20mm and for the bonded finish on hardener concrete base shall be 40mm thick. Glass strips, or aluminium or steel strips as specified shall be used along the edges of the joints. The depth of the strip shall be 2mm more than the thickness of the topping and shall be ground after topping has set and cured. These strips shall be fixed to the base by a suitable mortar bedding or by other approved methods.

For monolithic finish, the topping shall be laid within 2 hours of concreting operation i.e. before the concrete has set. The number of skilled and experienced masons to be employed shall depend on the number and size of panels approved by the Engineer.

The finish shall be laid in one or two courses according to the thickness required. Immediately after spreading it shall be compacted by ramming or other approved method.

Immediately after compacting, trowelling shall be done to obtain a level surface. Back trowelling should be done at least twice at an interval of 1.1/2 hours each till a hard, dense and abrasion resistant surface is obtained.

The topping shall be cured continuously for 14 days.

4 Surface treatment :

Sodium Silicate Solution shall contain 30% of silica and 9% soda. The first application shall be by spraying over the floor with a mix of 1 part sodium silicate solution with 4 parts of water. The solution shall be spread evenly with a mop or soft brush and wiping off any excess. The floor shall be allowed to dry for 24 hours. If the floor is strongly absorbent, a second application shall be given as per the method above, after washing the floor with water and after it has dried.

3 Ironite Topping :

This shall be laid for a thickness of 12mm (1/2") between 1 and 3 hours after laying the base concrete. The proportion used shall be one part of the Ironite, 5 parts of cement and 10 parts of stone chips 6mm onwards.

Any other materials like "Rockite" or "Improved Rockite" equipment or superior in performance may be used after tests are carried out to prove that these are as satisfactory as the ironite topping. The method of laying these toppings shall be as per specifications of the manufacturer.

4 Tiling Work:

5 Skirting :

The skirting shall be of the same materials as that of the floor tiles and shall be of the exact size specified. It shall be fixed to the wall with cement mortar 1:6 bedding. Grinding and polishing shall be carried out by hand using carborundum of appropriate quality.

6 Glazed Tile Flooring and Dado :

Glazed tiles shall be of approved make, size and shade as stated in the Schedule of Quantities and Rates and shall conform to IS:777 latest. No cracked, chipped or warped tiles shall be used in the works.

Preparation of surface :

All masonry faces shall be cleaned thoroughly by removing dirt, loose mortar, efflorescence etc. The concrete surfaces shall be brushed to remove all laitance and roughened to provide a bond for the bedding.

Fixing tiles :
The masonry and concrete faces shall be given a coat of cement plaster 12mm thick (in proportion 1:4). The surface of the plaster shall be scarified with wire brush for getting a good bond between the tiles and the bedding.

The tiles shall be soaked in clean water for about half an hour before using. The back of the tile shall be buttered with 1:2 plastic cement mortar to a thickness slightly in excess of the finished thickness required and the tile pressed to the wall and tapped back in position. Alternatively a rich fatty mortar shall be applied on the bedding and the tile pressed into it, care being taken to ensure that the keys of the tile are buttered up with mortar. Joints shall be uniform, even, straight and as thin as possible in any case not more than 3.00 mm. Surfaces of tiles have been fixed the joints shall be cleaned of grey cement and

refilled with cement paste of the same shade as that of the tiles. The tiled surface shall be left wet for a period of 7 days.

Glazed rounded corner convex or concave shall be provided where specified and no extra will be paid for the same.

After the completion of the work the surface shall be cleaned of all stains, etc.

8 <u>Ceramic Tile Flooring :</u>

Ceramic tile paving in terraces and other areas where called for shall be of non-slip ceramic tiles. Spartek or other make approved by the Architect. The tiles shall be of approved colour, size and shape and shall be laid to the pattern approved by the Architect. The tiles shall be of approved colour, size and shape and shall be laid to the pattern approved by the Architect. The tiles shall be of uniform colour, true to size and shape and free from cracks, twists, uneven edges, crazing and other defects. The tiles shall be generally of size 200x200 mm unless otherwise called for.

The tiles shall be laid over a bed of 20 mm thick cement mortar 1:3 (1 Cement : 3 coarse sand) and levelled to a true surface. The surface of the bedding mortar shall be left rough to provide bond for the tiles. A floting coat of thick cement slurry shall be laid over the screed to proper levels and the tiles set over the same firmly to correct line and levels.

The joints shall be filled and finished neat with cement paste pigmented to the shade of the tile. The joints shall be finished neat as directed and shall be straight, regular and uniform.

On completion, the surface shall be washed with water, rubbed with fine saw dust and left clean.

The finished floor surface shall be true to required levels.

Protection of Walls and Adjoining Works :
The Contractor shall make at his own cost, all necessary arrangement and take requisite precautions

to ensure that walls and other adjoining works remain protected from any damage(s), not only from his own workers/sub-contractor but also from that of other agencies working in co-ordination at the site of work.

9 Glass mosaic tiles :

This shall be set to wall or floor in the following manner :

The surface of the wall or floor is to be plastered with cement mortar 1:4 and allowed to set for a day. A coat of 12 mm thick cement mixed in lime water is to be then spread over the surface. After about half an hour, a thin coating of white cement for other coloured tiles is to be then applied. On this the sheets of mosaic tiles are to be placed and tapped gently with a wooden mallet to get the tiles in proper level. The paper is then soaked with water and peeled out carefully so as not to disturb the tiles from their positions. Any piece not in level or which is broken while tapping shall be pulled out immediately with a sharp instrument and then replaced without leaving time for the cement to set. After removing the paper, the mosaic surface is to be washed with water using a thin brass brush, thus removing the excess cement. On setting of cement, the tiles shall be polished with fine cloth or cotton waste. The surface is to be watered twice a day for four to five days.

10 Beer Bottle Finish :

This finish is provided on the outer face of the precast wall panels. Used 650 ml to 750 ml bottles of the opaque variety (used empty beer bottles) shall be permitted. The bottles shall be split vertically into half by running a hot filament around the centre of the bottle and then immediately immersed in cold water. Split concrete mould shall be used for correct alignment of the filament. Any other method of splitting the bottles shall be permitted after approval. Excepting the bottles in the uppermost and lowermost rows, all other bottles shall have their bottom removed in the same manner as above. These bottles shall be laid in a straight line with their cuts face down and with the neck of the lower bottle inserted into the base of the bottle above. A series of such lines of bottles shall be laid on freshly laid 10 mm thick cement mortar bedding. The surface of the bottles and the grooves between the lines of the bottles shall be cleaned thoroughly using dilute hydrochloric acid before erection of the wall panels. The above process shall be carried out immediately after casting the wall panels.

11 Tandur, Shahabad, Kotah Stone :

The stone slab shall be from approved quarry and shall be of sizes specified. The edges shall either be machine cut or hand cut as specified. When the stone tiles are machine cut, the corner angles shall be checked before laying and if not found correct, the edges shall be chiselled so as to obtain correct angle between the edges. The hand cut edges shall be smooth and even, and dressing of stone shall be for at least half the thickness of the tile.

The colour of the stone shall be uniform.

The method of preparation of base and laying shall be in accordance with IS:1443 and shall in general be the same as applicable to terrazo tiles. The top surface shall be polished with grinding machine with carborundum such that there shall not be any scratches on the surface.

12 Specification for Bottle Finish :

This finish is provided on the outer face of the precast wall panels. Used 650ml to 750ml bottles of the opaque variety (used empty beer bottles) shall be permitted. The bottles shall be split vertically into half by running a hot filament around the centre of the bottle and then immediately immersed in cold water. Split concrete mould shall be used for correct alignment of the filament. Any other method of splitting the bottles shall be permitted after approval. Excepting the bottles in the uppermost and lowermost rows, all other bottles shall have their bottom removed in the same manner as above. These bottles shall be laid in a straight line with their cuts face down and with the neck of the lower bottle inserted into the base of the bottle above. A series of such lines of bottles shall be laid side by side with a clear gap of 6mm. The bottles shall be laid on freshly laid 10mm thick cement mortar bedding. The surface of the bottles and the grooves between the lines of the bottles shall be cleaned thoroughly using dilute hydrochloric acid before erection of the wall panels. The above process shall be carried out immediately after casting the wall panel.

13 Marble/Granite/Slate Flooring :

Stone slabs for flooring, in layers skirting, Dado, treads, risers, etc. shall be selected quality MARBLE/GRANITE/SLATE SLABS/TILES slabs from an approved quarry and of thickness, finish and colour as approved by the Architect. The intent is to use best selected quality White Marble or JAISALMER YELLOW Marble slabs and Granite/Slate/Slabs/Tiles in appropriate pattern. Stone slabs shall be hard sound, dense, homogenous in texture, free from cracks, decay, weathering and flaws.

Granite Stone slab and tiles shall be of approved colour and shade and from an approved source from South India.

For polished stone flooring the slabs shall have the top (exposed) face machine polished before being brought to site. Edges of stone shall be Machine cut on all sides to a minimum depth of 15 mm so that a straight edge laid along the side of the stone shall be fully in contact with it. The edges of stone slab for counters stair treads, risers and steps shall also be machine cut and polished to full depth and chamfered or rounded as instructed by the Architect.

The thickness of the stone slabs shall be 20 mm to 25 mm for flooring work. For stair risers the thickness of slabs shall be 40 mm thick uniformly. Before starting the work, the contractor shall get samples of slabs approved by the Architect. Tiles shall be of sizes and thickness as called for in the Drawing / Documents.

Mortar :
The slabs shall be laid over a bedding of cement mortar 1:6 (1 Cement : 6 clean coarse sand) of thickness 20 mm to 30 mm to make up an overall thickness as called for.

Laying :
The RCC slabs or sub-grade concrete over which the slabs are to be laid shall be cleaned, wetted and mopped. The cement mortar shall be spread over a small area to an average thickness of 20 to 30 mm. The slab, washed clean, shall be laid on the mortar pressed, tapped with a wooden mallet, and brought to required level. It shall then be removed and laid aside. The top of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is then consistency shall be spread over

the same at the rate of 1 bag per 10 sqm area. The edges of the slab already laid shall be buttered with slurry of cement and pigment to match the shade of slabs. The slab to be laid shall then be placed back in position, pressed and properly bedded in level with adjoining slab with as fine a joint as possible. Other slabs are also laid in similar manner to correct levels with fine joints. The surplus slurry on the surface shall be cleaned off. Slabs which are fixed in the floor adjoining the wall shall enter under the skirting or dado as shown on the details. The junction between floor and wall finish shall be finished neatly as directed. The flooring shall be cured for minimum seven days. Any slight unevenness at the meeting of the slabs shall be cured for at least 10 days.

Grinding :
The grinding and polishing shall be commenced about seven days after the slabs are laid. The surface shall be carborundum stone grade 60. The surface shall then be washed clean and joints grouted with a grout of cement and appropriate pigment mixed in suitable proportion to match the shade of stone. It shall then be allowed to dry for 4 hours and wet, cured for 7 days. The grinding and grouting operation shall be repeated using carorundum stone grade 80 and 120 till a smooth finished surface is obtained.

After thoroughly cleaning the surface, grouting and curing as described earlier, the final grinding shall be carried out using carborundum stone grade 320. The surface shall again be washed clean, dusted over with Oxalic acid at 32 gms., per sqm sprinkled with water, rubbed hard with cotton waste and wiped clean the following day. Where use of machine for grinding is not feasible rubbing and polishing shall be done by hand in the same manner as described above.

Final Polish :
When all constructional and finishing work namely painting, joinery work, electrical, plumbing work etc. are completed and just before the area is occupied, the floor shall be worked clean with dilute oxalic acid solution and dried. Non-slip wax polish shall then be applied with soft linen on the clean and dry surface and polishing machine fitted with felt or hessian bobs shall be run over the surface, clean saw dust shall then be spread over the surface, polishing machine again applied, mopping up surplus wax and leaving glossy surface. Care shall be taken that the floor is not left slippery and that ordinary wax is not used under any circumstances. The finished surface shall be true to level and lines. The joints shall be as find as possible and the surface to finish approved by the Architect.

15 Inlays In Marble/Granite/Slate or Stone Flooring :

Stone slab for inlays in flooring shall be selected quality from an approved quarry and of thickness, finish and colour as approved by the Engineer / Architect.

Specifications for Marble/Granite/Slate flooring shall be applicable for inlays also.

The size of the stone shall be as per drawing, the width of the strip may be as low as 40 mm. The stone shall be cut to any odd shaped size to suite the architectural pattern.

Before laying and fixing the stones on the mortar bed, they shall be assembled dry on the floor to ensure the correctness of the pattern and to obtain approval from Engineer/Architect.

16 Vertical Cladding In Marble/Slate/Granite Stone or Tiles :

Vertical Cladding includes the work on internal walls, external walls, isolated RCC columns, etc.

Cladding stones or tiles shall be selected quality from an approved quarry and of thickness, finish and colour as approved by the Engineer/Architect.

The edges of exposed right angle corner joints of cladding stones/tiles shall be finished to suit corner angles, and a groove of 6 mm wide shall be cut, the corner edges polished as per detail.

Sufficient numbers of groove, 3 mm wide and 1 mm to 2 mm deep, shall be made on the back of cladding stone/tiles for proper bonding with mortar or tile adhesive paste.

Wherever specified, chamfers shall be made in the stone.

The joints shall be cut square to the face and shall be at right angles to each other.

Mortar Backing :
Sand for mortar shall be clean river sand without any salt content.

The thickness of mortar backing specified is nominal and may vary depending upon the thickness of cladding material used.

Scaffolding :
Scaffolding for all cladding work shall be of self supporting type. Holes will not be allowed to be made in the masonry or RCC work for anchoring the scaffolding.

Contractor shall apply evenly tile adhesive of approved manufacturers on the back of the tile without leaving any gap for fixing tile to the prepared surface. The thickness of such paste shall be 3 mm to 4 mm and special precaution should be taken when this thickness exceeds while using for tiles for varying thickness. The Contractor shall ensure that the tile adhesive used shall not leach and leave patches of stain on the finished surface of tiles.

Adhesive paste, prepared as per manufacturer's specification shall be used within the time limit specified and in no case it shall exceed 15 minutes. If more time is lapsed, fresh paste should be prepared and used. The cost of tile adhesives shall be included in the rate for cladding and no extra payment will be made for extra thickness of tile adhesive.

Clamps :
Cladding stones shall additionally be held in position by means of stainless steel/gun metal clamps as specified. The clamps, anchored into the backing masonry/RCC walls or columns in adequate manner, shall be inserted in holes or grooves drilled in cladding stone slabs at specified position and the holes or grooves grouted with appropriate mortar. The number and position of metal clamps shall be as shown in drawing and in any case it shall not be less than two per stone slab. The size of the stainless steel clamps shall be 20mm wide, 1.5 mm to 2 mm thick and length to suit the detailing. Stainless steel (or other approved material) Anchor fasteners shall be 3.4mm to 3.5mm dia and 35 mm long. Contractor shall obtain prior approval from Engineer/ Architect for use of alternative proven method of fixing stone slabs.

Care shall be taken to protect adjoining works including walls and other elements from staining or damage by cement slurry. Any gaps by which slurry can escape shall be temporarily but properly sealed and slurry removed without staining adjoining work.

Expansion joints as per drawing shall be provided in all cladding work. Spacing of joints both horizontally and vertically shall be between 3 to 4 metres.

The face shall be finished as specified or directed after filling the joints with white cement and matching pigment. The surface shall be protected from sun and rain and shall be cured for 10 days.

17 China Mosaic Work :

China Mosaic Set in Cement Mortar for flooring and for wall finish.

Preparation of Surface :
The surface shall be hacked, roughened and cleaned of all dust and other foreign matter. It shall then be wetted before applying the mortar.

Laying and Grouting :
China Mosaic Work shall comprise of laying China Mosaic chips/pieces in decorative pattern and design as approved by the Architect. The China mosaic chips shall consist of about 70% white pieces of 5 mm thick broken glazed tiles and about 30% coloured pieces of colour glazed tiles as per colours specified and selected by the Architect and shall not exceed 20 mm size. These pieces shall be laid evenly in required pattern and slopes, curves etc. and shall be set in a 20 mm thick bedding of cement mortar 1:3 (1 cement : 3 coarse sand) mixed with approved quality of waterproofing compound at 3% by weight of cement slurry applied at the rate of 3.50 kg of cement per sqm so as to ensure proper jointing of the China Mosaic to the bedding mortar, and pointing the joints neatly with white cement.
For wall finish, approved bonding agent shall be used as per manufacturer's specifications between masonry and mortar backing and between surface as plaster and mortar backing for tiles.

Curing :
The finished surface shall be properly cleaned and cured for atleast 10 days and shall be suitably protected from damage.

18 Marble mosaic/Terrazzo in-situ work in flooring, Dado, Skirting etc :

The terrazzo/mosaic finish shall be laid on an under layer of thickness as specified in the respective items. In addition to the under layer, unless otherwise specified, a cushioning layer of lime mortar or lime concrete with brick bat aggregate of specified proportion shall also be provided to the specified thickness.

The topping shall consist of layer of marble shapes of selected sizes, colour and design approved by consultants, mixed with cement with desired shade of pigment.

For lighter shade mosaic/terrazzo white cement shall be used and for neutral shade, grey cement shall be used. The proportion of terrazzo mix shall be three parts of cement and one part of marble powder mix the proportion of marble aggregate by volume shall be 1.5 parts unless otherwise specified.

The topping shall be mixed and laid in panels as described in IS:2114 and as per decorative designs prepared by consultants. The dividing strips for panels shall be Aluminium or as specified in the schedule of quantities. It shall be polished as specified in IS:2114.

Broken Mosaic Flooring :

Broken mosaic finish shall be laid on an under layer of thickness as specified in the item.

Pieces of mosaic tiles shall be obtained from broken marble mosaic tiles of approved shade conforming to IS:1257. The size of pieces shall be suitable to obtain the desired pattern of flooring as shown on the drawings or as approved by consultant.

Broken pieces shall be thoroughly wetted before fixing them. Ordinary or coloured cement grout shall be spread on the bedding. Mosaic tile pieces shall be fixed piece by piece to the desired pattern. The flooring shall be laid to correct level and slopes and compacted by straight screed tamper. The grout shall cream up to the surface. The junction of the flooring and the wall shall be rounded and the flooring shall be extended along the wall to about 15cm (6"). After the day's work, the surplus cement grout that may have come out of the joints shall be cleaned off. The following shall be cured for 7 days and then polished with a machine as stipulated in IS:1443.

Broken China Mosaic :

Broken china mosaic flooring shall be exactly as per broken mosaic tile flooring except that the broken pieces shall be of china of approved colour and manufacture. The floor shall not be polished.

Marble flooring :

Marble slabs shall be of the best Indian marble of white or other approved colour as specified in the item. They shall be hard, dense, uniform and homogeneous in texture. They shall have even crystalling grain and free from defects and cracks. The surface shall be machine polished to and even and perfectly plain surface and edges machine cut true to square. The rear face shall be rough enough to provide a key for the mortar.

No slab shall be thinner than the specified thickness at its thinnest part. The size of the slabs shall be as specified in the respective items.

The slabs shall be laid as described under mosaic tiles flooring in every respect.

Marble in Facia or Dado :

Marble slabs of approved shade, variety size and thickness as specified in the item shall be used. They shall be selected quality, dense, uniform and homogeneous in texture and free from cracks or other structural defects. The exposed face shall have no --- or unsightly stains and defects. They shall have uniform milky white or coloured8red shade or patterns of colours approved by Engineer. Samples shall be got approved by the Engineer before ordering the slabs. The surface shall be fine polished and sides machine cut, true to square.

When a single course of marble slab is to be fixed as in dado etc the slabs shall be fixed as described below

Mortar pads of 1:2 cm of uniform width shall be struck on to the wall at close intervals and the marble slabs, shall be pressed on them firmly. The remaining cavities, if any shall then be filled with thin grout of cement mortar of the same proportion. The sound coming on gently tapping of the slab will indicate if there are hollows. When the hollow cannot be filled with grout and the finished slab continues to give a hollow sound on tapping, the slab shall be removed and reset.

For facia work where more than one course is required, the marble slabs shall be fixed in the same way as described above except that the horizontal joints of the slabs, adjacent slabs shall be held together by a wrought iron/copper pin passing through the hole drilled into the slabs. In addition, wrought iron/copper holdfasts/dowels shall be provided to anchor the slab to the wall. The holdfast shall be countersunk into the joints of the slab and it shall be located about a metre apart subject to a minimum of one for each slab for each horizontal joint. The facing shall be fixed truly in plumb and in shall be as directed by Engineer. The surface shall be protected from sun and rain and cured for ten days and shall be finally polished.

The rate shall include erecting and removing double scaffolding equipment etc.

Polished or tool finished Granite/Malad/Sand stone :

The facia stone/slab shall conform to the specification under 'Material' and it shall be erected as shown on the drawing or as directed by Engineer.

The stone or stone shall be of size as shown on the drawing or as directed by the Engineer. The expose faces full beds and joints shall be dressed/finished as directed. The joints shall be cut square to the face and shall be at right angles to each other or as directed.

The facing shall be fixed in cement mortar truly in plumb and in perfect plane straight or curved as shown on the drawing, the bed being fully flushed with mortar. The joints, shall not exceed 1mm to 1.5 mm for machine polished/fine tooled/close punched and chisel dressed work. The stones shall break joints for about half the height of the course. Courses shall be shown on the drawing or as directed. The gap between the facing stone and the wall shall be filled either with 1:2:4 concrete or 1:2 cement mortar. Wrought iron/copper pins and holdfasts shall be used wherever directed. Lead caulking shall be used for fixing holdfasts. The surface shall be protected from sun and rain and cured for ten days.

The face shall be finished as specified or directed after filling the joints with matching shade cement/cement mortar of 1:1 proportion mixed with approved waterproofing material.

The rate shall include double scaffolding.

Vitrum tiles :
Tiles of colours and design as shown on the drawing or as directed by the Engineer shall be used fixed and finished strictly as per manufacturer's specifications and as directed. The rate shall be inclusive of double scaffolding equipment etc.

Stilan tiles or other heavy duty tiles :
Heavy duty flooring tiles shall be laid strictly according to manufacturer's specifications and machine polished as directed.

Cast iron grid tile flooring :
The tiles shall be manufactured from cast iron conforming to IS:210. The tiles shall be of the design as shown in the drawings and of standard dimensions 20cm or 30cm x 30cm as specified in the description of the item. Variation in weight to the extent of 5% on either side shall be permissible.

The ribs of tiles shall be tapering down with the thicker end at top so that the cementing materials filling the hollows between them is held fast and prevented from getting loose on the top. The top surface of the tiles shall be ground smooth, while the sides of the hollows shall be left rough.

The subgrade concrete or RCC slab on which the grid tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the grid tiles shall consist of one part of cement and two parts for stone grit 6mm and down grade laid to 25mm thickness tapped and corrected to proper levels. The bedding concrete shall be laid each time over such an area as would accommodate 8 to 10 tiles. The grid tiles shall be laid one by one, pressed into the bedding and tapped with a wooden mallet so that the mortar works up into the hollows of the grid tiles about 5mm and the top face of the tiles is at the correct finished level and plane. The flooring is cured for ten days and after thoroughly drying with mastic asphalt to obtain a smooth and uniform surface.

TECHNICAL SPECIFICATION FOR LAYING VITRIFIED TILES

Providing and laying 1st quality polished vitrified tiles of (8mm thick 600 x 600 size – which ever is applicable) in flooring of approved make and shade and free from cracks, warpage, fissures and flakes with straight edges and perfect corner laid at right angle as per design and pattern over a bedding of cement mortar of 30mm thick CM 1:5 finishing the joints neatly with white cement mixed with matching colour pigment and finish in all respect and all material and labour complete.

19 Mode of measurement and payment :

Mastic Asphalt Flooring: The rate quoted shall be based on final compacted thickness and shall include all labour, materials and the cost of rolling with approved roller or other equivalent method to obtain full compaction, surface preparation of concrete base and application of bitumen primer etc complete. It shall be measured and paid on square metre basis.
Grano flooring: The rate quoted shall be inclusive of all materials including shuttering if any, permanent edge supports of specified quality, finishing and curing and cleaning the entire surface of all matter and dirt.

It shall be measured and paid per square metre basis for the specified thickness.

Terrazo tiles, marble mosaic tiles, glass mosaic tiles, cement tiles, insitu mosaic flooring, marble, kotah stone granite, stone or tiles, glazed or ceramic tile flooring etc.:

The rate quoted shall be inclusive of all materials, laying, bedding and finishing materials, cutting the tiles, polishing by grinding machine, curing and cleaning etc. complete.

It shall be measured and paid on square metre basis. The area measured shall be exclusive of area of inlay if any. When the range of size of stone or tile is specified, the rate shall be inclusive of cutting stone or tiles and any odd shaped specified and or using smaller size of stones or tiles.

Skirting shall be measured and paid on running metre basis or if specified on square metre basis.
For treads and risers these shall be measured and paid per number of specified size and thickness

or, is specified, on square metre basis.

Beer Bottle Finish:

The rate quoted shall be inclusive of the cost of used beer bottles, cutting the bottles into two valves, cutting the bottom of the bottles, etc by using electrical heating element, bedding material, laying fixing, cleaning etc. use of self supporting scaffolding for vertical elements.

It shall be measured and paid per square metre basis. Length (or height) is measured from the top of the top most bottle to the bottom of bottom most bottle and width is measured between edge of the bottle at two extreme ends of the panel.

Inlays in Marble/Granite/Slate/Stones or Tiles :
The rate quoted shall be inclusive of all materials and using varieties of stones/tiles in a pattern as per drawing, cutting the tiles, bedding, finishing materials, using of white cement with pigment to suit colour of tiles, polishing by grinding machine curing and cleaning etc.

Vertical Cladding in Marble/Granite/Slate/Stones or Tiles, Glazed Ceramic Tile, etc. :
The rate quoted shall be inclusive of all materials, cutting the stones/tiles, making grooves, and using various types of stone/tiles in a pattern as per drawing, bedding and finishing materials, approved bonding agents, approved chemical tile adhesive pastes, stainless steel clamps and bolts, self supporting scaffolding, providing expansion joints with approved grade silicone sealants etc. The rate shall also include for cladding on any vertical surface including isolated columns.

China Mosaic For Flooring and For Wall Finish :
The rate shall be inclusive of all materials, breaking and mixing assorted coloured glazed tiles, bedding materials using waterproofing admixture pointing the joints with white cement etc and shall be measured and paid per square metre basis.

The rates for China mosaic finishes on wall shall, in addition to the above, be inclusive of self supporting scaffolding, approved chemical bonding agent etc.

SECTION – I

WATER PROOFING , ROOFING AND FACADE

4 Colour Coated Profiled Sheets :

1 Colour Coated Profiled sheets shall have base material of either High tensile cold rolled steel with Galvalium coating or Ordinary tensile cold rolled steel with Galvanized coating. High tensile cold rolled steel shall confirm to AS 1397 (minimum yield strength 550 Mpa) and coating shall confirm to AZ150 (150 gm/m2 zinc- aluminium alloy coating, total of both sides). Ordinary tensile cold rolled steel with Glavanized coating shall confirm to IS:513 & IS:277 (minimum yield strength 240 Mpa and min 175 gms/m2 zinc coating, total of both sides).

2 Finished paint coating for sheets shall be any one of following as specified in the items.

a) Silicon polyester coating
b) Polyester Coating
c) Plain Galvalium or Galvanized finish

3 The sheets shall be fixed on the steel purlins by roofing screws of Buildex make or equivalent, mechanically galvanized, colour matched nylon head in either self drilled holes or predrilled holes at crest of the sheets. The spacing of screws shall be as per manufacturer's specifications. The side lare sealed by stitching bolts.

4 All precautions with regard to storing, handling and laying as stipulated in clause L.3 above shall be considered applicable to Colour Coated sheets.

5 Measurement :

The quoted rates for each item of work covered by this specification shall include providing of all materials, tools tackle plant, scaffolding as required labour, and all other work necessary to complete the job as per this specification.

The sheets shall be measured and paid per unit (m2) flat area, covered in the plans of the sheets. Special accessories such as gutters, north light curves, ridge pieces etc. shall be measure and paid per unit length (m).

No separate payment will be made for laps of sheets and accessories, bolts nuts, washers, white washing, adjustable bolts and supports for gutters and other fixtures. These are assumed to be included in the quoted rates.

WATERPROOFING

1 Brick-bat Coba :

IS:3068 : Wherever specified this shall consist of 100 parts of broken bricks of the sizes of approximately 20mm to 40mm and 45 parts of lime mortar (1:2) or 1:6 cement mortar, machine mixed. The above ingredients shall be well mixed and only sufficient water added to make the mixture plastic. The mixture shall be laid over the concrete surface and shall be well rammed with wooden battens to the required slope. The surface shall be trowelled smooth so as to bring the mortar to the surface. The surface shall be kept moist for 7 days.

2 Bitumen felts based waterproofing and damp-proofing :

IS:1322 Specification for bitumen felts for waterproofing and damp-proofing

IS:1346 Code of practice for waterproofing of roofs with bitumen felts

IS:1609 Code of practice for laying damp-proof treatment using bitumen felts

IS:3067 Code of practice for general design, details and preparatory work for damp-proofing and waterproofing of buildings

IS:1580 Specification for bituminous compounds for waterproofing of buildings

IS:1580 Specifications for bituminous compounds for waterproofing and caulking purposes.

3 The waterproofing work shall be carried out by Contractors who have experience in doing waterproofing work and shall give a guarantee on a stamped paper for good performance of the waterproof treatment for a minimum of seven years period and shall, at their own cost, rectify the defects, if any, found during the guarantee period.

If approved by the Engineer, insitu fibre glass tissue reinforced bitumen layers equivalent to bitumen felt may be used.

4 Surface preparation :

Concrete and masonry surface :

Any cracks in the surface (other than hair cracks) shall be cut to V-shape, cleaned and filled with cement mortar 1:2 or with bitumen conforming to IS:702 as directed by the Engineer.

All fungus growth, if any, moss, dust shall be removed by wire brushing.

Masonry drain mouth shall be widened to two and a half times the diameter of the drain and rounded with cement mortar.

When a pipe passes through RCC slab a cement concrete fillet shall be built around the pipe and waterproofing taken over the fillet.

In brick parapet walls a chese shall be made in the parapet walls to terminate the bitumen felt. No chase shall be made in the RCC parapet walls.

5 Bitumen based waterproofing shall consist of either Normal Treatment or Heavy Treatment or extra heavy treatment as specified.

6 Waterproofing of roof, terraces, bathroom, water tanks etc by cement based waterproofing compounds and by injection grouting :

Where specified this work shall be carried out by the Contractor who is specialized in carrying out this work. The Contractor shall give a 10 year guarantee on a stamped paper for good performance of his work and shall undertake to rectify the work at his own cost if any defects are observed during the guarantee period.

In general the waterproofing shall be carried out as per specification of the specialist but duly approved by the Engineer.

The roof surface before waterproofing shall be cleaned thoroughly and watered and shall be kept wet at least 12 hours prior to carrying out of waterproofing. If any leakage is observed the source of leakage shall be located and it shall be treated either by injection grouting or by closing of the crack with application of cement mortar 1:2 after cutting a V-shape groove. The treatment shall be continued till the leakage is stopped.

Brick-bat coba in special waterproof cement mortar shall be laid to required slope, and shall be well compacted. A 40mm thick I.P.S. type finishing using waterproof admixture shall be provided and finished smooth by extensive trowelling. A false square shall be provided by pressing string, 3mm dia, on the surface. The top finish shall be continued upto a minimum of 300mm height in the parapet wall (in the case of bathroom it shall be carried out upto 1000mm high without fillet). Necessary grooves shall be provided in the walls to terminate the waterproofing treatment. At the junction of the wall and the floor a round or triangular fillet of size 200mm x 200mm shall be provided. The entire surface shall be cured for minimum 14 days by storing water to a depth of at least 150mm in the entire area. During this period if any leakage is observed the same shall be rectified. The slope of waterproofing shall be as specified in the schedule.

7 Underground water tanks and basements:

Waterproofing shall be carried out by either boxing or by injection grouting from inside as specified.

1 Box method:

Boxing shall start immediately after P.C.C. is completed and before the box concrete is laid. It shall consist of laying rough Shahabad tiles 600 x 600 or other approved size and thickness varying from 20 mm to 25 mm in waterproof cement mortar bedding. The joints between tiles shall be thoroughly grouted with waterproof cement grout.

The waterproofing course shall be continued without break along the external surface after the vertical elements are constructed. In case of basement, the source of leakage if any,

shall be located and shall be plugged by injection grouting. In the case of water tanks, the tank shall be filled up with water to full capacity and kept under observation for at least one week. If any leakage is observed the same shall be stopped by injection grouting.

2 Injection grouting waterproofing treatment from inside:

Before starting the work, (in the case of water tanks) the tank shall be filled with water and all leakage points noted shall be grouted by injection grouting. All the construction joints shall be grouted by injection grouting. The floor shall be treated with 75 mm thick concrete using waterproofing compound laid to proper slope. The vertical surface shall be given 25 mm thick cement plaster using waterproofing admixture.

The tank shall be again tested for water-tightness and if any leakages are observed they shall be rectified by injection grouting.

8 Providing extra thickness of waterproof treatment to the terrace and for filling in the depression in the floor in the toilet

Brick pieces of quarter half, and three quarter size are laid piece by piece in the form of horizontal brick masonry in "Cetroof" waterproof mortar made up of cement, sand and "Cetroof" waterproof powder. This treatment is carried out layer by layer to make up the desired thickness to achieve the slope of 1:120 for terrace and the same procedure is followed for filling in the depression in the toilets. The treatment is cured for about seven days.

9 Floor and walls of toilets (bathroom & water closets) kitchen mori, Gallery, fire escape passage/services duct passages etc items M 1(a), i.e. (i) & (ii)& (h)

Surface method :

The treatment shall be done by "Surface" method. But before the work in the floor and wall is done, all chasing or cutting in the floor and\or wall shall be done by the plumber. A layer of "Cetroof" plaster about 35 mm. (1.1\2)thick in the floor area of the depression and about 25 mm (1") thick on the side walls of the depression upto floor level shall then be laid. The waterproof plaster about 18 mm (3\4") thick shall then be continued on the walls above the proposed finished floor level upto a height of 600 mm (2 feet) with surface suitable and even to receive tiles to be laid by the contractor. In shower areas in the bathrooms, the treatment shall be for the full height of the wall.

The plumber shall then finish all his plumbing work i.e. of laying and fixing of pans, pipes and traps etc. without and further breaking or disturbing the treatment. The depression shall then be filled with "Cetroof" waterproof brickbat coba upto the level for putting tiles, the surface being finished even and suitable to receive tiles to be laid by the contractor.

Roof slab terrace Item M.1(b) surface method :

(A) The new terraces shall be treated with "Surface" method which starts directly over the RCC slab and includes the brickbat coba to provide the necessary gradient for the easy flow of rain water.

The coba is finally covered with "Cetroof jointless waterproof plaster finished smooth with trowel in cement colour, with false markings of 300 mm (one foot) squares. The treatment is carried along the vertical surface of the parapets and other adjoining walls, upto a height of about 300 mm (1 feet) in the shape of round wata. The average thickness of treatment is about 110 mm (4") the thickness at rain water outlet points being 75 mm (3") with a slope of 1 in 120.

The surface provided shall be hard and tough suitable for all normal commercial and domestic purposes.

If however, it is desired to cover treatment with decorative tiles, marbles etc then the surface of treatment shall be finished suitable to receive them.

(B) Due to the location of rain water pipes being far apart and due to the span being wider than 30 ft or 9 metres and the water is required to travel on one side only, then the thickness of the treatment increased proportionately to maintain the gradient for the easy flow of rain water.

(C) If a Garden and\or lawn is desired to be made over this treatment it can be made suitable for that also a extra charge. For this it is necessary that the slab shall have a depression of 600 mm (24") in relation to the adjacent vertical areas i.e. Parapet wall and\or other side wall to accommodate about 150 mm (6") thickness of waterproofing, 75 mm (3") thickness for filtering material, 225 mm (9") thickness for earth filling plus 150 mm (6")for free board.

Lift Pit Injection method :

The pit shall be treated from inside with 'Injection' and 'Surface' method which includes the internal plaster finished smooth with trowel. Injections shall be given to the floor and walls as and where found necessary and thereafter layer of "Cetroof" waterproof shall be laid on the floor and continued along the side walls to their full height. The thickness of treatment of the floor shall be about 6.6 mm and on the wall about 25 mm (one inch). The final surface of the floor and walls shall be finished smooth in cement.

Under ground tank - Injection and surface method :

In the case of new tanks after the plumbing work is completed under normal plaster to the outer surface of the walls, is provided by the main contractor before back filling. The tank shall be treated from inside with injection and surface methods which include the internal plaster finished smooth with trowel.

Injection shall be given to the floor and walls as and where found necessary and thereafter a layer of "Cetroof" waterproof shall be laid on the floor and shall be continued along the inner side of the end i.e. side walls and on both sides of partition and\or baffle walls upto their full height. This shall take care of both subsoil water leaking into the tank and the stored water leaking out of the tank.

The thickness of treatment on the floor shall be 65 mm (2.1\2") and on the walls 25 mm (1") it shall be finished smooth with trowel in cement colour without any further treatment.

It is essential and in the interest of work that the tank should be filled in by the main contractor immediately after the treatment is completed.

R.C.C Overhead tank Injection surface method :

In case of new tanks after the plumbing and plaster on the outer surface of the walls and floors is provided by the main contractor the tank shall be treated from inside with "Injection and Surface" method which includes the internal plaster finished smooth with trowel.

Injection shall be given to the floor and walls as and where found necessary and therefore a layer of "Cetroof" waterproof shall be continued along the inner side i.e. side walls as on both sides of partition walls upto their full height.

The thickness of treatment on the floor shall be 50 mm (2") and on the walls 20 mm (3\4"). It will be finished smooth with trowel in cement colour.

It is essential and in the interest of work that the tank should be filled in by the main contractors immediately after the treatment is completed.

Service ducts\basement Box method :

The under ground structure shall be treated by "Box Method". The bottom 150 mm (6") PCC shall be laid in a manner Projecting minimum 150 mm (6") beyond the ends of the R.C.C raft on all four sides. On the P.C.C waterproof layer, based on cement 75 mm thick (3") shall be laid. After the construction of the R.C.C raft and wall by the main contractor the said "Cetroof" layer is continued and carried along the outer surface of the walls upto a height of 300 mm (one foot) above the adjoining ground or apron level. The thickness of the treatment to the vertical surface shall be 30 to 35 mm (1.1\4" to 1.1\2").

10 *Waterproofing with Elastic Crystalline System*

Surface Preparation:

Surfaces to be waterproofed must be sound, clean, free of dust, paint, curing agents, loose plaster debris etc. Honeycombs should be opened up to ensure uninterrupted and even coating of waterproofing application. All final cleaning will be carried out with pressurized water using water jet. Apart from cleaning this will ensure that all pores, capillaries, pores and voids etc will be filed with water which is essential prior to treatment with cement based crystalline waterproofing systems.

All static cracks wider than 1 mm. in the substrate must be opened up to 12 mm X 12 mm. and treated with a mix of cement/sand mix with Bonding emulsion and water at least 24 hours prior to the application.

Fillets:

Similarly at all the junctions of the Horizontal slab and Vertical wall, the fillets must be built up with a mix of cement/sand mix with Bonding emulsion and water at least 24 hours prior to the application.

Down take / Pipe Insertions:

Pipe inserts If any must be installed prior to the waterproofing system. At the opening in the slab around the pipe, the substrate should be similarly opened up by cutting back around the pipes to give sufficient depth and cleaned thoroughly. This must be then built up with a mix of cement/sand mix with Bonding emulsion and water at least 24 hours prior to application.

Materials:

NB cement based crystalline waterproofing system
NB Elastic cement based crystalline waterproofing system
SB Bonding Emulsion liquid, Water, Brushes

MIXING:

To one bag of NB 1 (25 kgs) add 7 - 8 liters of water. Mix thoroughly to a slurry consistency. The system is now ready for application. To one bag of NB Elastic powders (25 Kgs) add 8 Kgs of liquid component.

.APPLICATION:

Dampen all the surface areas thoroughly with clean water using high pressure water jet apparatus, as this is necessary prior to the application of the NB system. The dampness in the substrate will ensure that the chemical reaction between the NB system and the chemicals in the concrete substrate takes place completely. However the application of the NB system should not be made over standing or running water.

NB-1Crystalline System(First *Coat*)

The NB system is brush applied, on to the already damped surface. The coverage is 0.75 kg per sq. meter first coat. The surface is allowed for the self curing for 8 Hrs.

NB-1Crystalline System(Second *Coat*)

Apply second coat of NB system on the first coat. The coverage is 0.75 kg per sq. meter. The surface is allowed for the self curing for 8 Hrs.

NB-1Crystalline System(Third *Coat*)

Apply third coat of NB system on the second coat. The coverage is 0.75 kg per sq. meter. The surface is allowed for the self curing for 8 Hrs.

NB Elastic System*(Fourth Coat)*:

The NB Elastic system is brush applied as a Fourth coat. This is to be applied with the thickness of 2mm Approx over the entire treated area.

Limitations:

The NB system cannot be applied on running or standing water.
The NB system once installed must be protected from damage by other agencies working in the installed area.

Further it can be protected by laying 20 mm (avg. thickness) cement sand screed (1:4) around the area for protection of waterproofing system on slab area & 12-15mm around the wall area. Curing of the screed will be done for 7 days. The quoted price does not include this item.

Materials:

Cement	43 Grades
Sand	River sand (silt content Max. 5%)
Water	Clean and free of deleterious substances

Mode of measurement and payment :

The rate shall be inclusive of cost of all materials including waterproof admixture, injection grouting, testing the tank and rectifying the defect and giving the guarantee on stamped paper. It shall be measured and paid on square metre basis.

8 Koster's alkaline cement – based crystalline water- proofing

Providing & installing Koster's alkaline cement-based crystalline NB system having Elasticity and self curing properties to the cleaned surface free of dust, paint curing agents, loose plaster debris etc. The waterproofing system is then Brush applied in 2 coats on pre- dampened surface including the sunken areas. The coverage is 0.60 kg per sq. meter per coat. for bathrooms the treatment should extend upto the shower spout level in the shower areas and extend 150 cms from the finished floor level. The waterproofing system shall include treatment of all Construction joints & pipe insertions with CK NB elastic system having elasticity of 80 %. Testing by pounding water to be done for 48 hrs. Brick Bat Coba may be applied directly on the NB system and laid to slope at extra cost.

SECTION – J

DOORS & WINDOWS

1 Teakwood work :

Timber used for joinery shall be of good approved quality or 2nd Class Teak wood unless otherwise specified (Ref.IS:4021) and shall be well seasoned (IS:1141) cut square, free from excess wane, from sapwood dead knot or other (Ref.IS:3364).

All timber for carpentry, joinery, rough frame work, backings, grounds, fixing strips and the like shall be treated with an approved wood preservative (Ref.IS:401) and the Contractor shall strictly observe the manufacturer's instructions for using this material. The maximum permissible moisture content in timber shall be in accordance with IS:287-latest.

All workmanship shall be of the best quality (IS:6534) Scantlings and boardings shall be accurately sawn and shall be of uniform width and thickness throughout. All carpenter's work shall be left with a sawn surface except where otherwise specified. Work shall be framed together and securely fixed in the best possible manner and with properly made joints. All brads, nails, screws, plugs, pins, etc. to be provided as necessary and as directed and approved.

Timber of approved quality is to be purchased at the commencement of the contract for further seasoning on the site. The preparation of timber is to commence simultaneously with the beginning of the work generally and to proceed continuously until all the wood work is prepared and stacked on or near the site. All the timber of large scantlings is to be sawn immediately on arrival at site to allow for any shrinkage that may take place. All timber brought to site shall be given anti-termite treatment.

Joints in various members forming any timber frame shall be provided only as shown in the drawings or as directed by the Engineer. Two millimetres will be allowed for each wrought face of the sizes specified except when described as finished in which case they shall hold to the full dimensions specified.

All work is to be properly tenoned, shouldered, wedged, pinned, braded, etc. to the satisfaction of the Engineer and all properly glued with best quality glue.

All joinery shall be finished off in a proper manner, planed and sand papered as required (IS:2338).

Use of nails shall not be permitted. Fixing of members shall be done by using screws or round brads, heads of which shall be properly punched in ends of timbers built into walls shall have air space lest between themselves and the walls.

All exposed faces of woodwork shall be sand papered once before erection for approval of the Engineer. No colour or other preservatives shall be applied without prior approval of the Engineer.

Frames for doors and windows will be provided with Mild Steel holdfasts made of 40mm x 3mm thick flats 200mm long and fixed into jambs M-15/10 P.C.C. 1200mm high frames with 6 Nos and frames above 2000mm with 8 Nos holdfasts. Each holdfast will be fixed to the frame with 3 Nos 50mm GI screws.

For fixing timber frames to concrete, rawl plugs and screws of 16 gauge shall be used wherever specified. Rawl plugs and screws of gauge 16 shall also be used for fixing rawl rough grounds, framing, hangers, hat hooks, curtain rails etc. Unless otherwise specified, screws used for the work shall be galvanised.

All timber surfaces coming into contact with masonry or concrete shall be given two coats of wood preservative or solignum approved by the Engineer.

Panelled and glazed shutters, styles and rails shall be as shown in the drawing, moulded and mortised together (Ref IS:1003). The shutters shall be square and free from twist.

All glazing is to be of sheet glass of selected quality and approved by the Engineer. It shall be clear and free from defects. It shall be cut to the required size and fixed to frame either with spring clips, with approved quality, or with teakwood beading as per details.

The Engineer may order any timber frame to be put together on the ground and submitted to suitable tests to his satisfaction before being placed in position. The cost of any such test shall be borne by the Contractor.

All surfaces of timber resting on or bedded in masonry or concrete shall be well coated with coal tar.

All fixing holes shall be pelleted and concealed from view.

35mm thick flush type block board (IS:2202) shall be manufactured from selected timber well seasoned and shall be of solid particle board core construction with 25mm thick teak wood lipping all around the edge. The stiles and rails shall be of one piece or alternatively, two or more pieces glued together. The thickness of the cross band shall not be less than 3mm and the thickness of the facing shall be of best quality commercial ply thickness not less than 1.5mm. Where veneer finish, or formica finishes or any other type is specified they shall be glued separately. All the plywood shall be glued under pressure. Glue used shall be phenol formaldehyde resins.

Fixtures :
All doors and windows shall be provided with best quality fixtures as specified in the drawing. Samples of all fittings shall be submitted for approval by the Engineer. Unless otherwise specified, hinges, tower bolts, aldrops, handles, baby latches, etc. shall be of best quality brass oxidised of specified size. Mortise lock, hydraulic closer and other fixtures shall be of approved make. All the fittings shall be fixed with brass screws.

Painting :
Painting shall be carried out only after the joinery has been inspected and approved by the Engineer. The surface preparation and applying of primer coats of paint and final coats of paint shall be carried out as per specifications for painting. Unless otherwise specified a minimum of 2 coats of primer paint and 3 coats of final paint to be applied.

Where polishing or varnishing is specified, the surface to be varnished or polished shall be protected from contamination such as inadvertent painting and surface damage. The polishing or varnishing shall be according to the specifications for varnishing or polishing under the section Painting.

2 Steel Door Frame (IS:4351) :

Unless otherwise specified or standard profile from commercial mild steel sheets of 1.25mm thickness. The profile shall be such as to suit the door shutter specified. Each frame shall consist of hinge jamb, lock jamb, head and base ties 25mm x 1.25mm thick or of specified angle threshold. The whole frame shall be of welded connection or rigidly fixed together by mechanical means. MS holdfasts shall be same as specified for wooden door frames. Necessary adjustable lock strike plate to make provision for locks or latches.

Unless otherwise specified, the frame shall be given a phosphate treatment after surface preparation and followed by two coats of paint which shall be baked after applying.

Where hot dip galvanising is specified the same shall be carried out as per IS:1477.

The frames shall be delivered and stored at site without any distortion or damage. They shall be erected with temporary struts to keep them in correct position and plumb. After each course of masonry is built, the gap between masonry and frame shall be filled with 1: 4 cement mortar. The holdfast shall be embedded in concrete mix M-15/10. The temporary strut shall not removed till masonry has set.

3 Steel Windows and Doors (IS:1361) :

All steel windows shall be obtained from approved manufacturer and the steel section used shall conform to IS:7452. Coupling members for composite windows shall be fabricated from steel conforming to IS:226.

The fabrication of frames shall be of best workmanship. The joints shall be welded and ground properly without leaving any cavity. Intersection of Tee section for glazing shall be tenoned and gap shall be closed by hydraulic pressure.

Necessary holes required for fixing coupling sashes, glazing clips, etc. shall be provided.

All necessary MS holdfasts required for embedding shall be fixed to frame. Wherever steel frame is to be fixed to concrete members, necessary holes shall be made for fixing with screws.

Bottom hung, top hung and side hung shutters shall be provided with standardised steel hinges and/or side arms (which when shutter is closed is invisible).

Centre hung shutters shall be mounted on a pair of brass cup pivots, each pivot consisting of inner and outer cup and capable of remaining open in any direction. The frame shall be provided with bronze spring catch.

The handles and pegstays shall be heavy duty and shall be brass oxidised.

Unless otherwise specified, the frames shall be finished with hot dip galvanising. Where specified painting shall be done in accordance with the specifications for painting.
The frames shall be erected in accordance with manufacturer's instructions. The frame shall be aligned and kept plumb by suitable supporting arrangement. As the masonry is being constructed the holdfasts are embedded in concrete mix 15/10. Where required for fixing with concrete

member, rawl plug and GI screws shall be used. The joints between the steel frame and masonry work, after being finished with plaster shall be finished with approved bitumen mastic.

Glass panes, unless otherwise specified shall be of 4mm thickness and shall be free from flaws, specks and bubbles. It shall have properly squared corners and straight edges, and shall be fixed to frame with glazing pins and approved putty.

4 Aluminium Windows and Doors (IS:1948 & IS:1949) :

Aluminium alloy shall conform to IS:733 and IS:285. The Contractor shall submit the sample of section he is proposing to use for the frame, for approval. He shall also indicate the weight of section per one metre length. He shall also submit for approval the sample of hinges, handles, pegstays or any other item that may require the approval of the Engineer.

The glass panes, unless otherwise specified, shall be of 4mm thickness for windows and 5.5mm thickness for doors and shall be free from flaws, specks and bubbles. They shall have properly squared corners and straight edges. Fixing to frames shall be done with approved glazing pins and approved quality rubber beading.

Frames consisting of extruded hollow tube sections or other profiles shall be square and flat, the corners of the frame being fabricated to a true right angle. The hinges shall be either of projection type, or friction hinges. Necessary coupling of approved shape shall be provided for composite windows. All holes required for fixing frame, for fixing glazing shall be provided. Only brass screws shall be used for fixing the frame to concrete members.

Vertical and horizontal members shall be of adequate rigidity to resist lateral forces. Design calculation shall be submitted for deflection of members.

All the fixtures for centre hung shutters, top and bottom hung shutters, or side hung shutters shall be got approved before they are used. The fixtures used should be such that it should be possible to open the shutter to any angle.

Unless otherwise specified, aluminium doors shall be provided with floor springs of approved quality and make.

All aluminium members shall be supplied in either matt or polished finish including anodising them by electrochemical process to an approved colour and to a thickness of average 0.25mm. The frame shall be protected with a layer of clear transparent lacquer based methacrylates or cellulose butyrate. The coating shall be removed after installation is completed and after completing finishing work in the adjoining area.

The erection of frame shall be same as detailed under steel windows. Where aluminium frames come in contact with steel members, they shall be separated by either a 3mm thick rubber gasket for full width of aluminium member or any other approved film so as to avoid metallic corrosion.

5 Rolling Shutters (IS:6248) :

Rolling shutters shall be as per the size to suit the dimensions of the openings shown in the drawing. Unless otherwise specified, they shall be fabricated out of 18 G thick mild steel laths of convex

corrugation with rolling centre either 75mm or 65mm and with minimum 12mm corrugation depth. The laths shall be interlocked by alternate end clips.

The side guides shall either be of rolled section or one piece pressed construction and shall be of size 25mm wide, 75mm deep, thickness shall not be less than 3mm.

The shutter shall be provided with bottom lock plate 3mm thick and reinforced by an angle iron stiffener at the bottom and MS flat at the top.

The suspension shaft shall be of adequate design and unless otherwise specified shall be formed from 8 guage seamless tube, 60mm O.D. with suitable flange coupling.

The springs shall be of approved high tensile steel flat or coil spring hardened and tempered. These shall be fitted inside the fabricated housing.

The ball bearings shall be double self aligning ball bearings fitted inside CI housing fixed on side brackets holding the suspension brackets at either ends.

The suspension of the shutter shall be bolted on specially fabricated cages formed from MS flats and plates all arc welded.

The hood cover shall be made of 20 gauge MS sheets with necessary stiffeners and framework.

The locking arrangement shall consist of hoop and stable on the bottom plate, lockable from both the sides.

Unless otherwise specified, for overall area of rolling shutters upto 5 m2 pull and push type hand operated shutters shall be provided, for area from 5 m2 to 10 m2 pull and push type with ball bearings shall be provided and for area larger than 10 m2, mechanically operated gear type and/or electrically operated shutters shall be provided.

The shutters, hood covers, etc. shall be carried out according to manufacturer's specifications. While fixing to concrete members, only shell anchors shall be used. Chiselling of concrete for fixing bolts will not be allowed.

6 <u>Fibre Glass Reinforcement Polyester (FRP) Doors :</u>

FRP Door Frames :
Supplying FRP frame of section 125mm x 65mm champhered type with provision to fix FRP shutters. FRP thickness to be 2.0 mm plus with extra reinforcement on sides and edges. The core of frame to be polyol foam/ with wooden styles embedded for taking hinges, fixtures etc. the side facing masonry to be only covered in FRP. The whole section to be totally waterproof, resistant to mild, acids, alkalies. Colour/painting as per direction of Engineer-in-charge. Frames shall be measured in linear metre.

FRP Door Shutter :

Supplying FRP moulded shutters 35mm thick, in panel, design as approved. FRP thickness to be 2.0 mm with extra reinforcements on sides and edges. The core of the shutter to be polyol foam done insitu with wooden styles embedded for taking hinges, fixtures etc. both sides of shutters to be finished in gel-coat. Shutters to have recess for hinges. The whole shutter to be totally water proof resistant to mild acids, alkalies. Colour/ painting as per direction of Engineer-in-charge.

Shutters shall be paid on actual dimension of shutters in square metre.

7 Mode Of Payment and Measurement :

Wooden Doors and Windows :

The rate quoted shall include the cost of all frames, shutters, glass panes, if any, and all necessary fixtures, wooden preservatives, fixing them in position and embedding the holdfasts in concrete and/or fixing the frames to concrete members with rawl plugs, screws, surface preparation, either applying specified number of coats of approved paint or polishing complete, and shall be paid on square metre basis.

For measurement of doors, the width shall be overall width of the frame measured prior to plastering, and height shall be measured from finished floor level to the top of topmost frame prior to plastering.

For measurement of windows, the width and the height shall be overall frame size measured prior to plastering.

Where only door shutters are to be paid separately as in the case of partition walls, they shall be paid on actual dimension of shutters.

Woodwork other than Doors, Shutters :

Unless otherwise specified, the woodwork shall be measured in cubic metre basis. The length, breadth and depth of the member shall be measured after planing.

Steel Doors and Windows :

The rate quoted shall include the cost of supplying, fabricating and fixing in position frames, putty, glass panes, all necessary fixtures, applying paints as specified, embedding hold fasts in concrete or fixing to concrete members rawl plugs and GI screws etc. complete and shall be paid on square metre basis.

For measurement for windows, the width and height shall be the overall dimension measured prior to plastering.

For doors, the width shall be the overall width prior to plastering and the height shall be from finished floor to the top of top frame measured prior to plastering.

Aluminium Doors and Windows :

The rate quoted shall include the cost of supplying, fabricating and fixing in position frames, glass

panes, rubber beading, all fixtures including floor springs, hinges, etc anodising, applying protective cover, embedding the holdfast in concrete and/or fixing the frames to concrete members with rawl plugs and brass screws and where necessary the cost of rubber gasket (3mm thick) barrier between aluminium member and steel member etc complete.

Measurement shall be same as described for steel doors and windows.

Rolling Shutters :

The rate quoted shall include the cost of supplying, fabricated, fixing in position with shell anchors, or rawl plugs, bolts, all necessary fixtures including surface preparation and applying paint as specified and shall be paid on square metre basis.

For measurement the basis shall be overall dimension of the rolling shutter.

8 Curtain Walling :

1 Materials :

a) Aluminium alloy for framing system shall conform to IS 1285. The Mechanical properties of
aluminium alloy shall have properties that of design Number 64430 Table 2 of IS 1285 Samples of aluminium sections shall be tested in an approved laboratories for mechanical properties.

Anodising of aluminium sections shall be as per ID 7018 and
IS 1868. Average thickness of anodising shall be 0.020 mm and shall be either Matt or polished finish. The anodised members shall be protected during the installations of frames as per IS 1948.

b) The silicone sealant shall be of approved grade and make. The sample of Silicon sealant shall be tested for confirmation of the quality as specified by the Silicone manufacturer.

c) The EPDM Neoprene rubber gasket, where used, shall be of approved

d) Grade and make. The sample of the gasket shall be tested for confirmation of the quality as specified by the manufacturer.

2 Curtain Walling System

Framing system :

The framing system, shall be of structurally and mechanically engineered design technology whereby the frames shall be prefabricated in the curtain waller's factory in modular units equivalent in size to one full floor in height and one full window module in width. Horizontal frames shall be of corresponding width and shall span in length between vertical faces. The perimeter of the frames shall be coupled together at sides and ends of horizontal panels, and toes and sides of vertical panels to provide, a structurally integrated air and waterproof movement joint on all four sides of each panel.

Structural Glazing System :

The glazing system shall be of professionally engineered 'Structural Glazing technology whereby each glass panel shall be manufactured in the glass factory in full completed modular units of precise size to fit into each modular unitised framing panel with pattern as designated.

The thickness and strengthening method of each pane of glass shall be engineered to accord with the manufacturers highest recommendation for each application.

The manufacture of each pane of glass shall be to the manufacturer's highest recommendations.
Quantities and sizes shall be established by the curtain waller and shall provide for spares to cover construction breakage and future maintenance. Openable window shall be provided as per the drawing with required hardware and shall conform the under mentioned standard.

Each pane of glass shall be factory bonded with structural silicone to the frame.

On site glazing shall be limited to constructional closure panels.

All bonded glass shall be held statically in position without strain for a Period of not less than 14 days as recommended by the silicone manufacture.

The entire system shall allow for expansion and contraction and building movements and shall be self draining at each horizontal panel joint.

Fixing of Panels to Structure :
Each panel, shall be factory prefabricated, preglazed and factory cured, and then installed on site.

Each panel shall have engineered corrosion proof fixing brackets bolted to the side frames, and bolted to the building structure.

Installation of Frames :
Each panel shall generally be installed from within the building.

Soffit panels shall be delivered from within building and installed from an external scaffold or from a mobile scaffold.

Smoke Seals :
Provide corrosion proof smoke seals of flexible design and construction between the building structure and the curtain walling to ensure a complete smoke seal of cavity spaces.

3 Design Responsibilities :

The curtain waller shall be responsible for the quality and efficiency of the design and application of the curtain wall technology required. The design shall be based on the schematic drawings of Architects including design analysis, preparation of detail shop drawings complete.

It is mandatory that the system be aesthetically pleasing and structurally sound and that the system has been pretested in an appropriate manner to international curtain walling standards in an accredited overseas laboratory.

4 Aesthetic Design Features :

Vision panels, and spandrel panels and soffit panels shall be of high performance class selected and manufactured to provide matching external appearance during the day. All framing shall be neatly and accurately formed and be of neat even thickness.

The junction between unitised panels shall be true to line.

All heat strengthened tempered glass shall have roller lines in a constant direction at all times.

Opening lites shall be extremely frameless in the main facades.

5 Design Loading :

The curtain walling shall be designated to with stand the following forces without failure:

a) Wind loading's as per IS 875
b) Earthquake Forces as per IS 1893 with important factor 1.0.
c) Building movement - 10 mm maximum.

6 Curtain Walling performance Criteria

a) Deflection - shall be limited to 1/20th of the span of the member.

No distortion - Composition of curtain walling member shall be adequate to fully resist distortion.

Movement-The curtain walling system shall be capable of accommodating all stress and movements that are likely to occur during the normal life of the cuts in wall.

Long term movements - Following long term movements shall be taken into account while detailing the curtain wall.

i) Shortening of the frames - 0.6mm for three storied structure to 2.0mm for10 stories structure.
ii) Racking of structure - Nil
iii) Differential deflection - 3mm

7 Building Construction Tolerances :

Before the fabrication of curtain wall, the contractor shall take the actual measurements of building and carryout necessary correction in the shop drawing.

8 Prototype Test Results :

The sub-contractor shall submit full representative test results to an approved international standard such as Australian Standards A.S. 2047 or other equivalent.

The results shall include :

i) Deflection test +ve and -ve
ii) Air-infiltration tests
iii) Water penetration tests.

9 Building Clearances

The following clearances have been incorporated into the building design.

a) Vertical cladding Nominal 150mm from outside of cladding to outside of structure.
b) Horizontal cladding (soffits) minimum. 230 mm from outside of cladding to any part of the structure.

10 Buildings Maintenance Unit (B.M.U.)

The curtain waller shall be responsible to provide an internationally accredited building maintenance system for the cleaning of the curtain walling located at Terrace Floor Level. However it shall not be required for cleaning of the sections of curtain walling beneath the cantilever sections of the building. Such sections shall be accessed for cleaning as follows :

Soffit - Grid opening lites in the outer wall.

Vertical walling - Vid special scaffolding to be supplied by the building owner.

The Contractor shall ensure that certain feasible methods of cleaning system is provided and brought out at the time of tendering.

Mode of Payment and Measurement

Wooden Doors and Windows :

The rate quoted shall include the cost of all frames, shutters, glass panes, if any, and all necessary fixtures, wooden preservatives, fixing them in position and embedding the holdfasts in concrete and/or fixing the frames to concrete members with rawl plugs, screws, surface preparation, either applying specified number of coats of approved paint or polishing complete, and shall be paid on square metre basis.

For measurement of doors, the width shall be overall width of the frame measured prior to plastering, and height shall be measured from finished floor level to the top of topmost frame prior to plastering.

For measurement of windows, the width and the height shall be overall frame size measured prior to plastering.

Where only door shutters are to be paid separately as in the case of partition walls, they shall be paid on actual dimension of shutters.

For Woodwork other than Doors, Shutters :

Unless otherwise specified, the woodwork shall be measured in cubic metre basis. The length, breadth and depth of the member shall be measured after planing.

Steel Doors & Windows :

The rate quoted shall include the cost of supplying, fabricating and fixing in position frames, putty, glass panes, all necessary fixtures, applying paints as specified, embedding holdfasts in concrete or fixing to concrete members with rawl plugs and GI screws etc. complete and shall be paid on square metre basis.

For measurement for windows, the width and height shall be the overall dimension measured prior to plastering.

For doors, the width shall be the overall width prior to plastering and the height shall be from finished floor to the top of top frame measured prior to plastering.

Aluminium Doors & Windows & Curtain walling :

Method 1 :

Measurement on area basis. The rate quoted shall include the cost of supplying, fabricating and fixing in position frames, glass panes, rubber beading, all fixtures including floor springs, hinges, etc anodising, applying protective cover, embedding the holdfast in concrete and/or fixing the frames to concrete members with rawl plugs and brass screws and where necessary the cost of rubber gasket (3mm thick) barrier between aluminium member and steel member etc complete. Sealing joint between all Civil work and Aluminium frame with neutral grade Silicone Sealant etc.

Measurement shall be same as described for steel doors and windows.

Method 2 : Where specified, in this method aluminium sections shall be measured and paid on the basis of actual weight used in the work which shall include the weight of aluminium fixtures such as hinges, handles, floor springs, including anodising, applying protective cover, fixing materials, charges etc.

The rate for the glass shall include the cost of all non-aluminium fixtures, such as neoprene gasket, Nylon rollers, anti rattling pieces, Silicone sealants between frame and civil work etc., and the actual area of glass used in the work shall be measured and paid.

Rolling Shutters :

The rate quoted shall include the cost of supplying, fabricated, fixing in position with shell anchors, or rawl plugs, bolts, all necessary fixtures including surface preparation and applying paint as specified and shall be paid on square metre basis.

For measurement the basis shall be overall dimension of the rolling shutter.

10 U-PVC (un-plasticized Polyvinyl Chloride) windows & doors.:

U-PVC doors & windows are to be confirmed as per the standards specified by BS 7413 & BS 7412 and as per detail sections attached.

BS 7413 confirms to

1. Surface finish
2. Reversion/ Residual stress
3. Dimensional Tolerances
4. Colour
5. Colour Fastness (UV stability)

BS 7412 confirms to

1. Weld strength
2. Dimensions & Tolerances
3. Correct hardware application
4. Wind Load
5. Air infiltration
6. Water penetration
7. Operation

SECTION – K

WATER SUPPLY & SANITARY INSTALLATION

1 GENERAL

All plumbing and sanitary work should be carried out by competent licensed plumber only, and the material and workmanship shall conform to the following I S Codes and relevant bye-laws of local Municipal Authorities. All necessary approvals and completion certificates from Municipal. Airport and other regulatory authorities shall be obtained by the contractor.

IS:1536-1976	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
IS:1537-1976	Specification for vertically cast iron pressure pipes for water, gas & sewage.
IS:1538-1976 Parts I - XXIV	Specification for cast iron fittings for pressure pipes for water, gas & sewage.
IS:6163-1978	Specification for centrifugally cast (spun) iron low pressure pipes for water, gas and sewage.
IS:1729-1979	Specification for sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS:3114-1985	Code of Practice for laying of cast iron pipes.
IS:1879-1975 Parts I-X	Specification for malleable cast iron pipe fittings
IS:1230-1979	Specification for cast iron rainwater pipes and fittings
IS:3486-1966	Specification for cast iron spigot and socket drain pipes
IS:3516-1966	Specification for cast iron pipe flanges and flanged fittings for petroleum industry
IS:3989-1984	Specification for centrifugally cast (spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories
IS:1978-1982	Specification for line pipe
IS:2643-1975 Part I	Dimensions for pipe threads for fastening proposes Part I - Basic profile & dimensions
IS:2643-1975 Part II	Dimensions for pipe threads for fastening purposes Part II – Tolerances

IS:2643-1975 Part III	Dimensions for pipe threads for fastening purposes Part III - Limits of sizes
IS:5603-1970	Specifications for fully automatic elbow joint
IS:5822-1970	Code of Practice for laying of welded steel pipes for water supply
IS:6631-1972	Specification for steel pipes for hydraulic purposes
S:1239-1979 Part I	Specification for mild steel tubes, tubulars and other wrought steel fittings Part I - Mild Steel tubes
IS:1239-1982 Part II	Specification for mild steel tubes, tubulars and other wrought steel fittings Part I - Mild Steel tubulars and other wrought steel pipe fittings
IS:6392-1971	Specification for steel pipe flanges
IS:458-1971 IS:783-1985	Specification for concrete pipes (with and without reinforcement) Code of Practice for laying of concrete pipes
IS:3597-1966	Methods of tests for concrete pipes
IS:4350-1967	Specification for concrete porous pipes for under drainage
IS:784-1978	Specification for prestressed concrete pipes (including fittings)
IS:7322-1985	Specification for specials for steel cylinder reinforced concrete pipes
IS:1916-1963	Specification for steel cylinder reinforced concrete pipes
IS:7563-1975	Code of Practice for structural design of cut and cover concrete conduits
IS:1592-1980	Specification for asbestos cement pressure pipes
IS:9627-1980	Specification for asbestos cement pressure pipes (Light duty)
IS:6530-1972	Code of Practice for laying of asbestos cement pressure pipes
IS:5531-1977 Part I-III	Specification for cast iron specials for asbestos cement pressure pipes for water, gas and sewage
IS:4985-1981	Specification for unplasticized PVC pipes for potable water supplies

IS:7634-1975 Part III	Code of Practice for plastics pipe work for potable water supplies Part III - Laying & jointing of unplasticized PVC pipes
IS:10124-1982 Part I	Specification for fabricated PVC fittings for potable water supplies Part I - General requirements
IS:10124-1983 Part VII	Specification for fabricated PVC fittings for potable water supplies Part VII - Specific requirements for threaded adaptors
IS:3076-1985	Specification for low density polyethylene pipes for potable water supplies
IS:651-1980	Specification for salt-glazed stoneware pipes and fittings
IS:3006-1979	Specification for chemically resistant glazed stoneware pipes and fittings pipes
IS:4127-1983	Code of Practice for laying of glazed stoneware
IS:1172-1983	Code of Basic requirements for Water Supply, Drainage and Sanitation
IS:2065-1983	Code of Practice for Water Supply in Buildings
IS:2401-1973	Code of Practice for Selection, Installation and Maintenance of Domestic Water Meters
IS:1742-1983	Code of Practice for Building Drainage
IS:2470-1985 Part I	Code of Practice for Installation of Septic Tanks Part I - Design Criteria and Construction
IS:2470-1985 Part II	Code of Practice for Installation of Septic Tanks Part II - Secondary Treatment and Disposal of Septic Tank Effluent
IS:5329-1969	Code of Practice for Sanitary Pipe Work above ground for buildings
IS:4111-1986 Part I	Code of Practice for Ancillary structures in Sewerage System Part I - Manholes
IS:4111-1985 Part II	Code of Practice for Ancillary structures in Sewerage System Part II - Flushing Tanks
IS:4111-1985 Part III	Code of Practice for Ancillary structures in Sewerage System Part III - Inverted Siphon

IS:2064-1973	Code of Practice for Selection, Installation and Maintenance of Sanitary Appliances
IS:2527-1984	Code of Practice for Fixing Rainwater Gutters and Down pipes for Roof Drainage
IS:6924-1973	Code of Practice for the Construction of Refuse Chutes in Multistoreyed Buildings
IS:12592-1988 Part I	Specification for precast concrete manhole covers & frames Part I - Covers
IS:1726-1974 Part VII	Specification for cast iron manhole covers & frames Part VII - Section I

All fittings and fixtures shall be got tested and approved and stamped by local Municipal Authorities. Formalities for obtaining approval for the drainage and plumbing work before starting the work and getting Completion Certificates after the work is satisfactorily completed, shall be done by the Contractor. The Contractor shall prepare a board on which all approved samples will be mounted and the same shall be displayed at the site office during the entire period of execution of work. The rates for all the plumbing and sanitary items shall be deemed to have included the cost for making holes in walls, providing and fixing screws, wooden plugs, cleats where necessary, cutting floors, chasing in walls & floors (concrete) etc, making good, testing, getting approval and Completion Certificate etc complete.

Unless otherwise specified, all exposed or concealed pipes, GI, CI or lead shall be painted with three coats of paint of approved quality and colour.

The items for concrete work shall be as per the specifications given in Section B (Concrete - Plain & Reinforced), Section C (Formwork) and Section D (Reinforcement). The items for brick masonry work shall be as per the specifications given in Section F (Masonry work) and Section G (Plastering & Pointing).

2 DRAWINGS :

The drawings are design drawings and are generally schematic. They do not show all offsets, T's, Cross, Y's, junction coupling/flanges etc, which are required for installation in the space provided. The Contractor shall follow the drawings, as closely as is practicable and install additional bends, elbows, or junctions, etc where required to suit local site conditions, from actual site measurement taken, subject to approval and without additional cost to the Owner.

The Engineer reserves the right to make any reasonable change in the location of fittings prior to fixing. All connections and appurtenances, shown in the various diagrams, shall be included in the finished job.

It shall be the Contractor's responsibility to coordinate with all other agencies, for proper and adequate installation clearances.

3 SHOP DRAWINGS

The contract drawings shall serve as guidelines for general layout of the piping and various items of equipment. The Contractor shall prepare and submit for approval, detailed shop drawings of all items, setting drawings, clearance drawings, etc.

It shall be the Contractor's responsibility to see that all deviations from drawings and specifications, shall be specifically noted on the drawings and brought to the attention of the Architects/Consultants, otherwise approval shall be automatically voided.

4 TRENCH LINES AND LEVELS

The Contractor shall check, dimension at the building site and establish lines and levels for the work specified.

All inverts, slopes and manhole elevations shall be established by instruments, working from an established datum point. Elevation markers and lines shall be provided so that slopes and elevations can be checked.

Established grid and area lines shall be used for location of trenches in relation to building and boundaries. Trenches shall be carried out to the true alignment and to required levels. No refilling will be allowed for the purpose of making up the bed of trenches, but to make up the same with lean concrete mix 1:3:6.

Use of sight rails, boning rods shall be adopted during the whole process of excavation and laying of the pipes.

Sight rails shall be fixed at suitable intervals which shall not exceed twenty metres before the excavation is begun. No extra charges will be paid for excess excavation.

Sufficient width shall be provided to the trenches to allow a space of 300mm on either side of the pipe to facilitate laying of the drains and jointing, subject to a minimum of 900mm.

When the trenches are in deep or bad ground, the sides of the trenches shall be supported with suitable timbering.

All pipes, water mains, or gas mains telephones and cables etc met within the course of excavation, shall be carefully protected and supported without any extra charges.

5 EXCAVATION AND BACKFILL

Excavation and backfilling shall be carried out conforming to specification for earthwork. Perform all necessary excavation and backfill required for installation of plumbing work, excavation shall conform to the limits indicated on the drawings.

6 STONEWARE PIPES, BENDS, JUNCTIONS, JOINTING & TESTING

All stoneware pipes, bends, junctions, gully traps, intercepting traps shall be salt glazed inside and outside and shall fulfill the conditions of IS:651-1965 and shall be of Perfect Potteries, Kashimira, Burn & Company, Navroji Vakil, Rajura or approved equivalent make.

Acid resisting stoneware pipes, bends, junctions, gully traps, etc shall be of the approved make or equivalent.

The pipes shall be hard, sound, truly circular in cross section, perfectly straight, free from all flaws and projections.

Before being laid, the pipes shall be thoroughly cleaned specially from the inside. Cracked or chipped pipes shall not be used on the work.

Tarred gasket or hemp yarn soaked in thick cement shall first be placed round the spigot of each pipe and the spigot then be placed well home into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly home so as to fill more than 1/4 of the total depth (12mm in depth) of the socket.

The remaining space in the socket shall then be tightly and completely filled with cement mortar composed of one part of cement and one part of sand, and shall be neatly levelled off, outside the socket of the pipe at an angle of 45 degrees. A wooden caulking tool shall be used for forcing the mortar home into the socket. The inside of each pipe shall than be carefully wiped with a mop or scraper, sufficiently long to pass two joints from the end of each pipe and any projecting or extra cement shall be removed to leave the inside of the pipe clean as the work proceeds. All the joints shall be kept moist either by means of wet hessian bags to protect them from the sun or wind. All pipes entering manholes shall be set in cement mortar to effect a complete watertight junction.

All round the pipe, there shall be a joint of cement mortar 12mm thick between it and the bricks. The end of all pipes shall be properly built in and neatly finished off with cement mortar with the manhole/ancillary structure.

After sufficient interval has been allowed for the joints to set and before filling the trench, the joints of the pipes and drains shall be proved water tight by filling the pipe with water to a level above the top of the highest pipe in the length to be tested, closing the ends of the sections and maintaining the water level for a period of one hour with a waterhead of 2.5m as per IS:4127. The drop in water level is not to be more than 2 litres per cm of diameter per kilometre during a period of 10 minutes.

All such testings shall be done wholly at the Contractor's expense, inclusive of apparatus, provision of water etc and the rate covers all the above work including c.c. beddings etc.

Any leakage or excessive sweating from a particular pipe shall be made good by cutting out the pipe and redoing and retesting the same at the contractor's own cost. Any leakage or excessive sweating from a joint may be allowed to be rectified by embedding the joint with M15/10 concrete 150mm thick all around and retesting the same at the contractor's own cost.

The pipes shall be laid to the alignment and gradient shown on the plan. Unless otherwise specified the maximum permissible slopes to the various diameters of pipes are as follows :

100mm dia pipe ..... 1 in 40
150mm dia pipe ..... 1 in 80
200mm dia pipe ..... 1 in 100

Unless otherwise specified the joints of pipes shall be laid on a bed of plain cement concrete M15/10 and minimum 150mm thick and shall be protected by providing haunching upto half the diameter of the pipes. The width of the concrete bed for various diameters shall be as follows :

100mm dia pipe ..... 400mm wide
150mm dia pipe ..... 450mm wide
200mm dia pipe ..... 600mm wide

For the remaining length of pipe, a 150mm thick murrum bedding, well compacted, shall be provided.

The backfilling material shall be got approved before the commencement of backfilling in the trenches. All backfill material shall be free from cinders, ashes, slag, refuse, rubbish, vegetable or organic material. The backfilling materials shall be packed in an approved manner around and over the pipe and compacted in layers not more than 300mm thick.

7 CONCRETE HUME PIPE DRAINS, LAYING, JOINTING & TESTING

Cement concrete pipes where called for on the drawings, shall be centrifugally spun reinforced cement concrete pipes of an approved manufacture. Pipes shall be true, perfectly sound, free from cracks, cylindrical, straight with a uniform bore throughout. Cracked or warped pipes with uneven texture shall not be used. Pipes shall be 'Hume' pipes or equivalent. These pipes shall conform to IS:458. The number of tests and the number of samples to be selected at random and the acceptability criteria shall be as per IS:458.

The pipe shall be straight and free from cracks excepting craze cracks. The ends of the pipe shall be square to their longitudinal axis, so that when placed in a straight line in the trench no opening between ends in contact shall exceed 3mm from 150mm including and upto 600mm and 6mm in pipes larger than 600mm dia.

The outside and inside surface of the pipes shall be smooth dense and hard, and shall not be coated with cement wash or other preparation. The pipes shall be free from local dents and bulges greater than 3mm in depth and extending over a length in any direction greater than twice the thickness of the barrel.

The pipes shall be transported, stacked, handled, laid in trenches in such a manner as to prevent damage to pipes. The pipes shall be inspected before being laid in trenches. Minor damage may be allowed to be repaired at site but such repairs shall be carried out only by the pipe manufacturer or under his supervision.

The pipes, before being laid, shall be brushed throughout to remove any soil or stone, that may have accumulated therein, the inside of the socket and outside of the spigot being carefully cleaned. For small pipes, they should be tilted up, to remove any accumulations.

Trenches for pipes shall be of sufficient width so as to provide a free working space on each side of pipeline.

The pipes shall then be carefully laid in position to true line and level.

Concrete Pipe shall be jointed as described in IS:783. After setting out the pipes, the collar shall be centred over the joint and filled in with tarred gasket till sufficient space is left on either side of the collar to receive the mortar. This space shall then be filled with 1:2 cement mortar (1 cement : 2 washed coarse sand) and caulked by means of proper tools. All joints shall be finished at an angle of 45 degrees to the longitudinal axis of the pipe on both sides of the collar. The joint shall be cured for at least 7 days with wet hessian bags.

Testing : Testing of pipes shall be carried out as per IS:783 and any leakage observed in the pipe or joint shall be made good by the contractor.

Backfilling of trenches shall be carried out in accordance with IS:783 latest. In cases where the foundation conditions are unusual, the pipe shall be enclosed around in 15cm thick M15/10 cement concrete.

1 CAST IRON PIPES & FITTINGS (CI S/S - CI/DF) TO IS:1536 LA OR A CLASS FOR LAYING, JOINTING AND TESTING AND FOR APPLICATION IN WATER MAIN - EMBEDDED IN FOUNDATIONS OTHROUGH BUILDINGS SUCH AS RAIN WATER LINES (WITHIN BUILDING) - OR DRAIN LINES (HORIZONTAL RUNS IN PLENUM/OR BELOW THE SLAB IN HORIZONTAL POSITION) :

All cast iron pipes and fittings shall be truly cylindrical of the clear internal dia. specified, of a uniform thickness, smooth and with strong and deep sockets free from flaws, air bubbles, cracks and sand- holes and other defects. They shall not be brittle but shall allow for ready cutting, chipping and drilling. The fittings shall be of medium type cast iron conforming to the latest version of IS:1537.

The pipes shall be lowered in the trench by means of suitable pulley blocks, shear legs, chain, ropes, etc. After lowering the pipes they shall be arranged to coincide the centre line with the centre line of alignment. The pipes shall be laid in position, socket end of all pipes facing the direction of flow. The spigot shall be carefully centred in the socket by one or more laps of hemp or spun yarn only being forced into the socket to leave the required depth for lead. When the spigot is shoved home, the yarning material shall be driven tightly inside base or hub of the socket. The proper depth of each joint shall be tested before running the lead by passing completely round it a wooden gauge, notched on to the corrected depth of lead. The pipe shall be carefully packed underneath so that they shall bear properly through their whole length. The lead shall be rendered thoroughly, fluid at each joint and shall be filled in one pouring. The lead used shall be pig lead with 99.8% purity and shall conform to IS:782 latest.

Quantity of lead for joint shall conform to IS:3114 latest and shall be as given below.

Nominal Size of Pipe mm	Lead/Joint Kg	Depth of lead joint mm
80	1.8	45
100	2.2	45
125	2.6	45
150	3.4	50
200	5.0	50
250	6.1	50
300	7.2	55

The joint runner shall fit snugly against face of the socket and the outside of the pipe shall be dammed with the clay to form a pouring lip to provide for filling the joint flush with the face and top of the socket.

After the joints have been run they must be thoroughly caulked until they are perfectly watertight. Caulking of joints will be done after a convenient length of pipe has been laid and leaded. The leading ring shall first be removed and any lead outside the socket shall be removed with a flat chisel and the joint caulked round three times with caulking tools of increasing thickness and a hammer of 2 to 3 kg weight. Lead joints shall not be covered till the pipe lines are tested under pressure, but the rest of the pipe lines may be covered to prevent expansion and contraction due to variation in temperature.

When it is inconvenient to use molten lead for joints, with prior approval they may be made with lead wool inserted in strings not less than 6mm thick and thoroughly caulked. The quantity of lead wool spun yarn for different diameter of pipes shall conform to IS:3114 latest.

The lead joints shall be tested to a pressure of 11 kg/cm2 minimum or such head as otherwise specified after being caulked and should any leakage occur, the leaking joints shall be remade and section retested at Contractor's own expanse until satisfactory results are obtained.

Water Pressure Mains : Shall conform to IS:1536-1967 Class LA as specified in the schedule. They shall be laid, jointed, and tested along with the CI Pipes as described in the specification for CI S/S pipes.
Flanged Pressure Mains : Flanged joints to be made by inserting rubber inserts and bolting up evenly on all sides.

A thin fibre of lead wool shall be used in making the joints watertight where facing of the pipes is not true.

The packing used should be of rubber insertion cloth three-ply and of approved thickness between 1.5mm to 3mm. The packing should be of the full diameter of the flange with proper pipe hole and bolt hole neat and even at both the inner and outer edges.

Where the flange is not fully faced, the packing may be of the dimension of the facing strip only. Its proper placing should be tested before another pipe is joined on.

After each section of the pipeline has been completed it shall be tested for water tightness before being covered. This can be done by closing each end by means of a valve of blank flange or plug and filling the pipe with water. The pressure should then be raised by means of a small hand operated pump till it registers 50% above the highest working pressure in the section and the test pressure should be ascertained by means of appreciable gradient, the test should be carried out at the lower end of the section with an air vent at outer end. Any leaking joints should be made good and the above test reapplied until no further leaks are apparent. CI or MS puddle pipe/CI air vents with mosquito proof nettings are to be provided as shown in drawings.

9 SOIL, WASTE, RAIN-WATER, VENT AND ANTI-SIPHONAGE PIPES & FITTINGS

All soil, waste and anti-siphonage pipes and fittings used within sunken floor areas or within Plumbing Shafts vertical run, shall be sand cast iron socket and spigot conforming to IS:1729. All cast iron pipes and fittings shall be of the best approved Indian make of soil variety preferably of spun quality and hot dipped in Dr Angus Smith Solution and free from flaws, air bubbles, cracks, sand-holes and other defects truly cylindrical and in uniform thickness. They shall not be brittle but shall allow for heavy cutting, chipping and drilling, and shall not be less than 5mm thick and of the diameter mentioned in the schedule of quantities and shall be of the largest length available and shall be fixed against the wall on special 'U' clamps - 25mm wide, 3mm thick and hot dip galvanised by means of round-headed flat nail of 75mm long on brick wall. In case of hollow block wall - 50mm x 50mm x 75mm long wooden gutties soaked in solignum, should be first fixed and then flat nails should be based and nails painted with two coats of paint of approved quality and colour.

Unless otherwise specified, jointing shall be carried out with molten lead. The spigot of the pipe must be forced well home into its socket and must be entered, so that the joint may be of even thickness all round. At least one complete lap of clean white hemp spun yarn shall be drawn into the bottom of the socket without being forced through the joint. As many laps as may be needed to leave the space of not less than 25mm for the lead shall then be poured into the joint and caulked tight. The joints shall then be run with molten lead in sufficient quantity so that after being caulked solid, the lead may project 3mm beyond the face of the socket against the outside of the spigot but must be flush with the outside edge of the socket. Clean outs at the head of CI S/S horizontal pipes running under the floor shall be of Cast Brass screwed in type. Floor and wall cleanouts shall be of cast brass screwed type. The connecting pieces shall of GI threaded to suit the clean out with lead caulked joint.

Inspection chambers, gully traps, etc. within the building shall be of approved pattern cast iron with bolts, nuts to close the cover, all to be fabricated as per actual requirement.

Supports, pedestals, and base for inspection chambers, gully traps and pipes shall be in M-15/20 cement concrete mix. Pipe sleeves and inserts, etc. through RCC walls either external or internal shall be of CI or MS provided with water bar flange.

During installation open pipes shall be plugged with wood cut to required shape and shall be maintained free from dirt.

GI waste pipes and fittings shall be of 'C' class I.T.C. or equivalent with GI unions, tail, piece, reducers and connections to be provided between joints to either lead or CI pipes.

Unless otherwise specified, the sizes of branch waste pipes for different fittings shall be as follows :

Lavatory Basin	- 32mm dia
Urinal	- 40mm dia
Sink	- 40mm dia
Nahani trap	- 50mm dia
Special floor trap	- 75mm dia or 100mm as required with bolted aluminium grating in 25mm x 25mm MS angle.

W.C. pan connectors shall be to suit the requirements as per drawing, with 40mm vent horn for connection to the anti-siphonage pipe with pan connector of CI or lead.

Connection to the sewage or storm water collection sumps to be perfectly watertight and as specified in the drawing.

Rainwater lead flashing shall be of 150 x 100mm or 230 x 150mm with CI dome shape grating and extension piece.

All rainwater pipes and fittings shall be CI pipe spigot & socket conforming to IS:1230-1979 or equivalent. This shall apply to pipe outside buildings or within the building or separate shafts.

The floor traps (nahani traps) for toilet blocks shall be cast iron with CP brass grating, bolted down design.

Where toilet slabs are sunk, the floor trap shall be of 100mm x 75mm heavy type CI 'P' trap, with CP brass grating, bolted down design.

Bathroom CP grating shall be of bolted down design out of heavy cast brass with the chromium plating of the best approved standard.

Cast iron grating shall be flat with perfect edge of the best quality procurable of the specified width and thickness and in the available lengths.

Spigotted and socketed 80mm, 100mm & 150mm CI pipes shall be of heavy pattern for the portion below the floor and embedded and laid over 150mm cement concrete M15/20, the width of the concrete being :

80mm dia	- 320mm wide
100mm dia	- 400mm wide
150mm dia	- 450mm wide
200mm dia	- 600mm wide

The pipes shall be laid to a slope and connected to the drain. On no account should lime or lime concrete come in direct contact with pipe.

10 GI PIPES & FITTINGS

The materials for pipe (galvanised) shall conform to IS:1239 (Part I) and for pipe fitting it shall conform to IS:1239 (Part II).

Wrought Iron or mild steel pipes shall be galvanised inside and outside treated and fixed in accordance with the Municipal requirements. The joints shall be distributed in strict conformity with Municipal regulations and in consultation with Hydraulic Engineer's department. They shall be secured clear of the wall surface by means of GI clamps at suitable intervals. All control valves, stop cocks, ball valves, bib-cocks shall be of the best approved quality procurable, heavy cast of drawn brass. All branches shall have individual control arrangement with fullway (peet) valves, to enable regulation and cut off as required. They shall be of best Indian manufacture, specified in the Schedule of Quantities and of Municipal tested stampings and bear ISI markings.

Laying & Fixing : Where pipes have to be cut or rethreaded, ends shall be carefully filed out so that no obstruction to bore is offered. In joining the pipes, the inside of the socket and the screwed ends of the pipes shall be rubbed over with white zinc and a few turns of teflon tape wrapped round the screwed end of the pipe which shall then be screwed home in the socket with a pipe wrench. Care must be taken that all pipes and fittings are kept at all times free from dust and dirt during fixing.

Adequate numbers of unions shall be provided on all pipes and near each valve, stopcocks, check valves etc. as directed by engineers.

Internal work : For internal work GI pipes and fittings outside the walls shall be fixed either visible by means of standard pattern holder bat clamps, keeping the pipes clear of the plastered wall by 12mm for cold water pipe and 40mm for hot water pipe. Wherever indicated on the drawing or as directed by the Engineer, chasing of walls shall be fixed truly vertical and horizontal or as directed by the Architects. All embedded cold water pipes are to be covered with bituminous polyethylene wrapping or hessian cloth dipped in bitumen or equivalent approved by the Hydraulic department of the Municipal Corporation. All embedded hot water pipes are to be painted with at least three coats of bituminous anti-corrosive paint and coated and wrapped as above and then wrapped with three ply asbestos fibre, mineral wool, glass wool or premoulded thermocole or equivalent wrapped tightly round the pipe.

External Work : For external work, GI pipes and fittings shall be laid in trenches. They should be wrapped, with bituminous polythene wrapping or hessian cloth wrapped in bitumen or equivalent approved by the Engineer. The width of the trench shall be of minimum width required for working. The pipes laid underground shall not be less than 600mm from the ground level. The work of excavation and refilling shall be done in accordance with the general specification for earth work.

Testing : All GI pipes and fittings are to be tested to a pressure of 11 kg per sq cm for 2 hours to ensure that pipes have proper threads and that proper materials (such as white zinc and hemp) have been used in jointing. All leaky joints must be made leak proof by tightening or redoing at Contractor's expense. All water fittings and brass fittings shall be fixed in the pipeline in a workmanlike manner. All joints shall be tested to a pressure of 11 kg/cm2 unless otherwise specified. The defective fittings and the joints shall be repaired, redone and replaced.

Wherever a GI pipe crosses a floor then a CI sleeve with 12mm all round clearance and projecting by 75mm above and below the floor should be provided. On no account should lime or lime concrete come in direct contact with CI pipe and fittings.

11 LEAD PIPES

Lead pipes shall be of solid drawn lead, the size mentioned being their internal diameter and shall conform to the requirements of Indian Standard specification.

The weight for the various bores shall be as follows :

100mm dia	11.4 Kg/m)	For soil, waste, anti-
75mm dia	8.5 ")	siphonage and vent
65mm dia	7.2 ")	
50mm dia	6.0 ")	
40mm dia	4.5 ")	
40mm dia	6.0 ")	For flushing and
32mm dia	4.5 ")	washing pipes
12mm dia	1.5 ")	
25mm dia	6.2 ")	Supply and
20mm dia	4.5 ")	Distribution pipes
12mm dia	3.0 ")	

The joints between the lead pipes and other fittings shall be made with brass thimbles and tailpiece and joining shall be with wiped solder joints.

Lead Traps

40mm dia	..... 3.5 kg/piece
50mm dia	..... 4.0 kg/piece
75mm dia	..... 5.0 kg/piece

12 INSPECTION CHAMBERS, MANHOLES, GULLY TRAPS, INTERCEPTING CHAMBERS, DROP CHAMBERS ETC:

GENERAL : Construction of manholes, inspection chambers shall conform to IS:4111 (Part 1 to IV)

INSPECTION CHAMBERS : Unless otherwise specified, inspection chambers of required depth shall be provided on all external drains, at all change of direction of the drain and where branch drain meets the main drain. They shall be of rectangular shape where depth does not exceed 900mm and shall have a clear opening of 900 x 450mm or as specified shall be constructed of 230mm thick brick in 1:5 c.m.

CIRCULAR MANHOLES & DROP MANHOLES : The internal diameter of manhole for different depth shall be as given below :

a) For Depths above 0.9m and upto 1.65m = 900mm dia

b) For Depths above 1.65m and upto 2.30m = 1200mm dia
c) For Depths above 2.30m and upto 9.0m = 1500mm dia
d) For Depths above 9.0m and upto 14.0m = 1800mm dia

Access shaft shall have a minimum internal dia of 750mm and shall be suitably corbelled to provide easy access to step irons or ladders with manhole.

In all chambers, a semicircular channel of diameter equal to that of pipe line shall be provided at the bottom to required slope, above the horizontal diameter the sides shall be extended vertically to the same level as the growth of the outgoing pipe and the top edge shall be suitably rounded off. The branch channel shall also be similarly constructed and at the junction with main channel and appropriate fall suitably rounded off in the direction of flow in the main channel shall be given.

For all manholes over 0.8m depth, cast iron rungs conforming to IS:5455 shall be provided. The top rung shall be 450mm below the manhole cover and the lowest not more than 300mm above the benching. Vertical spacing to be not more than 300mm. They may be set staggered, if required into two vertical runs which may be 380mm apart horizontally. Manhole covers and frames shall conform to the requirements of IS:1726 (Part I to VII) - Specification for cast iron manhole covers & frames or IS:12592-1988 - Part I : Specification for precast concrete manhole covers and frames, as specified.

Excavation : Excavation shall be true to dimension and levels. The cost of excavation shall include the cost of shoring, strutting, dewatering etc wherever required.

Bed Concrete : Unless otherwise specified the bed concrete shall be of concrete Mix M15/20.

The thickness of concrete bed shall be as given below :

For depth upto 900mm	**150mm**
For depth from 900 to 1,650mm	200mm
For depth from 1,650mm to 2,300mm	225mm
For depth beyond 2,300mm	300mm

Brickwork : All brickwork shall be with first class bricks in 1:5 cement mortar, thickness shall be as specified and in no case shall it be less than 230mm for depth upto 1650mm, 345mm thick for depth below 1650mm and upto 2300mm, 450mm thick for depth below 2300mm and upto 3000mm. Actual thickness of deeper manholes shall be based on structural requirements.

Benching and Channel : These shall be done in M15/10 concrete trowelled and finished smooth with a coat of neat cement to obtain a hard impervious finish.

Plaster Works : The inside and the outside surface of brickwork shall be plastered with 20mm thick 1:3 cement plaster and finished smooth with a coat of neat cement.

Manhole Covers & Frames : Manhole covers shall conform to IS:1726 (Part 1 to 7) or IS:12592-1988 Part I, as specified. The frames shall be firmly embedded in 100mm thick M20/20 concrete coping on the manhole/inspection chambers. The manhole cover shall be sealed by means of thick grease.

The top level of the manhole shall be in line with the finished ground level. However, if required and the finished ground level is not ascertained during construction of the manhole, the contractor shall

temporarily fix the manhole cover till such time the final/paved ground level is established, or temporarily cover the built up manhole at no extra cost to owner. In case of any damage to the covers due to traffic or any other reasons during the course of the project or in the maintenance period, attributed to the negligence of the contractor, the same shall be replaced immediately by the contractor at his own cost. The frame and the cover shall be painted with Black Bitumen Anticorrosive paint.

Drop Connections : In case the difference in invert levels between main drain and branch line require a drop more than 600mm, a drop connection shall be provided generally as described below.

Cast iron or stoneware four way junction shall be fixed in position, at right angles to the drop pipe, at the level where branch pipe enters the manhole provided suitable height of vertical drop pipe terminating into a plain bend, duly benched into the cement concrete M20/20. Access for cleaning the bend should be provided at finished ground level. The vertical drop pipe shall be encased in half brick wall all round & plastered externally with c.m. 1:3.

GULLY TRAP

Gully traps in all waste pipes shall be of best quality 230 x 150mm or 150 x 100mm as indicated and laid on 150mm thick M15/20 cement bedding. They should be enclosed in half brick thick wall with cement mortar and with cement plaster forming a hopper on top of trap and inspection chamber with full size 230 x 300mm cast iron frame and cover or open grating 300 x 300mm as required.

There shall be 75mm dia vent pipes at the sewer trap chamber and 75mm ventilating pipe at the manhole at the head of the drain to be routed as specified in schematic drawing or as directed at site.

Exposed traps for all wash basin and urinal or sinks like bottle or 'P' trap in public areas shall be of chromium plated cast brass.

Traps installed in floors with cast iron pipe shall be of the same quality and grade of the pipe; the size of outlet shall correspond to the socket of the pipe receiving it.

MS Grease traps at inlet of Kitchen and/or dish washer area shall be provided. Grease trap to conform to details given in drawing/schedule. Alternatively a baffle wall type chamber shall be provided after these wastes for collection of oil and grit, as specified in the drawing. These will generally be provided for large kitchens and canteens, etc.

An intercepting trap of required size shall be installed in the last inspection chamber prior to connecting with the public sewer or disposal system. This chamber shall be above 2000mm within the boundary of the property.

Rate : The rate shall be per number and include the cost of excavation, backfilling, disposing of surplus earth within 500m radius, M15/20 concrete, M20/10 concrete coping, benching, brick masonry, plastering, manhole cover and frames of specified weight, rung, etc including finishing the junction of pipe in the manhole. For manholes and inspection chamber the rate will be per number upto specified depth and extra over per additional metre depth over the specified depth.

13 SANITARY FITTINGS

All sanitary fittings shall be as specified in Schedule of Quantities and approved by the Engineer. The items for fixtures shall be complete including all accessories, as specified in the item including fixing screws, nuts and bolts etc. The price should include all taxes, duties, insurance loading and transport charges upto delivery at site.

European Type Water Closet with Low Down Flushing Tank

The water closets shall conform to IS:771 and shall be of the best quality approved by the Engineer. all closets shall be provided with flushing rims of the same materials and in one piece with the bowls. The closets shall be strong and firm and shall be such as to have minimum of fouling surface. They shall be made of non-absorbent materials, with durable glazed finish.

The seat and the cover shall be of best bakelite of approved quality, hinged and fixed to the closet itself. 6 Nos rubber bushing of approved quality shall be fixed to the bakelite seats.

The flushing cisterns conforming to IS:774 shall be of best quality with chromium plated handles, approved by the Engineer. The overflow pipes from the cisterns shall discharge into open space provided for the purpose. CP flush bend, CP angle stop cock, CP connector, etc shall also be provided for the cistern.

Indian Type WC pan with P or S Trap

The pans shall be white glazed made of best non-absorbent materials and of Hindustan Sanitaryware or other approved make and shall conform to IS:771. 100mm dia P or S Traps shall be with or without vent horn.

The flushing cisterns shall be of approved quality and will conform to IS:774. They shall be fixed to the walls by means of CI brackets. The cisterns and the brackets shall be painted with three coats of oil paint of approved quality and colour.

The cisterns shall be provided with pulling chains 32mm lead pipes connecting the cisterns and WC pans and 12mm dia WS feed pipes and overflow pipes with mosquito-proof couplings etc. including stop cocks.

Urinals

Urinals shall conform to IS:771 and shall be of approved make and unless otherwise specified they shall be of large flat-back type. Automatic cistern conforms to IS:2326 complete with metal siphons, CI Brackets, with 15mm dia spreader with 15mm dia CP brass stop cock and GI inlet connection etc. shall be provided at the following rate :

5 Litre Capacity one for three Urinals with 25mm dia flush pipe.

5 Litre Capacity one for four Urinals with 32mm dia flush pipe.

Where specified CP cast brass bottle trap shall be fixed with all necessary connections. Approved type of divisional panel as specified shall be provided between Urinals.

For non-automatic cisterns, 5/10/15 litre capacity cisterns will be provided for a set of one/two/three urinals respectively or as specified in the schedule of quantities. 100mm dia half round white glazed urinal channel shall be provided wherever specified separately in schedule of quantities.

Wash Basins

Wash basins shall be of approved make conforming to IS:771 and of the size specified and shall be fixed on a CI bracket. 32mm dia waste coupling, rubber plug with CP brass ball chain. 15mm dia Bilmat make or other approved make hot and cold mixer taps as specified, etc. complete shall be provided.

32mm dia CP brass bottle trap with CP pipe to wall along with wall flange etc of approved make shall be provided for wash basin.

Stainless Steel Sinks

Shall be of approved make and size and thickness. It shall either be set in masonry as specified or fixed on a CI bracket fixed to wall. Where drain board is specified, the same shall be provided with grooves and a proper slope to drain the water.

40mm dia CP brass bottle trap with pipe to wall & wall flange shall be provided for each sink.

The Contractor shall get the samples of the fittings approved from the Engineer before ordering the same.

14 ANGERS & SUPPORTS

Where specified proper solid angle iron/channel section, supports for all pipes complete with clamps shall be provided. Wherever insulations come, wooden guide to support pipe on the angle iron hangers/supports shall be provided. In general where a bunch of pipes run, as far as possible M S plate inserts are to be provided in the beams/slabs to facilitate welding of angle iron supports. For attachment in concrete, 'Dash' fasteners or Anchor plug type inserts or equivalent shall be used. Provide hangers within 3 feet of all changes in direction of mains and a minimum of three hangers per expansion bend wherever shown in drawing. Provide all additional structural steel angles, channels or other members not specifically shown but are required for proper support.

Where necessary additional hangers shall be provided to arrest water hammers or hydraulic resonance with proper rubber paddings.

Space hangers, as noted below, except on all soil pipe which shall have a hanger of multiple fittings, sufficient hangers shall be provided to maintain proper slope without slagging, in case of angle suspended line, the following is suggested :

A Pipe Sizes	Hanger Rod Dia
20mm through 50mm	10mm
65mm through 125mm	12mm

150mm and over 16mm

B Pipe Sizes Spacing of Supports

12mm to 20mm 1500mm apart

25mm to 40mm 1800mm apart

50mm and above 1800mm apart as per IS

Floor stands, wall brackets of masonry piers, etc. may be provided for all lines running near the floor or near walls. Pipelines, near concrete or masonry walls may be higher level than pipe. Hanging of any pipe from another is prohibited.

Hangers

Clevis or sand type hangers shall be provided. Hot water piping is to be provided with suspended supports as far as possible. Note that strap hangers are not permitted and clamps should be of removable type.

Insulated Hot Water Piping

A 38mm thick timber support for direct support of hot water line is required. Timber supports are to rest on brackets.

15 VALVES AND PRESSURE GAUGES

Pressure gauges shall have not less than 115mm dia 35mm gas threads, brass body, siphon and gauge cock of 10mm size. Dial ranges shall be adequate for the pressure encountered as specified. Provide valves on branch pipe connection to mains and at connections to equipment where indicated. All valves are to be located for easy access and are to be full bore of pipe connected together. Support all valves wherever necessary. Valves are to be as per IS:780 (Class I) for CI Sluice valve and to IS:778 for G M Valves and tested and approved by Bombay Municipal Corporation.

Valves Schedules

	Type	Size	Rating	Ends	Materials
Water, Oil air, steam (low pressure)	Gate	65mm & under	20 kg/cm^2	**Screwed**	Bronze
Water	Gate	75mm & over	20 kg/cm^2	Flanged	CI body bronze trim
Gas	Gate	65mm & under	40 kg/cm^2	**Flanged**	Bronze/SS spindle & trim
Water, Oil air, gas steam (low pressure)	Globe & angle	65mm & under	20 kg/cm^2	**Screwed**	Bronze
Water	Globa & angle	65mm & over	20 kg/cm^2	**Flanged**	Iron body Bronze trim.
Water	Horizon-tal & vertical check	65mm & under	20 kg/cm^2	**Flanged**	Bronze.
Water	Horizon-tal & vertical check	65 mm & over	20 kg/cm^2	**Flanged**	Iron body Bronze trim.

All globe & check valves shall have working parts suitable for hot and cold water, oil or gas as required. Valves shall be tagged with permanent label under hand wheel indicating type of duty.

All valves over 150mm dia in equipment rooms located over 2.0 metre above floor shall be provided with chain wheels with chains extending upto 2.0 metre above floor.

Ball Valve :

The ball valve shall be of high pressure or low pressure class and shall be of sizes as specified.

The nominal size of a ball valve shall be that corresponding to the size of the pipe to which it is fixed. The ball valve shall be of brass or gun metal as specified, and the float of copper sheet. The minimum thickness of copper sheet used for making the float shall be 0.45mm for float upto 115mm dia. and 0.55mm for float exceeding 115mm dia. The float shall be spherical in shape. The jointing of the float shall be made by efficiently burnished, lapped and soldered seam or by brazing. Plastic floats may also be used if specified.

The body of the high pressure ball valve when assembled in working conditions with the float immersed to not more than half of its volume shall remain closed against a test pressure of 10.5 kg/sq.cm. and low pressure valve against a test pressure of 3.5 kg/sq.cm.

The ball valve shall generally conform to IS:1703 - 1962. The weight of ball cock and the size of ball be as per table given below

Both low pressure and high pressure ball valves are designed for use on mains having pressures of 17.5 kg/sq.cm.

Dia (mm)		Total Wt. H.P.	Total Wt. L.P.
15	-	524 gms	481 gms
20	-	986 gms	867 gms
25	-	1549 gms	1411 gms
32	-	2120 gms	1873 gms
40	-	2646 gms	2303 gms
50	-	4454 gms	3959 gms

Cocks

Angle pattern stopcocks of approved manufacture are to be provided at each hot and cold water inlet.

Foot Valves

Provide cast iron body with brass disc and strainers of approved quality, on suction sides of pumps having negative suction.

Strainers

CI pot strainer with GM mesh screen in perforated brass strainer body of approved manufacture are to be provided before valves. Provide each strainer with a cock for blowing down. Screening area of strainer shall be minimum of 5 times more than pipe area with 0.8mm maximum size holes.

Air-Eliminators

Provide air vents, consisting of gate valve, where shown. Each valve outlet shall be piped to nearby drain.

16 CUTTING, PATCHING, REPAIRING AND MAKING GOOD

Cutting, Patching and Repairing required for the proper installation and completion of the work, specified in each division, including chasing, plastering, masonry work, concrete work, etc., and making good shall be carried out by the contractor wherever required. Holes which are cut oversize shall be refilled, so that a tight fit is obtained around the pipe or other object passing through. Any damage to waterproofed location should not be patched up, without rectification by the waterproofing agency (specialist contractor) to ensure his guarantee.

17 EQUIPMENT PROTECTION

Keep all pipe and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect all piping, conduit, fixtures, equipment or apparatus. Any such item damaged prior to final completion of work shall be restored to its original conditions or replaced at no expense to the Owner.

Accessibility

The installation of valves, thermometers, clean out fittings and other indicating equipment or specifications requiring frequent reading, adjustments, inspections, repairs, removal or replacement, shall be conveniently and necessarily located with reference to the finished building.

Thermometers and gauges shall be installed so as to be easily read from the floor.

18 INSERTS & SLEEVES

a) General

Layout work in advance of placing of concrete slabs or construction of walls, furnish and set inserts and sleeves necessary to complete the work. Cost of cutting or patching made necessary as a result of this operation shall be at no expense to the Owner. Openings shall be as per Engineers' approval.

b) Pipe Sleeves

1) Wall Sleeves

CI wall sleeves in cold store and black pipe 'A' class to be inside flush with wall on both sides. Sleeves shall be large enough in diameter to provide 25-30mm clearance around pipe for insulation. Exterior wall sleeves for cable entry/pipe/earthing strips, etc., shall be cast iron, flush with wall on both sides. Sleeves shall be large enough to allow caulking from outside lead wool.

2) Floor Sleeves

Interior floor sleeves for general areas shall be of CI extending 50mm more above finished floor. All pipes passing through sleeves shall be caulked with asbestos rope and finished with cement mortar. Insulated pipes shall have insulation butted to floor sleeve and sealed with insulating cement on both sides.

Exception

Chilled water or refrigerated suction piping insulated shall be run continuous through the sleeves and caulked.

Interior floor sleeves for kitchen areas shall be CI steel pipe extending 50mm above finished floor. Caulking shall be the same for general areas.

Floor on grade sleeves shall be the same as exterior wall sleeves, caulked and made watertight.

19 EQUIPMENT, MATERIAL AND WORKMANSHIP

All equipment shall meet the detailed requirements of the contract documents and it shall be suitable for the installation shown. The Engineer shall be notified of any shortcomings found during the tendering period. Equipment not meeting all requirements shall not be acceptable, even though specified by name along with other manufacturers.

Where two or more units of the same class of equipment are furnished, the product of the same manufacture shall be used. All materials and equipment, new and free from defects and of size, make, type and quality herein specified or approved by the Architect. All shall be installed in a neat and workmanlike manner.

20 CLEANING, OPERATION & TESTS

Plumbing Equipment Fixtures, Piping etc., shall be free of stampings, markings (except those required by codes), iron cuttings and other foreign materials.

Hot, cold and drinking water systems shall be cleaned thoroughly, filled and flushed with water.

The entire mechanical apparatus shall operate at full capacity without objectional noise or vibration.

Water Test

All pipes & fittings and appliances shall be inspected before delivery at site and tested, if required, at manufacturer's factory.

After laying and jointing, the length to be tested shall be suitably plugged at ends. The pipe shall be slowly and carefully charged with water, so that all air is expelled from the pipe by providing one 25mm inlet with a stop cover allowed to stand full of water. The test pressure shall be 11 kg/cm2, (or as specified for different categories of pipes) applied by means of manually operated test pump (or other approved pump). The pressure shall be maintained for 2 hours. The pressure drop at the

end of the period shall not be less than 0.5 kg/cm2. Pressure gauges shall be accurate and recalibrated before testing. As leakage observed shall be rectified as directed.

The Contractor shall supply all equipment, labour, and materials required for testing and maintain a test register.

Smoke Test

Fill traps with water, then introduce into system a pungent thick smoke produced by one or more smoke machines. When smoke appears at stacks on the roof, plug stacks and allow pressure of 25mm water column to build up in system. Maintain pressure for 15 minutes before inspection starts. The inspection shall be tight at all joints.

Test all down spouts or rain headers and their branches within the building by water as described for the above soil, waste and vent system.

21 PAINTING

Equipment

After complete installation and testing all the equipment including mounting frames, etc., equipment shall be painted with three coats of paint, as per colour code required by the consultants or as directed by the client.

Piping

After all the piping has been installed and tested, the piping shall be given one coat of anti-corrosive paint followed by two coats of paint as per colour code required by the client or as directed by the consultants.

NOTE: (i) All black pipes to be painted fully; GI pipes shall have 150mm wide band at 1500mm intervals.

(ii) Final coat to be given after one month of running of pipe.

22 EQUIPMENT & PIPING IDENTIFICATION

Pipe Markers

Each piping system shall be provided with a name plate properly clamped or stenciled. Letters are to be 75mm if 3 metre above the floor and 50mm minimum if below 3 metre height. Name plates on parallel groups of pipes etc. shall be neatly lined up. Wording of lettering shall correspond to the equipment designations used in piping legend and shall be as approved. Name plate to be of GI sheets (gauge 20 SWG on 25mm x 25mm angle) secured on to sheet metal and angle iron to be welded on main pipe. In case of insulated pipe, the 25mm x 25mm angle bracket should be projecting beyond insulation thickness.

Valve Register

To be submitted in six copies along with location and identification number in final drawing to be furnished by contractor.

23 MODE OF MEASUREMENT

General : All the rates for all the items shall include the cost of material, labour, equipment, tools, etc. testing the pipes, getting permission and completion certificates from relevant authorities etc. and including all taxes etc. complete.

All drain pipes shall be measured in linear lengths along the centre line of the drainage line laid. Deductions shall be made for chambers and fitting lengths etc. The rate shall include all work as specified in the respective items.

Stoneware or cast iron gully traps, bends, junctions, sewer traps, etc shall be measured in numbers as above.

All cast iron spigot and socket or flanged pipes shall be measured in linear lengths along the centre line completed. No deductions shall be made for fitting lengths. The rate shall include for all types of bends, Y-pieces, clamps, painting, etc complete, lead caulking or nut and bolt joints, etc., complete as specified in the respective items.

Same rate shall be applicable for pipes of same size and material laid in building at any level or floor.
Cast iron fittings such as spigot and socket fittings, flanged fittings shall be measured in numbers.
The rock cutting shall be measured in m3 of the stacks of excavated rock, the deduction for voids being 40% of the stack measurement. Only the rock which is removed by chiselling or blasting etc., shall be measured for this item of work. Boulders shall not be considered as rock. The excavated rock will become the owner's property.

All cast iron pipes, such as soil, waste, vent and rainwater shall be measured in linear lengths along the centre line, as completed, including length over fittings. The rates shall include all joints and clamps etc. as specified in the respective items.
Unless otherwise specified plain cement concrete for supports and for bedding etc., shall be measured in cubic metre of the completed work carried out as per instructions; cutouts of shuttering shall be inclusive of the rate quoted.

Inspection chambers shall be measured in numbers, complete as specified in the respective items in the schedule of quantities and specifications for sanitary installation work.
Lead pipes shall be measured in linear length and shall be of weights as per specifications of the respective item in installation work. The rates shall include making of necessary offsets and bends, etc. The brass fittings with solder joints shall be paid extra in number.

All sanitary fittings and fixtures shall be measured in numbers and the rate shall include all the work specified in the respective item.

All GI pipes shall be measured in linear lengths along the centre line of the pipe, including GI fittings. The rate for pipeline upto and including 65mm dia shall be inclusive of all GI fittings. In the case of pipeline of dia above 65mm, GI fittings will be measured in numbers, after deducting the lengths over fittings from the linear measurements. The rate in all cases will be inclusive of all work as specified in the respective items.

All peet valves, ball valves, non-return valves, sluice valves, etc., shall be measured in numbers after excluding them from linear measurement.

The diameters of pipes and fittings mentioned in the specifications are of the inside diameter in all cases, unless otherwise stated.
In case of fittings of CI, GI or stoneware of unequal bore, the largest bore shall be measured.

TECHNICAL SPECIFICATION FOR UNPLASTICIZED PVC PIPES

The pipe should be given adequate support at all times. Pipes should be stored on a reasonably flat surface free from stones and sharp projections so that the pipe is supported throughout its length. In storage , pipe racks should be avoided. Pipe should not be stacked in large pipes , especially under warm temperature conditions as the bottom pipes may distort , thus giving rise to difficulty in jointing. Socket and spigot pipes should be stacked in layers with sockets placed at alternate ends of the stacks to avoid lopsided stacks.

It is recommended not to store pipe inside another pipe

On no account should pipes be stored in a stressed or bent condition or near the sources of heat.

Pipes should not be stacked more than 1.5 m high. Pipes of different sizes and classes should be stacked separately.

The ends of pipe should be protected from abrasion particularly those specially prepared for jointing either spigot or socket solvent welded joints or shouldered for use with couplings.

In tropical conditions pipes should be stored in shade. In very cold weather the impact strength of PVC is reduced making it brittle and more care in handling shall be exercised in wintry condition.

If due to unsatisfactory storage of handling a pipe becomes kinked, the damaged portion should be cut out completely. Kinking is likely to occur only on very thin walled pipes.

SOLAR WATER HEATER

Solar water Heater with compressed PUF insulated storage tank, inner tank made of SUS 316L grade surgical steel and strong polyster powder coated rust free metal frame and laminated outer tank, with all fasteners are made of SUS 304 food grain for rust free and ISI marked. 1.5KW back-up heater with thermostat with high quality tested and tough / Borosilicate Glass Tubes for a warranty period of 7 years from the date of commissioning.

Technical specifications :-

Vacuum tube outer diameter	47mm
Vacuum tube inner diameter	37mm
Tube length	1800mm
Tank diameter	480mm
Tank volume	100liters to 250 liters
Temperature	70 degree C to 85 degree C
Tank Insulation	PUF 55mm to 80mm(Polyurethane foaming)
Stand frame	Aluminum Polyester Powder coated
Method of Welding	Seam less and Plasma Welding Technology
Type of fasteners	Stainless steel
Type of Grommets	Silicon rubbers
Type of circulation	Thermo siphon
Electrical Back Up	1.5 KW each (0pional)
Type of inlet feeding and cold	Using gravity feeding tank for non pressure low mixing of hot Water and long life of inner tank.

SECTION L - ELECTRICAL

A] GENERAL TECHNICAL SPECIFICATIONS

Electric Power Distribution and Wiring

Introduction

The Electric Power will be received and distributed in a building, through following means:-
Cabling and Switch gear to receive power.
The building is divided into convenient number of parts, each part served by a rising main system to distribute power vertically/ horizontally.
Power flows from rising main through tap-off box to floor main board to final DBs and then to wiring.
While rising main takes care of general lighting and power outlet load of the building, other loads like lift, pumps sets, AC Plants, other motor loads are fed by independent cables of suitable capacity fed from properly designed essential/ non- essential LT panels with suitably design switch gear having necessary control and safety features.
Therefore the distribution/wiring system essentially consist of provision of cables, switchgear, rising main, bus ducting, earthing, laying of pipes/ conduits etc.(in surface or recess) based on proper detail design to decide on various sizes/ capacities of these components and various controls and safeties involved, to provide an efficient, reliable, safe and adequate electrical distribution and wiring system.

System of distribution and wiring:

The wiring shall be done from a distribution system through main and/ or branch distribution boards. The system design and location of boards will be properly worked out.
Each main distribution board and branch distribution board shall be controlled by an incoming circuit breaker/ linked switch with fuse. Each outgoing circuit shall be controlled by a circuit breaker/ switch with fuse.
For non-residential buildings, as far as possible, DBs shall be separate for light and power.
Only MCCB/MCB/HRC fuse type DBs shall be used. Rewirable type fuses shall not be used.
Three phase DBs shall not be used for final circuit distribution as far as possible.
'Power' wiring shall be kept separate and distinct from light wiring, from the level of circuits, i.e., beyond the branch distribution boards. Conduits for light / power wiring shall be separate.
Essential/ non-essential/UPS distribution each will have a complete independent and separate distribution system starting from the main, switch board up to final wiring for each system. As for Example, conduit carrying non- essential wiring shall not have essential or UPS wiring. Wiring for Essential and UPS supply will have their own conduits system. No mixing of wiring isallowed
Generally, no switchboard will have more than on source of incoming supply. More than one incoming supply will be allowed only at main board with proper safety and interlocking so that only one source can be switched on at a time.
Each MDB/DB/Switch Board will have reasonable spare outgoing ways for future expansion.
Balancing of 3-phase circuit shall be done.

Wiring:

Submain & Circuit Wiring:
Submain Wiring:
Submain Wiring shall mean the wiring from one main/ distribution switchboard to another.

Circuit Wiring:
Circuit wiring shall mean the wiring from the distribution board to 1st tapping point inside the switch box, from where point wiring starts.

Measurement of submain and circuit wiring:
Circuit and submain wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit or channel as the case may be, exclusive the interconnection inside the switch board etc. The increase on account of diversion or slackness shall not be included in the measurement.
The length of circuit wiring with two wires shall be measured from the distribution board to the nearest switch box from which the point wiring starts. Looping of switch boxes also will be counted towards circuit wiring, measured along the length of conduit/ channel.
When wires of different circuits are grouped in a single conduit/ channel, the same shall be measured on linear basis depending on the actual number and sizes of wires run.
Protective (loop earthing) conductors, which are run along the circuit wiring and the submain wiring, shall be measured on linear basis and paid for separately.
Note: Conduit carrying submain will not carry circuit/point wiring. Similarly conduit carrying circuit wiring will not carry submain/point wiring. Conduit Carrying point wiring will not carry submain/circuit wiring.

Measurement of other wiring work:
Except as specified above for point wiring, circuit wiring and submain wiring, other types of wiring shall be measured separately on linear basis along the run of wiring depending on the actual number and sizes of wires run.

Point Wiring:

Definition

A point (other than the socket outlet point) shall include all work necessary in complete wiring to the following outlets from the controlling switch or MCB.
Ceiling rose or connector (in case of points for ceiling/ exhaust fan points, prewired light fittings, and call bell).
Ceiling rose (in case of pendants except stiff pendants).
Back plate (in case of stiff pendant).
Lamp holder (in case of goose neck type wall bracket, batten holders and fittings which are not prewired).

Scope:

Following shall be deemed to be included in point wiring.
Conduit/ Channel as the case may be, accessories for the same and wiring cables between the switch box and the point outlet, loop protective earthing of each fan/light fixture.
All fixing accessories such as clips, screw, Phil plug, rawl plug etc. as required.
Metal or PVC switch boxes for control switches, regulator, sockets etc., recessed or surface type, and phenolic laminated sheet covers over the same.
Outlet boxes, junction boxes, pull-through boxes etc. but excluding metal boxes if any, provided with switch boards for loose wires/ conduit terminations.
Any special block required for neatly housing the connector in batten wiring system.
Control switch or MCB, as specified.
3 pin 0r 6 pin socket, ceiling rose or connector as required. (2 pin and 5 pin socket outlet shall not be permitted).
Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
Bushed conduit or porcelain tubing where wiring cables pass through wall etc.

Measurement

Point Wiring (other than socket outlet points)
Unless and otherwise specified, there shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting, and classified as laid down in 1.4.4.

Classification:
Points measured under 1.4.3 on unit basis shall be classified as under according to the type of building.

Residential Buildings:-
Group 'A', for Point wiring for type I, type II and type III residential quarters and hostels.
Group 'B', for point wiring for type IV and above type of residential quarters and barracks.
Nonresidential Buildings:
Group 'C' for all type of non-residential buildings such as offices, hospital, laboratories, educational institutions, libraries etc.
For any other type of building:-
The group under which the points are to be classified shall be decided by the concerned Chief Engineer (Elect.).

Point wiring for socket outlet points:
The light (6A) point and power (16A) point wiring shall be measured on linear basis, from the respective tapping point of live cable, namely, switch box, another socket outlet point, or the sub distribution board as the case may be, up to the socket outlet.
The metal/PVC box with cover, switch/MCB, socket outlet and other accessories shall be measured and paid as a separate item.
Note: There shall normally be no "on the Board" Light plug point.
The power point may be 16A/ 6 pin socket outlet, where so specified in the tender documents.

Group Control point wiring:

In case of points with more than one point controlled by the same switch, such points shall be measured in parts i.e. (a) from the switch to the first point outlet as one point and classified according to 1.4.4, and (b) for the subsequent points, the distance from that outlet to the next one and so on, shall be treated as separate point (s) and classified according to 1.4.4.
No recovery shall be made for non-provision of more than one switch in such cases.

Twin Controlled light point Wiring:

A light controlled by two numbers of two way switches shall be measured as two points from the fitting to the switches on either side and classified according to 1.4.4.
No recovery shall be made for non-provision of more than one ceiling rose or connector for connection to call bell in such cases.

Wiring System
Wiring shall be done only by the looping system. Phase/ live conductors shall be looped at the switch box. For point wiring, neutral wire/ earth wire looping for the 1st point shall be done in the switch box; and neutral/ earth looping of subsequent points will be made from point outlets.
In wiring, no joints in wiring will be permitted anywhere, except in switch box or point outlets, where jointing of wires will be allowed with use of suitable connector.
The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgear.
Color coding:-
Following colour coding shall be followed in wiring:-
Phase : Red/Yellow/Blue. (Three phase wiring)
Live : Red (single Phase Wiring)
Neutral : Black
Earth : Green.
Termination of circuits into switch board:-
Circuit will consist of phase/ neutral/ earth wire. Circuit will terminate in a switch board (first tapping point, where from point wiring starts) in following manner:-
Phase wire terminated in phase connector.
Neutral wire terminated in neutral connector
Earth wire terminated in earth connector.
The switchboard will have phase neutral and earth terminal connector blocks to receive phase/ neutral/ earth wire.

Run of wiring:
The type of wiring shall be as specified in the tender documents namely, surface conduit/ recessed conduit, steel/ PVC, channel.
Surface wiring shall run as far as possible along the walls and ceiling, so as to be easily accessible for inspection.
Above false ceiling, in no case open wiring shall be allowed. Wiring will be done in recessed conduit or surface conduit.
In recessed conduit system, routes of conduit will be planed, so that various inspection boxes provided don't present a shabby look. Such boxes can be provided 5 mm above plaster level, and they can be covered with plaster of Paris with marking of junction boxes.
Where number of electrical services like electrical wiring, telephone wiring, computer cabling, pass through corridors, it may be proper to plan such service with properly designed aluminium/PVC channels duly covered by a false ceiling, so that subsequently such services can be maintained and additional cables can be provided.
Generally conduits for wiring will not be taken in floor slabs. When it is unavoidable special precaution to be taken to provide floor channels with provision for safety and maintenance. Alternatively false flooring can be provided.

Passing through walls or floors:
When wiring cables are to pass through a wall, these shall be taken through a protection (steel/PVC) pipe or Porcelain tube of suitable size such that they pass through in a straight line without twist or cross in them on either side end of such holes. The ends of metallic pipe shall be neatly bushed with porcelain, PVC or other approved material.
All floor openings for carrying any wiring shall be suitably sealed after installation.

Joints In wiring:
No bare conductors in phase and/ or neutral or twisted joints in phase, neutral, and/or protective conductors in wiring shall be permitted.
There shall be no joints in the through-runs of cables. If the length of final circuit or submain is more than the length of a standard coil, thus necessitating a through joint, such joints shall be made by means of approved mechanical connectors in suitable junction boxes.
Termination of multi-stranded conductors shall be done using suitable crimping type thimbles.

Socket Out lets:
Socket outlets shall be 6A 3 pin, 16 A 3 pin or 16/6 A 6 pin. 5 pin socket outlets shall not be permitted.
The third pin shall be connected to earth through protective (loop earthing) conductor, 2 pin or 5 pin sockets shall not be permitted to be used.
Conductors connecting electrical appliances with socket outlets shall be flexible type with an earthing conductor for connection to the earth terminal of plug and metallic body of the electrical appliance.
Sockets for the power outlets of rating above 1 KW shall be of industrial type with associated plug top and controlling MCB.
Where specified, Shutter type (interlocking type) of sockets shall be used.
Every socket outlet shall be controlled by a switch or MCB, as specified. The control switch/MCB shall be connected on 'live' side of line.
5A/6A and 15A/16A socket outlets shall be installed at the following positions, unless otherwise specified.
Non-residential Building- 23 cm above floor level.
Kitchen – 23 cm above working platform and away from the likely position of stove and sink.

Bathroom- No socket outlet is permitted for connecting a portable appliance thereo. MCB/IC switch may be provided above 2 m for fixed appliance, and at least 1 m away from shower.
Rooms in residences- 23 cm above floor level, or any other level in special cases as desired by the Engineer-in-charge.
Unless and otherwise specified, the control switches for the 6A and 16A socket outlet shall be kept along with the socket outlets.

Cables:
Copper conductor cable only will be used for submain/circuit/point wiring.
Minimum size of wiring:
Light Wiring: 1.5 sq.mm.
Power Wiring: 4.0 sq.mm.
Power circuit rated: More than 1 KW, Size as per calculation.
Insulation:
Copper conductor cable shall be PVC insulated, Fire retardant, Low smoke (FRLS) type conforming to BIS Specification.
Multi stranded: Cables are permitted to be used.

Wiring Accessories:

Control switches for point:
Control switches (single pole switch) carrying not more than 16A shall be modular type. The switch shall be 'on' when the knob is down.
Modular type switches of reputed make along with matching mounting boxes shall be used in non-residential building and residential quarters of all types. Modular type sockets, stepped type fan regulators shall be used. All such boxes, switches and accessories shall be of same make of modular switch manufacturer.
It is recommended to provide double pole MCB in proper enclosure as power out let for window type AC units, geysers etc.

Switch Box:
Switch box shall be hot dip galvanized, factory fabricated. Suitable in size for surface/ recess mounting and suitable in size for accommodating the required number of switches and accessories (where required to be used for application other than modular switches/ sockets).
Switch box also can be of non-metallic material. The technical sanctioning authority will approve specified makes of reputed quality and specifications.

Ceiling rose:
A ceiling rose shall not be used on a circuit, the voltage of which normally exceeds 250V.
Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.
A ceiling rose shall not embody fuse terminal as an integral part of it.

Lamp Holders:
Lamp holders may be batten, angle, and pendant or bracket holder type as required. The holder shall be made of brass and shall be rigid enough to maintain shape on application of a nominal external pressure. There should be sufficient threading for fixing the base to the lamp holder part so that they do not open out during attention to the lamp or shade.
Lamp holders for use on brackets and the like shall have not less than 1.3 cm nipple and all those for use with flexible pendant shall be provided with cord grips.
All lamp holders shall be provided with shade carriers.
Where center contact Edison Screw lamp holders are used, the outer or screw contact shall be connected to the 'middle wire', or the neutral conductor of the circuit.

Fittings:
Types:
The type of fittings shall be as specified in tender documents.

Indoor Type fittings:
Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projecting edge, and of such size as will enable them to be wired with the conductors used for the final circuit without removing the braiding or sheathing. As far as possible all such tubes or channels should be sufficient size to permit looping back.
Wires used within prewired fitting shall be flexible with PVC insulation and 14/0.193mm (minimum) copper conductors. The leads shall be terminated on built-in-terminal block, ceiling rose or connector, as required.
Fittings using discharge lamps shall be complete with power factor correction capacitors, either integrally or externally. An earth terminal with suitable marking shall be provided for each fitting for discharge lamps.
Fittings shall be installed such that the lamp is at height of 2.4m above floor level, unless otherwise directed by engineer –in-charge.
Fittings made of CRCA shall be phosphatized and powder/ epoxy painted. For coastal areas and humid area like toilets, kitchen, for prolonging the life of such fittings, corrosion free materials like engineering plastic, aluminium, stainless steel etc. should be used.

Outdoor fittings:

Outdoor fittings shall have suitable IP protection. It is preferable that street light fittings are of cast aluminium body of IP65, for reducing recurring maintenance cost and improved performance. Where required IP 66 fittings also can be provided for reducing maintenances frequency and cost.

Other fittings, which are not available with tested IP 65/54 protection can be properly fabricated with weatherproof feature, proper gasketing etc. As far as possible corrosion free material like cast aluminium, Stainless Steel, engineering plastics may be used for fabrication of such fittings, to prolong life such fittings there should not be any exposed wiring in such outdoor fittings.

Attachment of fittings and accessories:

Conduit wiring system:
All accessories like switches, socket outlets, call bell push and regulators shall be fixed in flush pattern inside the switch/ regulator boxes. Accessories like ceiling roses, brackets, batten holders etc. shall be fixed on outlet boxes, if so directed by the engineer-in-charge.
Aluminium alloy or cadmium plated iron screws shall be used to fix the accessories to their bases.
The switch box/ regulator box shall normally be mounted with their bottom 1.25m from floor level, unless otherwise directed by the Engineer-in-charge.

Fixing to Walls and ceiling:
Wooden plugs for fixing to wall/ceiling will not be allowed. Fixing will be done with the help of PVC sleeves/Rowel plugs/ dash fasteners as required.
Drilling of holes shall be done by drilling machines only. No manual drilling of hole will be allowed.

Fans, Regulators and Clamps:

Ceiling Fans:
Ceiling fans including their suspension shall conform to relevant Indian Standards.
All ceiling fans shall be wired to ceiling roses or to special connector boxes, and suspended from hooks or shackles, with insulator between hooks and suspension rods. There shall be no joints in the suspension rod.
For wooden or steel joists and beams, the suspension shall consist of GI flat of size not less than 40 mm x 6 mm, secured on the sides of the joist or beams by means of two coach screw of size not less than 5 cm for each flat. Where there is space above the beam, a through- bolt of size not less than 1.5 cm dia, shall be placed above the beam from which the flats are suspended. In the Latter case, the flats shall be secured from movements by means of another bolt and nut at the bottom of the beam. A hook consisting of MS rod of size not less than 1.5 cm dia shall be inserted between the MS flat through oval holes on their sides. Alternatively, the flats may be bent in wards to hold tightly between them by means of a bolt and nut, a hook of 'S' form.
In case of 'I" beams, flats shall be shaped suitably to catch the flanges and shall be held together by means of long bolt and nut.
For concrete roofs, a 12 mm dia. MS rod in the shape of 'U' with their vertical legs bent horizontally at top at least 19cm on either side, or bound to the top reinforcement of the roof shall be used.
In buildings with concrete roofs having a low ceiling height, where the fan clamp mentioned under sub clause (v) above cannot be used, or wherever specified, recessed type fan clamp inside metallic box, as shown in fig. 6 shall be used.
Canopies on top of suspension rod shall effectively hide the suspension.
The leading in wire shall be of nominal cross sectional area not less than 1.5 sq.mm. and shall be protected from abrasion.
Unless otherwise specified, all ceiling fans shall be hung 2.75m above the floor.
In the case of measurement of extra down rod for ceiling fan including wiring, the same shall be measured in units of 10 cm. Any length less than 5 cm shall be ignored.
The wiring of extra down rod shall be paid as supplying and drawing cable in existing conduit.

Exhaust Fans:
Exhaust fan shall conform to relevant Indian Standards.
Exhaust fan shall be erected at the places indicated by the engineer-in-charge. For fixing an exhaust fan, a circular opening shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag bolts embedded in the wall. The hole shall be neatly plastered to the original finish of the wall. The Exhaust fan shall be connected to the Exhaust fan point, which shall be wired as near to the opening as possible, by means of a flexible cord, care being taken to see that the blades rotate in the proper direction.
Exhaust fan for installation in corrosive atmosphere, shall be painted with special PVC paint or chlorinated rubber paint.
Installation of exhaust fans in kitchen, dark rooms and such other special location need careful consideration; any special provisions needed shall be specified.

Regulators:
The metallic body of regulators of ceiling fans/ exhaust fans shall be connected to earth by protective conductor.

LT distribution switchgear:
Switch boards are to be located in common areas like corridors, lobby etc. and not to be located in locked room.

Switch board shall be located only in dry situation and in well-ventilated space. They shall not be placed in the vicinity of storage battery or exposed to chemical fume.
Switch boards shall not be erected above gas stove, or sinks or within 2.5 meter of any washing unit in washing rooms of launderings or in the bath rooms, toilet, or kitchen.
As far as possible main boards shall not be located in basement. Such main boards can be located in ground floor.
It is preferable to locate floor main boards in rising main shafts of adequate size, with steel doors (having ventilation) or in suitable room.
Similarly DBs can be in suitable nitches in corridor walls having doors.
Locating main boards under staircase or standing open in corridor is not a desirable practice, besides being highly unaesthetic.
The main Switch board, which receives power to the building, should be invariably located in a switch room, having round the clock access, for emergency attendance to switchboard.

TABLE I

Maximum number of PVC insulated 650/1100V grade aluminium/ copper Conductor cable confirming to IS: 694-1990.

Nominal cross sectional area of conductor in sq.mm	20 mm		25 mm		32 mm		38 mm		51 mm		64 mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

Note:

The above cable shows the maximum capacity of conduits for a simultaneous drawing in cables.

The columns headed 'S' apply to runs of conduit which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit, which deflect from the straight by an angle of more than 15 degrees.

Conduit sizes are the nominal external diameters.

NON-METALLIC CONDUIT WIRING SYSTEM

SCOPE

This chapter covers the detailed requirements for wiring work in non-metallic conduits. This chapter covers both surface and recess types of wiring work.

APPLICATION

Recessed conduit work is generally suitable for all application. Surface conduit work may be adopted in places like workshops etc. and where cessed work may not be possible to be done. The type of work shall be as specified in individual works.

Flexible non-metallic conduits shall be used only at terminations, wherever specified.

Special precautions

If the pipes are liable to mechanical damages, they should be adequately protected.

Non- Metallic conduit shall not be used for following application:-
In concealed/ inaccessible places of combustible construction where ambient temperature exceeds 60 degrees C.
In places where ambient temperature is less than 5 degrees C.
For suspension of fluorescent fittings and other fixtures.
In areas exposed to sunlight.

MATERIALS

Conduits

All non-metallic conduit pipes and accessories shall be of suitable material complying with IS: 2509-1973 and IS: 3419- 1989 for rigid conduits and IS: 9537 (Part 5) 2000 for flexible conduits. The interior of the conduit shall be free from obstructions. The rigid conduit pipes shall be ISI marked.
The conduits shall be circular in cross- section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non- metallic conduit are given in Table III
No non-metallic conduit less than 20 mm in diameter shall be used
Wiring capacity
The maximum number of PVC insulated aluminium/ copper conductor cable of 650/1100 V grade conforming to IS: 694- 1990 that can be drawn in one conduit of various sizes is given in Table- I. Conduit size shall be selected accordingly.

Conduit accessories
The conduit wiring system shall be complete in all respect including accessories.
Rigid conduit accessories shall be normally of grip type
Flexible conduit accessories shall be of threaded type.
Bends, couplers etc. shall be solid type in recess type of works, and may be solid or inspection type as required, in surface type of works.
Saddles for fixing conduits shall be heavy gauge non-metallic type with base.
The minimum width and the thickness of the ordinary clips or girder clips shall be as per Table IV.
For all sizes of conduit, the size of clamping rod shall be 4.5 mm (7 SWG) diameter.

Outlets

The Switch box shall be made of either rigid PVC molding, or Mild Steel, or cast Iron on all sides except at the front. The regulator boxes shall however be made only of mild steel or cast iron
PVC boxes shall comply with the requirements laid down in IS: 14772- 2000. These boxes shall be free from burrs, fins and internal roughness. The thickness of the walls and base of PVC boxes shall not be less than 2 mm. The clear depth of PVC boxes shall not be less than 60 m.

INSTALLATION

Common aspect for both recessed and surface conduit works.

The erection of conduits of each circuit shall be complete before the cables are drawn in.
Conduit joints
All joints shall be sealed/ cemented with approved cement. Damage conduit pipes/ fittings shall not be used in the work. Cut ends of conduit pipes/ fittings shall not be used in the work. Cuts ends of conduit pipes shall have neither sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling them through such pipes.
The engineer- in- charge, with a view to ensuring that the above provision has been carried out, may require that the separate lengths of conduit etc. after they have been prepared shall be submitted for inspection before being fixed.
Bends in conduit
All bends in the system may be formed either by bending the pipes by an approved method of heating, or by inserting suitable accessories such as bends, elbows or similar fittings, or by fixing non-metallic inspection boxes, whichever is most suitable. Where necessary, solid type fittings shall be used.
Radius of bends in conduit pipes shall not be less than 7.5 cm. no length of conduit shall have more than the equivalent of four quarter bends from outlet to outlet.
Cares shall be taken while bending the pipes to ensure that the conduit pipe is not injured, and that the internal diameter is not effectively reduced.

Outlets
All switches, plugs, fan regulator etc. shall be fitted in flush Patten. The fan regulators can be mounted on the switch box covers, if so stipulated in the tender specifications, or if so directed by engineer-in-charge.

Additional requirements for recessed conduit work.

Making chase.
Fixing conduit in chase
The conduit pipe shall be fixed by means of staples, or by means of non-metallic saddles, placed at not more than 60 cm apart, or shall be fixed by any other approved means of fixing.
At either side of bends, saddles/staples shall be fixed at distance of 15 cm from the center of the bends.

Erection in RCC work
Fixing inspection boxes.
Fixing Switch boxes and accessories.
Fish wire.
Bunching of cables.
For ease of maintenance, cable carrying direct current or alternating current shall always be bunched so that the outgoing and return cables are drawn in same conduit.

Earthing Requirements

A protective (earth) conductor shall be drawn inside the conduit in all distribution circuits to provide for earthing of non-current carrying metallic parts of the installation. These shall be terminated on the earth terminal in the switch boxes, and / or earth terminal blocks at the DB's.
Gas or water pipe shall not be used as protective conductors (earth Medium)

TABLE- III

Dimensional details of rigid non-metallic conduit

(All dimensions in mm)

Sr. No.	Nominal outside diameter (in mm)	Maximum outside diameter (in mm)	Minimum Inside diameter (in mm)	Maximum permissible eccentricity (in mm)	Maximum permissible ovality (in mm)
1	20	20 +0.3	17.2	0.2	0.5
2	25	25 +0.3	21.6	0.2	0.5
3	32	32 +0.3	28.2	0.2	0.5
4	40	40 +0.3	35.8	0.2	0.5
5	50	50 +0.3	45.0	0.4	0.6

TABLE- IV

Ordinary clips or girder clips

Size of Conduit	Width	Thickness
20mm & 25mm	19 mm	20 SWG (0.9144 mm)
32mm & Above	25 mm	18 SWG (1.219 mm)

TRUNKING CABLE MANAGEMENT SYSTEM

SCOPE

This chapter covers the requirements of mini trunking (casing wiring) and adaptable metallic or PVC trunking ("otherwise also called wire ways").

Adaptable trunking shall be used for power cables and data cables to run parallel in two different compartments with partition.

Mini Trunking is suitable for surface wiring work indoors where necessitated, either due to aesthetic or technical requirements, such as case of extension of existing wiring, avoidance of recessed wiring in RCC columns etc. PVC insulated cables and/ or other approved insulated cables to IS: 694-1990 shall be used in this type of work.

Wherever data cables are used for information outlets, adaptable trunking shall be used.

This System using PVC trunking shall be adopted in residential buildings or office building where there is a need of tidy wiring system.
PVC trunking for distribution of Voice Data Power should be used for cable management and should accept RJ45 Data socket and power socket or other wiring accessory like switches, indicators etc.
Where the trunking has to be necessarily adopted in situations under (i) above, PVC Trunking shall be used.
Preferred size of the mini trunking should be 25x16mm, 32x16mm, 40x25mm, 40x40mm, 160x50mm or 200x50mm for making up to four isolated compartments.
Trunking Should be equipped with rail on its surface on which clip-on partition can be clipped which should accept frames/plates for wiring devices up to 6.8 modules.
Trunking should have insulation rating of 5mega Ohm. Trunking should have the following fire resistance characteristics.

Operating temperature between - 400 C to 600 C.
Glow wire test 9600 C

Oxygen index – 50 ± 5
UL94 - VO

Material

The mini Trunking and adaptable trunking shall be of the same material, Viz. either PVC or anodized aluminium in extruded sections.
The mini Trunking shall have a square or rectangular body. The trunking cover shall be "CLIP-ON" type with double grooving in case of PVC wire-ways, and "CLIP-ON" type for metallic wire ways. All surfaces shall have smooth finish inside and outside. The top of the side walls of body shall be suitable for the above type of fixing arrangement of trunking. PVC trunking or Aluminium trunking should have uniform thickness throughout its length and shall be of factory finish.
PVC trunking shall be of good quality PVC, free from defects like deformation, unevenness, blister, cavities etc.
Dimensions

The size of mini trunking for the various sizes of cable and maximum number of 650/ 1100 V grade PVC insulated aluminium/ copper conductor cables that can be carried in one trunking are given size wise in Table V.
The thickness of mini trunking & adaptable trunking shall be 1 mm minimum
When mini trunking cover is clipped onto the trunking body, cover should completely overlap on the base (casing).

Out let Boxes
The outlet boxes such as switch boxes, regulator boxes and their phenolic laminated sheet covers shall be as per requirements.

Installation
Attachment to wall and ceiling

The mini trunking and adaptable trunking shall be fixed by means of suitable screws to approved type of asbestos or fiber fixing plugs, at intervals not exceeding 60 cm for all sizes for mini trunking. In case of adaptable trunking, the screwing distance shall be such that the weight of the trunking & cable hold firmly on the wall or ceiling. On either side of the joints, the distance of the fixing arrangement shall not exceed 15 cm from, the joint.
All trunking body shall be fixed directly on wall or ceiling as above.
Trunking shall be used only on dry walls and ceiling, avoiding outside walls as far as possible and shall not be buried in walls not fixed in proximity to gas, steam or water pipes or immediately below the heater.
Adaptable trunking shall be with pill off cover for protection against dust. Pill off cover shall be removed only on completion of painting of walls.

Passing through floors or walls

When conductors pass through floors, the same shall be carried in an approved PVC conduit, or heavy gauge steel conduit properly bushed at both ends. The conduit shall be carried 20 cm above floor level and 2.5 cm below ceiling level and neatly terminated into the casing. Steel conduit pipes wherever accessible shall be securely earthed.

Joints in casing and capping

The wire ways in straight runs should be in single piece as far as possible so as to avoid joints. Trunking shall be of 2m or 3m standard length for the ease of insulation.

All joints shall be scare-fed or cut diagonally in longitudinal section, and shall be smoothed down by filing to make the joints a very close fit as far as possible and without burrs. They shall be screwed at joints with two or more screws as would be necessary.

Joints arising out of bends or diversion shall be done using standard accessories like internal angle, external angle, flat angle (elbows), Flat junction (T) and end caps. For the separation of data and power cables there shall be partition in both trunking and accessories. Internal and external angle shall have variable angle for the alignment at the wall corners. In no case the radius of curvature of the cables inside a bend shall be less than 6 times their overall diameter.

Trunking should be of white colour in case of PVC trunking and white or Gray colour in case of Aluminium trunking.

Mini trunking attached to ceiling shall be carried completely across the ceiling/ wall whenever required by engineer in charge, instead of being stopped at an outlet location and in all such cases, dummy mini trunking must be provided.

Attachment of capping

Wherever required by engineer in charge, capping shall not be fixed until the work has been inspected with the wires in position and approved. The inspection will be done from time to time as the work progresses.

Cover shall be attached to body after all the insulated wires are laid inside.

No screw or nails shall be used for fixing PVC cover to the body.

Aluminium cover shall be fixed by using cadmium plated flat head/round head screw with an axial spacing not exceeding 30 cm.

Installation of Cables

For ease of maintenance, cable carrying direct current or alternating current shall always be bunched together so that the outgoing and return cables are drawn in the same trunking.
Mini trunking shall be of such design that it holds the wires inside the trunking body (casing) at suitable intervals, so that at time of opening of the trunking cover (capping), wires may remain in position in the trunking body (casing) and do not fall out.

Earth Continuity

A protective (earth continuity) conductor shall be drawn inside for earthing of metallic boxes of the installation as well as for connection to the earth pit of socket outlets.
In the case of metallic trunking there shall be a metallic link between adjacent trunking covers with screw connections, and also connections from the end casing to the earth terminal of metallic boxes/ outlets/ switch board as per the case may be, for the complete body earthing of the system.

TABLE V

Maximum number of PVC insulated 650/1100 Volt grade Aluminium/ Copper conductor cable confirming to IS: 694-1990

Nominal Cross sectional area	10/15 mm x 10 mm	20/15 mm x 10 mm	25/15 mm x 16 mm	32 mm x 16 mm	40 mm x 25 mm	40 mm x 40 mm
1.5	3	5	6	8	12	18
2.5	2	4	5	6	9	15
4	2	3	4	5	8	12
6		2	3	4	6	9
10		1	2	3	5	8
16			1	2	4	6
25				1	3	5
35					2	4
50					1	3
70					1	2

Note: Dimensions Shown above are outer dimensions of mini trunking.

M.V. PANEL & D.B

Scope

This covers supply/ erection/ testing and commissioning of the equipment suitable for 415 V, 3 phase, 50 Hz 4 wire system.

For each equipment required IP rating and short circuit rating capacity will be specified. Governing BIS also will be specified.

All the equipment will be factory fabricated in an approved factory having modern fabrication and testing process. it d=shall have seven tank pretreatment process comprising of degreasing, rinsing, de-rusting, rinsing, phosphatising, rinsing and passivation followed by power coat painting having a paint thickness of 60 microns or as specified. The powder paint will be subjected to oven-heated process. All panels will be provided with suitable gasket to make it dust/ vermin proof.

SPECIFICATION OF LT CUBICAL PANEL:

Cubical panel shall be floor mounted (on a base frame) totally enclosed and extensible type. The general construction shall conform to IS: 8623/93. He design shall include all provision for safety of operation and

maintenance personnel. Degree of IP protection shall be IP-42 for indoor type application and IP-54 for outdoors, unless otherwise specified.

The panel shall be compartmentalized type having space and arrangement for incoming cable/bus ducting, incoming switchgear/ switchgears, bus coupler, insulated and properly supported compartmentalized bus bar, outgoing compartmentalized switchgear, bus bar supports, joint shrouds, cable alleys of suitable size for cabling routing, support and terminations, interconnection between bus bars and switch gear with auxiliary bus bars/ insulated conductors/ strips etc. Also the panel will be provide with necessary instrumentation like CTs, PTs, Ammeters, Voltmeters, Phase indicating lamps, other required instruments, wiring, fuses etc.

It shall be fabricated out of CRCA not less than 2.0 mm thick for load bearing members and 1.6 mm for doors of LT panels. The frame work may be Angle Iron/ Channel/ Bolted type construction. General constructions shall employ the principle of compartmentalization and segregation of each circuit. Unless otherwise approved, incomer and bus section panels shall be separate and independent and shall not be mixed with sections required for feeders. Each section of the rear accessible type board shall have hinged access door at the rear. Operating handle of the highest unit shall be at a height not more than 1.7 mts. Overall height of the board shall not exceed 2.3 meter.

Arrangement for incoming/outgoing cable termination:
Cable entries shall be provided either from the rear or from the front through cable alleys of suitable size. Removable gland plate to be provided for each cable entry. Cable support arrangement to be provided inside cable alley so that cables are neatly arranged and fixed. From each outgoing switch, insulated strip/ conductor of suitable size to be provide up to suitable terminal block, which will receive incoming and outgoing cable termination. It is desirable that cables are not terminated directly to switch gear, but terminated through proper terminal blocks.

Specification of cable terminal block:
Terminal block of reputed make shall be used. The housing material shall be polyamide having unbreakable and fire-retardant characteristic. All the metal parts shall be made up of copper alloy including the screws. Mounting shall be 'Din' or 'G-rail' type. Screws shall be self captive type. No protection cover is required, and the block should be touch proof.

Bus bar/ Supports/ Clearances:
The bus bar system may comprise of a system of main/ auxiliary bus bars run in bus bar alleys.

Rating:
Bus bars shall be made of wrought aluminium or aluminium, alloy, or electric grade copper, confirming to relevant Indian Standard, as specified. The ratings of the bus bar shall be 100A, 200A, 300A, 400A, 500A, 600A, or 800A as specified.

Currentdensity:
Bus bar shall be of sufficient cross-section so that a current density of 130A/sq.cm (800A/sq.inch) is not exceeded at nominal current rating for aluminium bus bars, and 160A/sq.cm (1000A/sq.inch) for copper bus bars. The minimum sizes of sections of bus bar are given in table VI.

Cross Section of bus bar:
The cross section of the neutral bus bar shall be the same as that of the phase bus bar for bus bars of capacities up to 200A; for higher capacities, the neutral bus bar must not be less than half the cross section of that of the phase bus bar.

Insulation:
Each bus bar shall be suitably insulated with PVC sleeves/ tapes.

The insulation of the rising mains shall be capable of withstanding the voltage of 660V of A.C.

Bus bar Supports
Bus bar support insulators shall be class F insulators made of non- hygroscopic, non-combustible, track resistant and high strength FRP/SMC/DMC material, and shall be of suitable size and spacing to withstand the dynamic stresses due to short circuit currents. The spacing between two insulators should not exceed 250 mm.

Bus bar Clearances:
The Minimum clearance to be maintained for enclosed indoor air insulated bus bars for medium voltage application shall be as follows:

Between	Min. Clearances
Phase to earth	26 mm
Phase to phase	32 mm

Note: for strip connection from bus bars to switch gear, the above clearances don't apply.

Bus bar joints shall be thoroughly cleaned and suitable oxidizing grease shall be applied before making the joint.
High tensile bolts, plain and spring washers shall be provided to ensure good contact at the joints.
The overlap of the bus bars at the joints shall be not less than the area of cross section of the bus bars.

Bus Bar Marking:
Bus bars and main connections shall be marked by colour or letter as per table VII.

Earthing:
2 Nos. 20x3 mm copper strip for LT panel up to 400 Amp. Capacity or 2 Nos. 20x5 mm copper strip for LT panel of higher capacity shall be fixed all around the panel connected to 2 Nos. earth bus copper strips connected to incoming earth conductors.

Commissioning:
After erection, LT panel will be commissioned after:

Tightening of all the nuts and bolts.
Closing any left out holes to ensure the entire panel is insect proof.
Megger testing.
Earth testing.

SPECIFICATION OF PREWIRED DB

As a general practice only prewired MCB/HRC type DBs shall be used, on account of their superior technical features, compared to convectional DBs, which don't allow for proper wiring space and wiring termination. Rewirable fuse type DBs shall not be used.

Prewired DBs shall have following feature:

Recess/ Surface type with integral loose wire box.
Phase/ neutral/ earth terminal blocks for termination of incoming & outgoing wires.
Din channel for mounting MCB's
Arrangement for mounting incomer MCB/ RCCB/ RCBO/ MCCB as required.
Copper Bus bar.
Earthing terminals.
Wiring from MCB's to phase terminal block.
Interconnection between terminal block/ incoming switches/ bus bar/ neutral terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.
Terminal blocks should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq mm.
Terminal block shall be made of flame retardant polyimide material.
Colored terminal block and FRLS wires for easy identification of RYB Phases, Neutral and Earth.
Prewired DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits. (This is an optional feature).
The prewired DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.
Detachable plate with Knock out holes shall be provided at the top/bottom of board. Complete board shall be factory fabricated and pre-wired in factory ready for installation at site. The box and cover shall be fabricated from 1.6 mm sheet steel, properly pretreated, phosphotized with powder coated finish.
Where specified it shall be of double door construction provided with hinged cover in the front.

Note: Prewired DB will be factory manufactured by reputed manufacturer of MCB DBs.

TABLE VI

Aluminium/ copper bus bar sections

Current ratings in amps. Upto	Recommended rectangular cross-section			
	Aluminium		Copper	
	No. of strips/ phase	Size in mm	No. of strips/ phase	Size in mm
100	1	20x5	1	20x3
200	1	30x5	1	25x5
300	1	50x5	1	40x5

400	1	50x6	1	50x5
500	1	75x6	1	60x5
600	1	80x6	-	-
800	1	100x6	-	-
1000	1	100x10	-	-
1200	1	125x10	-	-
1600	2	100x10	-	-
2000	2	125x10	-	-
2500	3	125x10	-	-

Note:

In larger bus bar of sizes above 1000 amps, the sections can be accepted in other rectangular cross-sections and numbers also, provided the total cross-sectional area offered is not less than the total cross-sectional area shown in the above table against the respective bus bar rating.
With aluminium bus bars, only aluminium wire/ solid bar connections shall be made for incoming/ outgoing mountings on the switchboards.
With copper bus bars, only copper wire/ solid bar connections shall be made for incoming/ outgoing mountings on the switchboards.

CABLES

a) Standards: - Cables shall conform to the following standards except where specifically stated otherwise.

- IS : 1554
- IS : 692
- IS : 7098
- IS : 502

b) The cables shall be of any company which is from approved list attached with the Tender. If there is any doubt about the authenticity of the cables supplied, the Engineer in Charge will send a sample of the cable to a Government approved laboratory for testing and all expenses incurred for this purpose will have to be borne by the contractor. The Engineer in Charge may also send for verification a sample of the cable along with the test certificates and excise duty gate passes, to the Company claimed to have manufactured the cable.

c) The cables shall be supplied , inspected , laid, tested and commissioned in accordance with drawings, specifications , relevant standard specifications and cable manufacturers instructions.

d) The MV cables shall be PVC insulated aluminium or copper conductor armoured cable of 1100 volts grade and as specified.

The HV cables shall be PVC insulated aluminium conductor armoured cable of 11000 volts grade cross linked polyethelene (TROPOPHEN) with shielding and as specified.

The telephone cables shall be PVC insulated, copper conductor armoured jelly filled and conforming to P&T Specification ITD S/WT129D.

e) All cables shall be inspected upon receipt at site and checked for any damage during transit. The contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of cable jointing . This apportioning shall be got approved by Engineer in Charge before the cables are cut to lenghts .

f) Where joints are unavoidable the location of such joints shall be got approved .

Cable straight joints shall be heat shrinkable type and used only to join the cables where the manufacturer's delivery lengths of cables is less than the required length and where existing cables are to be extended as directed. Individual connectors shall be insulated by shrinkable types providing high level of Insulation eliminating the need to stagger the cores. Galvanised steel casing shall be provided for protection against mechanical damages. Sleeves shall be provided for abrasion resistance, corrosion protection and water tightness.

LAYING OF CABLES:

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable . great care shall be exercised in laying cables to avoid forming kinks. The relative position of the cables laid on the cable tray shall be preserved and the cables shall not cross each other at all changes in direction in horizontal and vertical planes. The cable shall be bent smooth with a radius of bend not less than 12 times the diameter of cable. Distinguishing markers shall be fixed on the cable on every floor and at ends in red, yellow and blue colours

shall be wrapped just below for identification insulating tapes of appropriate voltage and the sockets for phase identification.

The minimum width of trench for laying single cable shall be 35 cm. Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the inter-axial spacing between the cable , except where otherwise specified shall be at least 20 Cm. There shall be clearance of at least 15 Cm between axis of cables laid in single tier formation. The total depth of trench shall not be less than 75 Cm for cables upto 1.1 KV.and not less than 110 Cm for HV cables When more than one tier of cables in unavoidable and vertical formation of laying is adopted , depth of cables above shall be increased by 30 Cm. for each additional tier to be formed .

The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided . Where gradients and changes in depth are unavoidable these shall be gradual. Excavation should be done by any suitable means manual or mechanical . The excavated soil should be stacked firmly by the side of the trench such that it may not fall back into the trench. The bottom of the trench shall be level and free from stones brick bats etc. The trench shall than be provided with a layer of clean, dry sand cushion of not less than 8 Cm in depth. At the time of issue of cables for laying, the cores shall be tested for continuity and insulation resistance. The cable drum be properly mounted on jacks or on a cable wheel at a suitable location , making sure that the spindle ,jack etc. are strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains . The entire cable length shall as far as possible be paved off in one stretch. However, where this is not possible, the remainder of the cable may be removed by " Flaking " i.e. by making one long loop in the reverse direction . After the cable has been uncoiled and laid into the trench over the rollers , The cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 metres apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line . Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 17 Cm. above the base cushion of sand before the protective cover is laid. In case of vertical multi-tier formation after the first cable has been laid , a sand cushion of 30 Cm. shall be provided over the initial bed before the second tier is laid. If additional tiers are formed , each of the subsequent tiers also shall have second cushion of 30 Cm. as stated above . Unless otherwise specified , the cables shall be protected by second class bricks of not less than 20 Cm X 10 Cm (nominal size)as per CPWD building specification protection covers placed on top of the sand (bricks to be laid breadthwise) for the full length of the cable.

The trenches shall be back-filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 Cm. Unless otherwise specified a crown of earth not less than 50 Cm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

Cables inside buildings shall be laid on the cable trays, or in cable trenches or in pipes . Distinguishing markers shall be fixed on every floor. All cables passing through wall shall run through asbestos cement pipes of adequate diameter or as directed. Parallel cables shall be spaced at least 50 Cm apart maintaining their relative position over the entire length.

Engraved PVC labels showing the cable destination/ start shall be affixed to the cables wherever there is change in angle of laying, type of laying , entrance and exit from building etc
Tests
All routine tests are to be carried out as stipulated in IS. Manufacturer's test certificate and excise duty gate pass must be furnished, without which the cables will not be accepted.
The method of Measurement for cables shall be the actual measured lengths of cables laid and shall include all the necessary work such as removing the precast rcc slab, placing back the precast rcc slabs, removing and placing back the chequered plate etc

CABLE TRAYS, STEEL WORK, CHEQUERED PLATE, PANEL SUPPORTS ETC
The steel used shall conform to IS: 226 (latest edition). The steel should be free scale, blisters, laminations, cracked edges and defects of any sort. All steel shall be checked carefully for its straightness and any bend noticed should be removed by pressure and not by hammering. Necessary test certificates shall be furnished to Engineer in Charge if requested.

The cutting of steel sections shall be by punching, shearing machine. The plates may be cut by oxy-acetylene flame and cut edge shall be properly finished smooth by file. The ends of the structural/other members shall be sawn or cropped to length and whenever directed shall be chipped off. The holes in plates, angles etc. shall be drilled and not punched or gas cut.

EARTHING

SCOPE

This chapter covers the essential requirements of earthing system components and their installation. For details not covered in these specifications IS code of practice on earthing (IS: 3043-1987) shall be referred to.

APPLICATION

The electrical distribution system in the Department is with earthed neutral (i.e. neutral earthed at the transformer/ generator end). In addition to the neutral earthing, provision is made for earthing the metallic body of equipments and non-current carrying metallic components in the sub-station, as well as in the internal/ external electrical installations.

Earthing system is also required for lightning protection, computer installations and hospital operation theaters, etc. for functional reasons.

Earthing requirements are laid down in Indian Electricity Rules, 1956, as amended from time to time, and in the regulations of the Electricity supply Authority concerned. These shall be compiled with.

Application for Internal E.I.

Every sub-main will have earth continuity conductor to run along with sub-main wiring. In case of 3- phase submain wiring two earth continuity conductors shall be provided.

Every circuit will have its earth continuity conductor to run along with circuit wiring. In case of 3- phase circuit two earth continuity conductors shall be provided.

Looping of earth is allowed only in case of point wiring.

When2/3 power outlets are looped to one circuit, earth looping of these outlet is permissible.

TYPES OF ELECTRODES & MATERIAL

Earth Electrodes

Types

The type of earth electrode shall be any of the following, as specified.
Pipe Earth Electrode.
Plate earth electrode.
Strip or conductor earth electrode.

Electrode materials and dimensions.

The Materials and minimum sizes of earth electrodes shall be as per Table IX.

GI pipe electrodes shall be cut tapered at the bottom, and provided with holes of 12 mm dia, drilled not less than 7.5 cm from each other up to 2 m of length from the bottom.

The length of the buried strip or conductor earth electrode shall be not less than 15 m. This length shall suitably be increased if necessary, on the basis of the information available about soil resistance, so that the required earth resistance is obtained. Prior approval of the engineer-in charge shall be taken for any such increase in length.

All hardware items used for connecting the earthing conductor with the electrodes shall be of GI in the case of GI pipe and GI plate earth electrodes, forged tinned brass in case of copper plate electrodes.

Earthing Conductor & sizes

The earthing conductor (protective conductor from earth electrode up to the main earthing terminal/ earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper, and in the form of wire or strip as specified.

The sizes of earthing conductor shall be specified, but this shall not be less than the following
4mm dia. (8 SWG) copper wire.

25mm x 4mm in the case of GI strip, or,

20mm x 3mm in the case of copper strip.

Earthing continuity/ loop earthing conductor & sizes

The material and size of protective conductors shall be as specified Below

Size of Phase Conductor	Size of protective conductor of the same material as phase conductor
Up to 4 sq.mm.	4 sq.mm.
Above 4 sq.mm. up to 16 sq.mm.	Same size as phase conductor
Above 16 sq.mm. up to 35 sq.mm.	16 sq.mm.
Above 35 sq.mm.	Half of the phase conductor

LOCATION FOR EARTH ELECTRODES

Normally an earth electrode shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases, electrodes may be located further away from the building, with the prior approval of the Engineer-in-Charge.

The location of the earth electrode will be such that the soil has a reasonable chance of remaining moist as far as possible. Entrances, Pavements and roadways, should be avoided for locating earth electrodes.

INSTALLATION

Electrodes

Various types of electrodes

Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in fig. 11.

In locations where the full length of pipe electrode is not possible to be installed due to meeting a water table, hard soil or rock, the electrode may be to reduce length, provided the required earth resistance result is achieved with or without additional electrodes, or any alternative method of earthing may be adopted, with the prior approval of the engineer-in-charge. Pipe electrodes may also be installed in horizontal formation in such exception cases.

Plate electrode shall be buried in ground with its faces vertical, and its top not less than 1.5 m below the ground level. The installation shall be carried out as shown in Fig. 12.
When more than one electrode(Plate/Pipe) is to be installed, a separation of not less than 2 m shall be maintained between two adjacent electrodes

The strip or conductor electrode shall be buried in trench not less than 0.5 m deep.

If conditions necessitate the use of more than one strip or conductor electrode, they shall be laid as widely distributed as possible, in a single straight trench where feasible, or preferably in a number of trenches radiating from one point.

If the electrode cannot be laid in a straight length, it may be laid in a zigzag manner with deviation up to 45 degrees from the axis of the strip. It can also be laid in the form of an arc with curvature more than 1 m or a Polygon.

Artificial treatment of soil

When artificial treatment of soil is to be restored to, the same shall be specified in the schedule of work. The electrode shall be surrounded by charcoal/ coke and salts as indicated in Fig. 11 and 12. In suchcases, excavation for earth electrode shall be increased as per the dimensions indicated in these figures.

Watering arrangement

In the case of plate earth electrodes, a watering pipe 20 mm dia. Medium class pipes shall be provided and attached to the electrodes as shown in Fig. 9 and 10. A funnel with mesh shall be provided on the top of this pipe for watering the earth.

In the case of pipe electrodes, a 40 mm x 20 mm reducer shall be used for fixing the funnel with mesh.

The watering funnel attachment shall be housed in a masonry enclosure of size not less than 30 cm x 30 cm x 30 cm.

A cast iron/ MS frame with MS cover, 6mm thick, and having locking arrangement shall be suitably embedded in the masonry enclosure.

Earthing conductor (Main earthing lead)

In the case of pipe earth electrode, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

In the case of pipe earth electrode, wire type earthing conductor shall be secured as indicated in fig.11 using a through bolt, nuts and washers and terminating socket.

A double C-clamp arrangement shall be provided for terminating tape type earthing conductor with GI watering pipe coupled to the pipe earth electrode. Galvanized "C" Shaped strips, bolts, washers, nuts and check nuts of adequate size shall be used for the purpose.

The earthing conductor from the electrode up to the building shall protected from mechanical in jury by medium class, 15mm dia. GI pipe in the case of wire, and by 40 mm dia, medium class GI pipe in the case of strip. The protection pipe in ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth in due co-ordination with the building work.

The earthing conductor shall be securely connected at the other end to the earth stud/ earth bar provided on the switch board by:

Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and

Bolt, nut and washer in case of strip conductor.

In the case of substations or alternators, the terminal shall be made on the earthing terminal of the neutral point on the equipment and/ or the earth bus, as the case may be.

Loop Earthing/ Earth continuity conductor

Earth terminal of every switch board in the distribution system shall be bonded to the earth bar/ terminal of the upstream switch board by protective conductor(s)

Two protective conductors shall be provided for a switchboard carrying a 3-phase switchgear thereon.

Looping earthing of individual units will not be however necessary in the case of cubical type switchboards.

The earth connector in every distribution board (DB) shall be securely connected to the earth stud/ earth bar of the corresponding switch board by a protective conductor.

The earth pin of socket outlets as well as metallic body of fan regulators shall be connected to earth stud in switch boxes by protective conductor. Where the switch boxes are of non-metallic type, these shall be looped at the socket earth terminals, or at an independent screwed connector inside the switch box. Twisted earth connections shall not be accepted in any case.

EARTH RESISTANCE

The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 8 ohms.

Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode(s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by engineer-in-charge.

MARKING

Earth bars/ terminals at all switch boards shall be marked permanently, either as "E" or as

Main earthing terminal shall be marked "SAFETY EARTH – DO NOT DISCONNECT"

USE OF RESIDUAL CURRENT DEVICES (RCDs)

An extract on selection and application of RCDs (also known as RCCBs) from IS: 12640- 1988 is given at Appendix G. Provision of RCD shall be specified individual cases keeping in view the type, use, importance, system of earthing and nature of electric installations to be protected by the RCCBs, requirements of the local electric supply company, etc. The sensitivity shall be 30mA, 100mA, 300mA, or 500mA, as specified.

TABLE IX

Materials and sizes of earth electrodes

Type of Electrode	Material	Size
Pipe	GI medium class	40mm dia 3.45 m long (Without any joint)
Plate	GI Copper	60 cm x 60 cm x 6 mm thick 60 cm x 60 cm x 3 mm thick
Strip	GI Copper	100 sq.mm section 40 sq.mm section
Conductor	Copper	mm dia (8 SWG)

Note: Galvanization of GI items shall conform to Class IV of IS: 4736-1986.

GENERATOR

Diesel Generator (DG)

Scope:

Specification No (GEN-DG)

Providing D.G. Set at site, carrying out all preparatory works, assembling, installing, making adjustments, confirming all pre-commissioning requirement as per manufacturer's instructions, commissioning, final testing, putting in to operation and handing over of the complete system of D.G. set including inspection from inspectorate office. The work include necessary minor civil works including opening on wall/slab/floor and making good as it was etc. & comprehensive maintenance of the DG set for 1 Year from date of commissioning.

Material:
Diesel Generator set with continuous rating, 3 Phase, 415 V, 50 Cycles A.C. Supply of specified capacity , comprising of totally enclosed air/water cooled diesel engine with standard control panel & tool kit (refer drawing no. GEN-DG-1 & GEN-DG-2)

Diesel Engine

The engine shall be of standard design of original manufactures. It should be a totally enclosed air/water cooled diesel engine with 4 stroke multi cylinders developing suitable BHP (as per 11/3) for giving power rating of (as Table 11/3) at the load terminals of alternator at 1500 R.P.M at armature temperature of 40o C for height at 1000 Meter above M.S.L. at 50% R.H. The engine shall be capable of delivering specified power at variable loads for P.F.0f 0.8 (lag) with 10 % over load available in access of specified output for 1 hour in every 12 hours. The average load factor of the engine over period of 24 hours shall be 0.85 for power output. The engine shall confirm to IS: 10000 and Amended up to date.
The engine shall be fitted with following accessories:-
Dynamically balanced fly wheel.
Necessary flexible coupling and guard for alternator and engine applicable
Lubricating oil cooler
Air cleaner Dry/ Bath type
Lubricating oil pressure gauge
Lubricating oil Filter with replicable element
Dry exhaust manifold with suitable exhaust heavy duty residential type exhaust silencer and vertical hot air duct both logged with asbestos rope exhaust piping of required length to reduce noise level
12/24 V. Electric starting equipment complete with standard batteries, dynamo, cut-out ammeter, necessary wiring, self-starter etc. The system shall be capable of starting D.G. set within 20 to 30 seconds even in winter condition with an ambient temperature down to 00 C.
Mechanical governor of class A2 for up to and including 200 KVA capacity and electronic governor of class A1 for capacity above 200 KVA shall be provided as per tender design of manufacturer. Governor shall be self-contained unit capable of monitoring speed.
Radiator
Daily fuel tank: Daily fuel tank filled to the full capacity at the time of handing over to the client.

Daily fuel service tank of minimum capacity as table 11/1, below, fabricated from M.S. sheet with inlet, outlet, connections air vent tap, drain plug and level indicator (gauge) M.S. fuel piping from tank to engine with valves, unions, reducers, flexible hose connection and floor mounting pedestal, twin fuel filter. The location of the tank shall depend on standard manufactures design.

Table 11/1

Minimum capacity of daily fuel tank for Generators

Sr. No.	Capacity of D.G. set	Minimum Fuel Tank capacity
1	Up to 25 KVA	100 Litters
2	Above 25 KVA to 62.5 KVA	120 Litters
3	Above 62.5 KVA to 125 KVA	225 Litters
4	Above 125 KVA to 200 KVA	285 Litters
5	Above 200 KVA to 380 KVA	520 Litters

Engine Control Panel:
Engine control panel should be fitted with following accessories / indicators and shall have display:-
Start/ stop key switch
Lube oil pressure indication
Water temperature indication
RPM indication
Engine Hours Indication
Battery charging indication
Low lube oil trip indication
High water temperature indication
Over speed indication

Battery Charger:
The battery charger shall be of Trickle & Boost type, and suitable to charge required numbers of batteries at 12V//24 complete with, transformer, rectifier, charge rate selector switch, indicating ammeter, Voltmeter, battery over charging protection with audible alarm. Connections between the Battery charge & Batteries shall be provided with suitable copper leads with lugs.
Battery:
Battery capacity and copper cable sizes for various engine capacities shall be as per the details given in Table No 11/2. Cable sizes shown are for maximum length of 2m length, if higher size of cable is required it shall be selected in such a way that voltage drop does not exceed 2V.

Table 11/2

Battery Capacity and copper Cable Sizes for various Engine Capacities

Sr. No.	DG set Capacity	Battery Capacity (AH)	Copper Cable size Cable size in mm2	Electrical System (Voltage)
1	Up to 25 KVA	80	35	12
2	Above 25 KVA to 62.5 KVA	120	50	12
3	Above 62.5 KVA to 125 KVA	150	50	12
4	Above 125 KVA to 200 KVA	180	50	24
5	Above 200 KVA to 380 KVA	180	70	24

For AMF applications, a static battery charger working on mains supply recommended to keep the batteries charged at all times.

Alternator:
Alternator of specified rating, 415 Volts, 1500 RPM, 3 Ph., 50 Hz, A/C supply with P.F 0.8 lagging at 400 C armature temperature for height 1000 meter. Above MSL at 50 % R.H. alternator shall be brush less type self-regulated having static excitation system having capacity of desired output confirming to IS: 4722-1968 with automatic Voltage regulation + 5% operated voltage from no load to full load, two numbers of earth terminal on opposite sides. Terminal box shall be suitable for underground cables and same shall be with stand mechanical and thermal stresses developed due to any short circuit at the terminals. The alternator shall be in accordance with following standards:-
IS: 4722 The performance of rotating electrical machines
IS: 4889 Rules for method of declaring efficiency of electrical machines
IS: 13364 Part I 1992 Alternator-voltage Regulation up to 20 KVA
IS: 13364 Part II 1992 Alternator- Voltage Regulation above 20 KVA to 80 KVA

Performance:

Voltage dip shall not exceed 20 % of the rated voltage for any step load or transient load as per IS: 8528 (part I). The winding shall not develop hot spots exceeding safe limits due to unbalanced of 20 % between any two phases from no load to full load.
The performance characteristics of the alternator shall be as below:-

Efficiency at full load 0.8 P.F.
Up to 25 KVA- not less than 82 %
Above 25 KVA and up to 62.5 KVA- not less than 86 %
Above 62.5 KVA/ up to 250 KVA- not less than 90 %
Above 250 KVA- not less than 93%

Total Distortion factor Less than 3 %
10 % Overload one hour in every 12 hrs. of continuous operation
50 % overload 15 seconds.

Common Base Plate:

Engine and alternator shall be coupled by means of flex plate/ flexible coupling as per manufacturer standard design and both units shall be mounted on a common base plate together with all auxiliaries to ensure perfect alignment of engine and alternator with minimum vibrations. The base plate shall be suitable for installation on suitable anti- vibrating mounting system comprising of 6 anti-vibrating pads duly provided.

Control Panel:

Floor/ Wall Mounted control panel Box comprising of Voltmeter, ammeter, selector switches MCCB/MCB of adequate capacity, indicator lamp duly wired with RC fuses. Alternator & control panel shall be connected with provided suitable capacity armoured cable with necessary glands & lugs etc.

Exhaust System:

It shall comprise of following parameters:-
Exhaust system should create minimum back pressure.
Smooth bends shall be used for minimizing the back pressure
Minimum no of bends shall be used for minimizing the back pressure
Pipe sleeve of larger diameter should be used while passing the pipe through concrete wall & gap shall be filled with felt lining.
Exhaust piping inside the Acoustic enclosure/ Generating set room should be lagged with asbestos rope and covered with aluminium sheet cladding to avoid heating of the area.
the exhaust outlet should be in the direction of prevailing winds and should not allow Exhaust gases to enter air inlet/ Window, etc.

Factory Testing:

DG set shall be tested in presence of Engineer in charge or his authorized representative in the factory for following before Dispatch:
Full load Trial for 12 Hour. Fuel, lubricating oil, etc. shall be arranged by the agency.
10 % overload trial for one hour within 12 hrs. test

Certificates:
Manufacturer's test certificate for engine, Alternator and of the set.
Necessary certificate for the engine model so selected along with compliance of noise and emission norms as per latest CPCB guidelines for D.G. set should be furnished from the manufacturer along with manufacturer's technical details
Permission from Electrical Inspector.

Method of construction

The D.G set with canopy shall be erected with due care and ensuring the perfect level with the help of sprit level, on provided cement concrete foundation and connecting the provided earthing connections the exhaust system shall be connected to exhaust manifold. After ensuring the filling of fuel, lubricating oil and medium of coolant, the set shall be commissioned, with giving necessary full load trials or with the available load at site. The set shall then be handled over to the department along with the installation report given by manufacturer and with all the necessary certificates and permissions obtained.

Mode of Measurement

Executed quantity will be counted on number basis. (i.e. each)

Table No 11/3

Rating of Alternator and minimum BHP of Engine

Sr. No	KVA Capacity of Alternator	Minimum BHP of Diesel Engine	Average fuel consumption liter per hour at 100% Load
1	10	12	3.0
2	15	19	4.1
3	20	26	6.0
4	25	32	6.4
5	30	42	8.3
6	40	50.5	10.3
7	50	65.8	13.0
8	62.5	76	15.6
9	75	91	16.0
10	82.5	102	18.6
11	100	127	22.8
12	125	154	28.0
13	140	166	30.0
14	160	198	34.3
15	180	235	40.0
16	200	254	44.0
17	250	313	54.0

Automatic Mains Failure Panel

Scope:

Specification No (GEN-AMF)

The work includes supplying, installing, Testing & commissioning of automatic mains failure control panel including auto by-pass, suitable for specified rating of DG set complete with accessories and comprehensive maintenance of the panel up to 1 year from date of commissioning.

AMF Panel Shall comply following IS Specification:
IS: 2147 1962 Degree of Protection.
IS: 4722 H.V. testing for panel

Material:
Panel Shall consist of following:
Power module a pair of electromechanically interlocked contactors for all the phase/phases & neutral. (for mains and Generator)
Overload relay for generator contactor, neutral contactor for mains and generator, control and metering module: Line Voltage monitor. Generator voltage monitor, Ammeter, 3 times attempt to start facility.
MCB/ MCCB of suitable rating for auto/ manual operation, Auto/ manual switch. Emergency stop push buttons.
Manual start push button.
Frequency Meter.
Engine hour and RPM meter. (Taco meter)
Two earthing studs.
Protection module: The Engine shutdown in the unlikely event of low lube oil pressure, high indicators with alarm of Full/ Maximum Load on generator.
Indicators for load on mains, Load on DG set, Engine fails to start, Emergency stop, Battery charger complete with transformer/ rectifier, D.C Voltmeter and ammeter, selector switch for trickle, off, and boost charging and current adjustment.
Main supply failure monitor.
Timers.
Fault reset push button.

Method of construction:
AMF panel complete with relays, timers, set of CT's for metering & protection and energy analyzer to indicate currents, phase and line voltages, frequency, power factor, KWH, KVARH & provision for overload, short circuit, fault, under frequency, control cabling from AMF panel to diesel Engine and elsewhere if required, complete with metering as per material list.

System Operation:
Auto Mode
A line voltage monitor shall monitor supply voltage on each phase when the mains supply voltage fails completely or falls below set value (variable between 80 – 95 % of the normal value) on any phase, the

monitor module shall initiate start-up of diesel engine. To avoid initiation due to momentary disturbances, a time delay adjustment between 0 to 5 second shall be incorporated in startup intimation.
A three attempt starting facility shall be provided 6 seconds ON, 5 seconds OFF, 6 seconds ON, 5 seconds OFF, 6 Seconds ON. If at the end of the third attempt, the engine does not start it shall be locked out of start and master timer shall be provided for this function, suitable adjustment timers are to be incorporated which will make it feasible to vary independently ON-OFF setting periods from 1 -10 seconds, if alternator does not build up voltage after the first or second start as may be the case, further starting attempt will not be made until the starting facility is reset.
Once the alternator has built up voltage, the alternator circuit breaker shall close connecting the load to alternator. The load is now supplied by the alternator.
When the main supply is restored and is healthy as sensed by the line voltage monitor setting, both for under voltage or unbalanced, the system shall be monitored by a suitable timer which can be set between 1 minute to 10 minutes for the load to be transferred automatically to main supply.
The panel shall start the set in the event of fault condition of under voltage, over voltage, phase reversal, high frequency, neutral snapping, short circuit, etc., on the main side. If the above fault condition arises if the load is being fed from the DG set, then the panel start cut off the load from the set with an audible alarm, and the set shall run on no load.
Manual mode:
In a manual mode, it shall be feasible to start-up the generator set by the operator on pressing the start push button.
Three attempts starting facility shall be operative for the start-up function.
Alternator circuit breakers closing and trip operation shall also be through operator only by pressing the appropriate button on the panel and closed shall be feasible only after alternator has built up full voltage.
Test Mode:
When under test mode, pressing of test button should complete the startup sequence simulation, and engine shall be started.
Engine shall build up voltage but the set shall not take load by closing alternator circuit breaker when the load is on mains, monitoring performance for voltage/ frequency etc. shall be feasible without supply to load
If during test mode, the power supply has failed, the load shall automatically get transferred on DG set.
Bringing the mode selector to auto position shall shut down the set provided main supply is ON if the mains supply is not available at that time, the alternator shall take load.

Mode of Measurement: Executed quantity will be counted on number basis (i.e. each)

Acoustic Enclosure (AEC)

Scope:

Specification No (GEN-AEC)

The work includes supplying & erecting the Acoustic Enclosure (Canopy) fabricated from CRCA sheet of specified gauge, suitable for indoor/ outdoor installation exposed to weather conditions & to limit overall noise level to 75 dB at distance 1 Meter from the enclosure as per CPCB / MPCB norms under free field condition.

Material:
Acoustic enclosure (Canopy) shall be fabricated out of the CRCA sheet of thickness not less than 1.6 mm on the outside cover with inside cover having not less than 0.6 mm thick perforated power coated CRCA sheet.

Method of Construction:
The construction of Acoustic enclosure (Canopy) should be such that, it shall prevent entry of rain water splashing into the enclosure, and shall allow free & quick flow of rain water to the ground in the event of the heavy rain.
The detailed construction shall confirm to the details as under:-
The Hinged door shall be made from not less than 16SWG (1.6 mm) thick CRCA sheet and will be made air tight with neoprene rubber gasket and heavy duty locks.
All sheet metal part should be processed through 7 tank process.
The enclosure should be powder coated.
The enclosure should accommodate the daily service fuel tank of the DG set to make the system compact.
There should be provision of fuel gauge, which should show the level of the fuel even when the DG set not running. The gauge should be calibrated. The fuel tank should be filled from outside as in automobiles and should be with a lockable cap.
The batteries should be accommodated in the enclosure in battery rack.
The canopy should be provided with high enclosure temperature safety device.
The acoustic lining should be made up of high quality insulation material/ glass/ mineral of rock wool of minimum 50mm thickness and shall be of 75 kg/m3 density for sound absorption as per standard design of manufacturers to reduce the sound level as per CPCB norms. The insulation Material shall be covered with fine glass cloth and would be supported by perforated MS sheet duly powder coated.
The enclosure shall be provided with suitable size and no. of hinged type doors along the length of the enclosure on each side for easy access inside the acoustic enclosure for inspection, operation, and maintenance purpose. Sufficient space will be provided inside the enclosure on all sides of the DG set for inspection, easy maintenance, and repairs. The canopy should be as compact as possible with good aesthetic look.

The complete enclosure shall be of modular construction.
The force ventilation shall be as per manufacturer design using either engine radiator fan or additional blower fans. If the acoustic enclosure is to be provided with forced ventilation then suitable size of axial flow fan with motor (Auto- start arrangement) and suitable size of axial flow exhaust fan to take the hot air from the enclosure complete with necessary motors and auto start arrangement should be provided. The forced ventilation arrangement should be provided with auto stop arrangement to stop after 5 minutes of the stopping of DG set.
The acoustic enclosure should be suitable for cable connection through bus – trucking. Such arrangements on acoustic enclosure should be water proof and dust-proof confirming to IP-65 protection.

Mode of Measurement: Executed quality will be counted on number basis (i.e. each)

CHAPTER NO. 3 LIST OF APPROVED MAKES OF EQUIPMENTS, MATERIALS AND MANUFACTURERS

GENERAL

LIST OF APPROVED MAKES OF EQUIPMENTS, MATERIALS AND MANUFACTURERS

The following are the list of approved brands/makes of equipments required under this tender. Please note that wherever there is a multiple choice of brands/makes approved, any one make as nominated by the Employers/Consultants will have to be supplied by the Contractor without any extra cost to the employers. No deviation in this will be accepted by the employers.

I/We hereby declare that I/We have read and understood the above instructions which have been issued as conditions of the contract.

In case any of the makes for any of the materials is missed out in the following list, then the contractor shall inform the Consultants about the same and obtain the approval. Thereafter, he can produce with the supply of the equipments.

LIST OF APPROVED MAKES FOR CIVIL AND PLUMBING WORK

	ITEM DESCRIPTION	APPROVED MAKES
	GREY CEMENT – OPC-43 / 53 GRADE (conforming to IS 8112)	The Contractor shall procure 43 / 53 grade (conforming to IS 8112) ordinary Portland cement, as required in the work from reputed manufacturers of cement having a production capacity not less than 1 million tonnes or more per annum such as ACC / RAJASHREE / L&T / ULTRATECH / VASAVDATTA / GRASIM / GUJARAT AMBUJA / COROMONDAL or approved by engineer, as approved by the Ministry of Industry, Government of India, and holding license to use ISI certification mark for their product.
	CONSTRUCTION CHEMICALS	FOSROC, DR FIXIT, SIKA, BASF, MC BAUCHEMIE OR APPROVED BY ENGINEER
	FIBRE REINFORCED CONCRETE COVER	ASTRA OR EQUIVALANT APPROVED BY ENGINEER
	REINFORCEMENT STEEL (TMT Fe415 / CRS 50 Grade) (conforming to IS 1786 : 2008)	TATA/SAIL / RINL / VIZAG / ESSAR / ISPAT / JSW In case of non-availability of steel from primary producers such as TATA/SAIL / RINL / VIZAG / ESSAR / ISPAT, the Engineer may permit secondary producers of TMT reinforcement bars provided the secondary producers satisfy the following conditions: i. The secondary producers must have valid BIS licence to produce HSD bars conforming to IS 1786 : 2008. In addition to BIS licence, the secondary producer must have valid licence from either of the firms Tempcore, Thermex, Evcon Turbo & Turbo Quench to produce TMT Bars and shall conform to the specifications as laid by Tempcore, Thermex, Evcon Turbo & Turbo Quench as the case may be. ii. The TMT bars produced from primary producers shall conform to manufacturer's specifications. iii. TMT bars procured either from primary producers or secondary producers, the specifications shall meet the provisions of IS 1786 : 2008 pertaining to Fe 415D or FE 500D or Fe 550D grade of steel as specified in the tender.
	BINDING WIRE	18 SWG - G.I. WIRE
	CEMENT CONCRETE BLOCK	DESAI CONCRETE CASTING & RAGHU CCBLOCK AS CONFIRMING TO IS

	ITEM DESCRIPTION	APPROVED MAKES
	ANTI-TERMITE TREATMENT	PEST CONTROL INDIA LTD / EXPRESS PESTICIDES CORP. / ELITE CORP. OR APPROVED BY ENGINEER
	KERB STONE, BALUSTERS	ASTRA / MICHAEL & MICHAEL OR APPROVED BY ENGINEER
	LIGHT WEIGHT BRICKS	SIPOREX, CITADEL
	LATERITE STONES	LOCAL LATERITE STONE HAVING MINIMUM CRUSHING STRENGTH 30 KGPER SQ CM
	CONSTRUCTION CHEMICALS / CONCRETE	MC BAUCHEMIE "NAFUFILL SBR" / FOSROC / DR FIXIT OR ADDITIVE / WATERPROOFING COMPOUND APPROVED BY ENGINEER
	POLYSULPHIDE	FOSROC / SIKA / DR FIXIT OR APPROVED BY ENGINEER
	CERAMIC / VITRIFIED TILES	NITCO / KAJARIA / SOMANY / ORIENT / JOHNSON/ SONARA OR APPROVED BY ENGINEER
	CHEMICAL ADHESIVES FOR TILE FIXING	FOSROC / BAL / PIDILITE / ROFFE OR APPROVED BY ENGINEER
	INTERLOCKING PAVER	ASTRA / BASANT / PAVEWELL / DESSAI (Exflor) OR APPROVED BY ENGINEER
	TACKTILE	ENDURA OR EQUIVALENT APPROVED BY ENGINEER
	GLASS MOSAIC	ITALIA, BISAZZA, PALLADIO
	STRUCTURAL STEEL	TATA / SAIL / VIZAG / ESSAR / TISCON / ISPAT OR APPROVED BY ENGINEER
	RUST REMOVAL	INCOR-RC10 OR APPROVED BY ENGINEER
	RUST PREVENTER	STEEL GUARD NANO COAT OR APPROVED BY ENGINEER
	INTERIOR ACRYLIC PAINT	ICI (DULUX) / BERGER (RANGOLI)-COLOUR BANK / BEAUTY BOLD(NEROLEX)/ACRYLIC PRIMER EMULSION(ASIAN) OR APPROVED BY ENGINEER
	ACRYLIC PREMIUM EXTEROIR PAINT	ICI WEATHERSHIELD / BERGER WEATHER COAT-COLOUR BANK, APEX OR APPROVED BY ENGINEER
	ZINC CHROMATE YELLOW	SHALIMAR, ASIAN, BERGER, NEROLAC, J & N
	SYNTHETIC ENAMEL OIL PAINT	ICI (DULUX), BERGER (LUXOL)-COLOUR BANK OR APPROVED BY ENGINEER
	DOOR ACCESSORIES	DORSET / GODREJ / KICH OR APPROVED BY ENGINEER
	DOOR (2 Hrs FIRE RATED)	
	ALUMINIUM	: JINDAL, INDAL, HINDALCO, BHORUKA, SUDAL
	FLUSH DOOR	: KENWOOD, ANCHOR, NATIONAL, KITPLY, CENTURY
	GLASS (2 Hrs FIRE RATED)	: SCHOTT PYRAN, FIRELITE GLASS, PILKINGTON, AIS GLASS, FYRE-TEC,MODIGUARD, SAINT GOBAIN, ASAHI INDIA.
	FLOOR SPRINGS AND DOOR CLOSERS FOR DOORS	:SEVAX, DORMA, EVERITE, OMEGA, EVEREST UNIVERSAL 68, HINDUSHAN, GODREJ
	CYLINDRICAL LOCK, RIM LOCK	: GODREJ, EUROPA, DORMA
	LAMINATES	FORMICA, GREENLAM, MERINO, CENTURY, DECOLAM
	ADHESIVE FOR WOODS	: PIDILITE, ICI, HUNTSMAN

	ITEM DESCRIPTION	APPROVED MAKES
	MARINE PLY	: ANCHOR, KENWOOD
	SILICON SEALANT	: DOW CORNING, G.E. SILICONS
	MIRROR	MODIGUARD OR SAINT GOBAIN OR APPROVED BY ENGINEER
	PVC CORRUGATED ROOF SHEETS	FINOLEX OR APPROVED BY ENGINEER
	TRANSPARENT POLYCARBONATE SHEETS	FLEXITUFF / FINOLEX / GE OR APPROVED BY ENGINEER
	GALVALIUM/ZINCALIUM SHEETS	TATA BLUE SCOPE OR APPROVED BY ENGINEER
	SILICON SEALANTS	DOW CORNING, GE SILICONS, WACKER SILICONS, HOLEX, DECOT OR APPROVED BY ENGINEER
	SELF DRILLING SCREWS FOR ROOF SHEETS	CORROSHIELD FASTENERS OR APPROVED BY ENGINEER
	CONVENTIONAL WATER PROOFING TREATMENT	DR. FIXIT (WATERPROOF POWDER) / SIKA (LATEX POWER/SIKA RAINTITE) OR APPROVED BY ENGINEER
	CONCRETE ROOF TILES	ENDURER ROOFING TILES, MONIER ROOFING TILES OR APPROVED BY ENGINEER
	CRYSTALLISATION PROCESS FOR WATERPROOFING	KOSTERS NB SYSTEM(CHOWGULE) / CK DEUXAN (CHOWGULE)/XYPEX (SILICOAT) SIKA/ KOSTERS / MC BAUCHEMIE
	WATER PROOFING COMPOUND	PLASTOCRETE PLUS OF SIKA OR EQUIVALENT
	SANITARY WARE	HINDWARE / PARRYWARE/ CERA OR APPROVED BY ENGINEER
	SANITARY FITTING	JAQUAR / CRABTREE OR APPROVED BY ENGINEER
	PIPE & PIPE FITTINGS	FINOLEX /ASTRAL FLOWGUARD/ SUPREME/ PRINCE OR APPROVED BY ENGINEER
	HUME PIPE	MICHAEL AND MICHAEL OR APPROVED BY ENGINEER
	PUMP SET	KIRLOSKAR/ GRUNDFOS/CROMPTON/V-GUARD OR APPROVED BY ENGINEER
	WATER TANK	SINTEX, SHAKTI OR APPROVED BY ENGINEER
	STAINLESS STEEL SINK	NIRALI / ANUPAM APPROVED BY ENGINEER
	PRECAST RCC SLABS	ASTRA / MICHAEL AND MICHAEL OR APPROVED BY ENGINEER
	CEMENT PARTICLE BOARD	BISON OR APPROVED BY ENGINEER
	ELECTRODES	ADOR WELDING LIMITED "SUPERBOND" OR APPROVED BY ENGINEER
	GROUT FOR FOUNDATION ANCHOR BOLT	EMCEKRETE GROUT OF MC BOUCHMIE OR APPROVED BY ENGINEER
	WALL PUTTY	CEM-PLAST WHITE SURFA COATS/ BIRLA WHITE WALL CARE PUTTY/ BISON WALL PUTTY OF BERGER OR APPROVED BY ENGINEER
	WATER HEATER	RACOLD/ JAQUAR OR APPROVED BY ENGINEER
	CEMENT CHEQURED TILE	QUALICRETE/ ULTRA / DURACRETE OR APPROVED BY ENGINEER

	ITEM DESCRIPTION	APPROVED MAKES
	STAINLESS STEEL FRICTION HINGES	EBCO SECURISTILE / COTSWORLD / OZONE OR APPROVED BY ENGINEER
	S.S. HANDLES, HINGES	CONFIRMING TO ASTM 304 GRADE OR APPROVED BY ENGINEER
	G.I. PIPES AND FITTINGS	JINDAL / ZENEITH / TATA OR APPROVED BY ENGINEER
	BRASS BALL VALVE	ZOLOTO / TBS / SANT / LEADER / FIRTOP, AIRFIELD OR EQUIVALENT APPROVED BY ENGINEER
	PEST CONTROL	PEST CONTROL (INDIA) , MAYKAR PEST CONTROL , SOUTH(INDIA)PEST CONTROL PRIVATE LIMITED
	SS PATCH FITTING	OZONE / SHANU OR EQUIVALENT APPROVED BY ENGINEER
	WASTE BIN	SINTEX/OTTO OR EQUIVALENT APPROVED BY ENGINEER
	STAINLESS STEEL BINS	OZONE OR EQUIVALENT APPROVED BY ENGINEER
	FIBER REINFORCED MANHOLE COVER	ASTRA OR EQUIVALENT
	C.I. COVERS	NECO OR EQUIVALENT APPROVED BY ENGINEER

.

LIST OF APPROVED MAKES FOR ELECTRICAL WORK

SR. NO.	ITEMS	MAKES (ISI MARKED)
1	PVC PIPES AND ACCESSORIES	PRECISION / AVONPLAST / GRANDLAY / AKG / MODI / POLYCAB
2	COPPER MULTI-STRAND WIRES	POLYCAB / FINOLEX / GLOSTER / L&T / KEI / SKYTONE / RALLISON / INDO ASIAN / HPL / TEREXEL / RR / HAVELLS /
3	SWITCHES / SOCKETS / TV, TELEPHONE SOCKET, ETC. (MODULAR)- CAT A	CLIPSAL / ANCHOR (WOOD), LEGRAND (MOSAIC) / MK (WRAPROUND) / CRABTREE (ANTHENA) / INDOASIAN (HAUSMANN) / LEON (DELUX)
4	SWITCHES / SOCKETS / TV,TELEPHONE SOCKET, ETC. (MODULAR)- CAT B	ANCHOR (ROMA) / LEGRAND (MYLINC) /LEON (ELEGANT)
5	MCB / ELCB / RCCB / ISOLATORS / MCCB /DISTRIBUTION BOARDS	**CAT A :** LEGRAND / HAGER / L & T / SIEMENS / ABB
		CAT B : STANDARD / INDO ASIAN (GOLD PLUS) / GROUP SNEIDER / MERLIN GERIN / HPL (MOOLER) / C & S
6	SFU / FUSE SWITCH UNIT	SCHNEIDER / SIEMENS / L & T / CROMPTON / GE / INDOASIAN / HPL/ CUTTLER HAMMER / C & S / MERLIN GERIN
7	OUTDOOR BOXES	CLIPSAL / HENZEL / HUNTER / SINTEX / NATIONAL
8	HRC FUSES	SCHNEIDER / GE / L & T / SIEMENS / HPL / ABB / INDOASIAN / C & S
9	INDUSTRIAL SOCKETS	CLIPSAL / LEGRAND / CROMPTON / CUTTLER HAMMER / C & S
10	FAN REGULATOR	TO MATCH WITH THE SWITCH / SOCKETS

SR. NO.	ITEMS	MAKES (ISI MARKED)
11	UG CABLES	POLYCAB / ASIAN / GLOSTER / GEMSCAB / UNIVERSAL / CCI / NICCO / FINOLEX / KEI / TEREXEL/INDO ASIAN
12	CABLE GLANDS	DOWELS / BRACCO / SIEMENS / COMET / JAINCO
13	CABLE JOINTING	RAYCHEM / CCI – XYCON / CABSEAL / M SEAL
14	CEILING FANS	CROMPTON / BAJAJ / ANCHOR / ORIENT / USHA / HAVELLS / KHAITAN
15	EXHAUST / PEDESTAL FAN	CROMPTON / BAJAJ / ANCHOR / ORIENT / USHA / ALMONARD / KHAITAN
16	FIXTURE	PHILIPS / CROMPTON / BAJAJ / WIPRO / GE / KESSELAC (AS SPECIFIED IN BOQ)
17	TELEPHONE WIRE / CABLES	FINOLEX / TATA (LUCENT) / ITL / SKYTONE / GRANDLAY / GEMSCAB / DELTON / NATIONAL / L&T / DELTON / POLYCAB
18	CABLE TRAY & RACE WAYS (FACTORY FABRICATED)	SLATTCO / GLOBE / RICO STEEL / INDIANA / SADHANA / LEGRAND
19	NETWORK CABLE	DIGISOL / SCHNEIDER / AVAYA/ SYSTEMEC / FINOLEX / LEGRAND
20	TRANSFORMER	CROMPTON / KIRLOSKAR / VOLTAMP / BHARAT BIJLEE / KTL / ABB / MEGAWIN / URJA(UPTO 500KVA ONLY)
21	DG SET (ASSEMBLED BY AUTHORIZED OEA / OEM)	**ENGINE –** CUMMINS / PERKINS / CATTERPILLAR / KOEL / GREAVES COTTON/LEYLAND
		ALTERNATOR – STAMFORD / JYOTHI / CROMPTON GREAVES / KEC
22	CAPACITOR	SIEMENS / ASIAN / KHATAU JUNKAR / L & T /ABB / UNIVERSAL
23	ACB	SIEMENS / L & T / GE / ABB / SNEIDER/ C & S
24	VCB / HT SWITCH WITH CUBICLE / SF6	SIEMENS / ABB / CROMPTON / AREVA / L&T /MEGAVIN
25	CT'S / PT'S	AE / INDCOIL / KAPPA / RICCO / PRAGATI / MEGAVIN
26	APFC RELAY	L & T / GEC / EMERCON / ALSTOM
27	CONTACTOR / TIMER / STARTER	L & T / CUTTLER HAMMER / SNEIDER / SIEMENS / HPL – MOLLAR /C & S
28	TRIVECTOR METER / ENERGY METER	AE / RISHAB / C & S / TECNIC / SIEMENS / SNEIDER / L & T / INDOASIAN
29	EPABX	AVAYA / NEC / LG ARIA / SIEMENS / ALCATEL

SR. NO.	ITEMS	MAKES (ISI MARKED)
30	TELEPHONE INSTRUMENT	BPL / TATA / SIEMENS /AVAYA / NEC
31	AMMETER / VOLTMETER / POWERFACTOR METER / FREQUENCY METER	AE / RISHAB / IMP / MECO / ABB / HPL
32	LIGHTNING PRO. SYSTEM	SYNERGY / INDELEC / STORMASTER(LPI)
33	HT / LT PANELS	SUN CONTROL / KENSON ENGINEERS / KRIS CONTROLS / ELECTCONTROL / PES / VIVID / CONTROL CENTRE / IMPERIAL / PEATON ELECTRICAL / DB ENTERPRISES
34	GI PIPES	ZENITH / TATA / JINDAL
35	ROTARY SWITCH / SELECTOR SWITCH	SIEMENS / L & T / GE / KAYCEE
36	TELEPHONE TAG BOX	ITL OR ANY EQUIVALENT APPROVED MAKE
37	UPS / INVERTER	DUBAS / DB POWER / POWER WARE / APLAB / EMERSON / APC / STREAMLINE
38	BATTERIES	EXIDE / AMARON / PANASONIC / AMARAJA
39	RMU WITH CUBICLE	SIEMENS / SNEIDER / ABB / MEGAWIN / CGL / L&T
40	CHANGEOVER SWITCH	HPL / INDO ASIAN./ C& S
41	VOLTAGE STABILIZER	ORICON / V- GUARD / EVEREST
42	UNITISED COMPACT SUBSTATION	CROMPTON/MEGAWIN/ABB/TESLA
43	GI OCTAGONAL POLES	BAJAJ / ASTER / KL INDUSTRIES

CHAPTER NO. 4 MORTH SPECIFICATIONS